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January 20, 1984

File: 11.5.2

Mr. Robert Shewmaker
U.S. NRC Office of Nuclear Reactor Regulation
4350 E.W. Highway
East-West Towers
West Building, Room 505
Bethesda, Maryland 20814

Rec'd 1/24/84

Public Service Co. of New Hampshire
Seabrook Station - Units 1 & 2
Responses to Potential IDI Findings
for Structural Discipline

Dear Mr. Shewmaker:

Based on our discussion at the Exit Meeting of December 28, 1983 and various telephone conversations, we are offering additional information for the items listed on Attachment A. Our responses correspond to Serial Numbers on Attachment A. We are also confirming our understanding of these items and our responses. It is our belief that our understanding and responses reflects various telephone conversations of the last few days related to this matter.

Our responses and/or understanding of these items are as follows:

F 4-3 1. See Attachment B.

F 4-4 2. A detailed calculation was performed for eccentric loading on the member due to bent plate connection and the result was found to be very satisfactory. These calculations will be attached to the appropriate calculation set.

F 4-5 3. Our understanding is that the problem does not exist with the liner test program conducted by Prof. Burdette and hence the issue is considered closed. However, the Pipe Support Discipline will respond by separate correspondence for the embedment plate test program conducted by Prof. Burdette.

F 4-7 4. We have reviewed Calculation Set CS-15 with respect to the latest input from the Structural Analysis Group and have found that the results are satisfactory. However, the calculation will be formally revised within a to reflect this information. We understand that this will be satisfactory to close any concern on the subject.

F 4-8 5. Calculation Set WB-61 including reference to SSE condition has been revised to clarify the design of beam B-9 and completely signed through as a formal revision. This item will be considered closed.

A5

F4-10 6. Calculation Set WB-68 has already been revised with proper use of SP-17. The results of these changes have been found to be satisfactory. This item will be considered closed.

F4-11 7. Calculation Set CI-2 has been revised with proper consideration of the SSE load condition. The result of the calculation does not change. This item will be considered closed.

F4-13 8. The eccentric connection in annular steel framing was evaluated as per Mr. Lipinski's request. Proper stiffnesses were utilized in the analysis of this connection and found that the moment carried by the joint and the embedment plate was comparatively small. Bolts were found adequate as they are. This analysis and design of the connection will be made part of appropriate calculation sets for further reference. We understand that this should be satisfactory to resolve Mr. Lipinski's concern and will be stated so in a final report.

9. Concern about inconsistencies in various documents regarding tank farm design requirements are being reviewed. Appropriate action will be taken to clarify all effected documents such as FSAR, Structural Design Criteria, System Description, etc. at a later date.

F 4-24

F4-17 10. Re-evaluation and, if necessary, re-analysis will be performed for tank farm to resolve Mr. G. Harstead's concern. The work is already in progress with the Structural Analysis Group for this area.

F4-13

F4-19 11. We have evaluated the eccentric connection of the girder framing into the column in annulus steel. We find that the effect of this eccentricity is very nominal at the joint and also on the members. Conclusion of our study indicates that the members and connection is adequate as it is. This calculation study will be filed with the effected calculation sets. We understand that this will be satisfactory and stated so in the final report.

F4-20 12. We have not been able to locate a previous copy of Calculation Set PB-76 for the design of platforms. However, as you have noted during your audit, we do have a final calculation set which proves that the platform steel is adequately designed as it stands.

F 4-21 13. A note on UE&C Dwg. F-101402 was revised to clarify the grouping of shear ties as requested by Mr. Lipinski. However, there was no change in the existing steel as was furnished by the Bethlehem Steel drawing. This change was done to avoid misinterpretation of terminology. This item is considered closed.

F 4-23 F 4-25 14. The NRC's concern about the use of live load along with seismic event is being reviewed at present by UE&C. This item will be responded to at a later date after we have adequate information at hand.

In a telecon between K.M. Kalawadia of UE&C, Don Johnson of Yankee, and Robert Shewmaker, R.E. Lipinski and Gunnar Harstead of NRC on January 20th at 10:30 A.M., all of the above items were reviewed and the NRC had accepted these answers.

If you have any questions, please call K. M. Kalawadia.

Very truly yours,

K. M. Kalawadia

K. M. Kalawadia
Supv. Structural Engineer

KMK:jg
attachments

ATTACHMENT A

PUBLIC SERVICE CO. OF NEW HAMPSHIRE

SEABROOK STATION - UNITS 1 & 2

STRUCTURAL DISCIPLINE

POTENTIAL IDI FINDINGS

SERIAL NO.	DESCRIPTION
1	Some of the memos in the Structural Discipline files do not have control numbers. A list of few of these memos have been handed out to the Structural Disc.
2	Inconsistencies in design drawings and vendor drawings exist for connections. Bent plate connection shown on vendor drawing was not properly identified on engineeirng drawing.
3	Q. A. Requirements were not imposed on testing program Purchase Order with Ed Burdett. Calibration procedures for equipment are in question. Consider violation of GEDP 22 and QA 3.
4	Calculation Set CS 15 did not use proper input data from SAG report.
5	Tank Farm Calculation Set WB61 had 3 designs for beam B-9. Design not clear. Consider violation of GEDP-0005.
6	Tank Farm Calculation Set WB68 - Design of column line 4.5 and 5.0 using ACI SP17 was not done properly. SP17 procedure was not followed correctly.
7	Calculation Set CI2 does not address SSE loading as defined in SD66.
8	Structural Steel connection in annular steel does not account for accentricity.
9	Tank Farm design basis is not quite clear for the seismic requirement and tornado requirements.
10	Tank Farm Calculation Set SBSAG 5WB does not represent proper stiffnesses for the analysis. Modeling is not done properly to account for concrete fill.
11	In Containment annular steel joint eccentricity to columns were not considered in analysis.

ATTACHMENT A

(Cont'd)

SERIAL NO.	DESCRIPTION
12	Calculation Set PB76 did not exist at the time of releasing drawings for construction in 1976-1978 - violation of AP22.
13	Inconsistency exists between Bethlehem Steel drawings and Engineering drawings in identifying stirrups for the containment reactor pit. Note on the drawing should be revised properly.
14	No live load was considered in design of beam in RHR vault with the seismic load conditions. FSAR and design criteria not quite clear regarding this.

These items were discussed in pre-exit meeting. If anyone has any questions or need further details, please contact K.M. Kalawadia.

PUBLIC SERVICE CO. OF NEW HAMPSHIRE
SEABROOK STATION - UNITS 1 & 2

ATTACHMENT B

SERIAL NO.	DATE	CORRESPONDENCE FROM / TO	SUBJECT	CLARIFICATION/REMARKS
1	10/15/79	Mehta to Hatwal	Tornado loads on Admin. & Serv. Bldg.	This letter was for information only. No calculations req'd by receiving party. Calculations were already performed by the originating party.
✓ 2	6/18/79	Pernice to Hatwal	Seismic on Admin. & Serv. Bldg.	- ditto -
3	11/23/82	Wilson to Kalawadia	MS & FW Pipe Chase Blowout Panels	Calculations were performed with 72 PSF. A letter was sent to accept vendor supplied material to the design basis. Correspondence to this effect is attached to the calculation set.
4	2/25/74	Scott to Robinson	Transmittal of basic Press-Temp-Time Data for LOCA & Containment Design; Initial Load Combinations for contain.design & sub-compartments.	Control Number SBSAG 3CS exists as per AP-22.
5	8/7/74	Karousakis to Rhoads	Finalized containment & sub-compartments design parameter.	This memo is written to confirm design parameters. Outcome of these analysis are reported in form of a report SBSAG 7CS which includes this information.
6	2/20/74	Karousakis to Hulshizer	Transmittal of Temp. Transients for Containment Secondary Shield Wall & Wall Temp. Profiles.	This memo is sent as an additional informal transmittal of data from other reports as it states in the contents of the memo. Hence control number not required.
7	3/17/76	Robinson to Grusetskie	Final report for Seismic Analysis	Control Number SBSAG-4CS4 exists as per AP-22.

ATTACHMENT B (Continued)

SERIAL NO.	DATE	CORRESPONDENCE FROM / TO	SUBJECT	CLARIFICATION/REMARKS
8	11/3/80	Tseng to Flora	Containment Wall Temperature Gradient.	Control Number PIN 9763.06-02-exists as per AP-22.
9	11/19/75	Robinson to Crusetskie	Containment Axisymmetric Analysis	Control Number SBSAG-7CS4 exists as per AP-22.
10	11/4/75	Robinson to Grusetskie	Containment Analysis Addendum to SBSAG-7CS3.	Control Number SBSAG-7CS3 exists as per AP-22.
11	10/22/75	Robinson to Grusetskie	Containment Analysis	Control Number SBSAG-8CS was assigned as per AP-22.
12	10/13/76	Robinson to Lin (Speed Ltr.)	Containment Axisymmetric Analysis - Operating Temp. Gradient.	Control Number SBSAG-7CS was assigned as per AP-22.
13	9/18/74	Grusetskie to Robinson	Pressure/Temperature Design & Analysis Criteria.	Control Number SBSAG-7CS as per AP-22.
14	5/29/75	Robinson to Rhoads	Preliminary Containment Displacements.	This memo transmits preliminary results for initial use.However, final results are sent under control report no. SBSAG 7CS and SBSAG 4CS. Hence it is not necessary to have control no. for this memo.
15	9/12/74	Robinson to Grusetskie	Boundary Condition Restraints	This memo was written to confirm telecon. We do not see any impact on final design.
16	6/15/79	Ebner to Sarsten	Seabrook Structural Audit	This memo contains information for internal management and has no impact on any of our calculation performances.
√ 17	11/19/76	Hulshizer to Dmytryk	Capabilities of Structural Personnel.	- ditto -

PUBLIC SERVICE CO. OF NEW HAMPSHIRE
SEABROOK STATION - UNITS 1 & 2
ATTACHMENT B (Continued)

SERIAL NO.	DATE	CORRESPONDENCE FROM / TO	SUBJECT	CLARIFICATION/REMARKS
✓18	2/3/75	G.F. Cole to Osterman	Design Review Master List	- ditto -
✓19	12/31/74	Boyle to SDE's	Design Review	- ditto -
20	9/23/75	Ebner to Hulshizer	Chief Engineer's Design Reviewe of Primary Aux. Bldg.	- ditto -
21	9/8/75	Kalawadia to Barnes	Design Review of PAB (DRR S11)	Design Review of PAB (DRR S11) is a control number of this building.
✓22	6/17/82	Rhoads to Aggarwal	Sign-off of Electrical ECA's	This memo contains information for internal management & has no impact on any of our calculation performance.
✓23	4/2/82	Bhatt to Seabrook Structural Engrs & Design Supvs.	Structural Organization Chart (Field) and Minor Change Definition.	This memo contains information for internal management & has no impact on any of our calculation performance. However, the attachment has a Control Number SM-0053.
✓24	3/18/82	Hulshizer to All Seabrook Personnel	Processing of ECA's originating Home Office-Structural.	This memo contains information for internal management & has no impact on any of our calculation performance.
25	5/30/78	Hanson to Rhoads	Comments on the Implementation of Administrative Procedure #34.	- ditto -
✓26	5/5/78	Rothong to Seabrook SDE's & Design Supvs.	Document Review	- ditto -
27	3/7/78	-	Notes of Conference regarding Design Change Notices (DCN's)	This is Notes of Conference which relates to the DCN procedures only. There was no direct impact on calculations.

Conf Call

Kal Kalawadia	UE&C	1/20/84	Shewmaker	NRC
Johnson	YAEC		Harstead	
			Lipinski	

(F 4-3)

3CS number } AP-22, GEDP-0005
4CS

(F4-4) calc. completed, stresses w/in allowables

(F4-5) — Kalani's item

(F4-7) Reviewed, revised and incorporated correct reference everything w/in allowables

(F4-8) · completed

(F4-10) "

(F4-11) members & stresses OK
WB-61 per Harstead to be checked & put together with this

(F4-13) +4% — no impact on design

(F4-?) Tank Foam Structure categorization — OPEN

(F4-19) recalculation in progress — OPEN
A6

(F4-20) +2.7% stress for worst case

F 4-21 note changed

~~F~~4-23 ~~[illegible]~~ OPEN

OBSERVATION

No. ~~#1~~ L1 Author R. E. Lipinski Date 11/16/83

Description of Item:

~~Angle~~ Member (the angle) ~~sh~~ has been drawn incorrectly (horizontal leg should be reversed)

References (specific drawings, etc.):

Calcs Set CS-22 Sh 85 of 139

A. Why is it mentioned?

1. Lack of thorough check of calcs.
2. Potential danger that it could be detailed incorrectly.

B. Why is it not a finding or unresolved item?

~~Since the loads~~

To be determined later

C. Is no response needed?

No

A1

~~42~~

OBSERVATION

No. 42 Author R. Lipinski Date 11/16/83

Description of Item:

Angle in section A-A should be drawn with horizontal leg reversed

References (specific drawings, etc.):

Calc. Set CS-22 sh 98 of 139

A. Why is it mentioned?

1) Lack of proper review of calcs
2) Could be detailed this way

B. Why is it not a finding or unresolved item?

To be determined later

C. Is no response needed?

No.

OBSERVATION

No. ~~L3~~ 43 Author R. E. Lipinski Date 11/16/83

Description of Item:

Revised sheets of calculations were not included in the listing "Calculation ~~Contact~~ Revision Control Sheet" Form SB-10 5/74.

References (specific drawings, etc.):

CS-22 sheets 17 and 23

A. Why is it mentioned?

this is violation of GEDP-0005

B. Why is it not a finding or unresolved item?

Revision (change of material) is ~~no~~ indicated on the subject calculation sheets.

C. Is no response needed?

No ____

OBSERVATION

No. 4.4 Author R. E. Lipinski Date 11/29/83

Description of Item:

a) p. 2-44 has been changed and not listed in Revisions

b) page listing changes (print) is illegible

c) Sh. 209 - allowable stress is changed from .6 to .75 of fy without listing in changes or providing justification

References (specific drawings, etc.):

Additional Information for Pipe Support Design Guidelines, June 17, 1981, Rev. 1.

A. Why is it mentioned?

1) The document is not up to date

2) Changes are not approved and not listed

B. Why is it not a finding or unresolved item?

Couldn't find Administrative Procedure which addresses this issue

C. Is no response needed?

No - Corrective action should be initiated

LIPINSKI

OBSERVATION

No. 4.5 Author R. E. Lipinski Date 11/29/83

Description of Item:

Pipe Support Design Guidelines Rev. 1, June 17, 1981. Section 2, "Design" — Subsection 2.2.1.c refers to Subsection 1.5 which is not in in the "Guidelines"

References (specific drawings, etc.):

As stated

A. Why is it mentioned?

this item illustrates inconsistency in the document.

B. Why is it not a finding or unresolved item?

this item is considered to be editorial not technical.

C. Is no response needed?

~~yes~~ No. — Corrective action is needed

OBSERVATION

No. 4-10 Author R. E. Lipinski Date 12/16/83

Description of Item:

Two legs of Rack MM-IR-14 and MM-IR-15 rest on a steel plate, away from the supporting steel member, thus forming a cantilever. Sound engineering design would require a stiffener plate between the plate and the supporting member, under the legs of the racks.

Reasons: a) The ARS have been developed for the supporting beam, not the plate and therefore the vibrations of the plate will be different from those as defined by the ARS

b) the leg of the rack is situated at the corner of an opening which may cause stress concentration.

References (specific drawings, etc.):

Primary Auxiliary Bldg - Equipment Vault Framing at El. 3'-2" dated 11/18/83, Rev. 0, Drgs F-101558 Rev. 6, dated 7/9/82 and F101562, Rev 4 dated 9/28/83

A. Why is it mentioned?

This modification will improve the design

B. Why is it not a finding or unresolved item?

The calculated stresses in the plate are low so that there is an ample margin of safety.

C. Is no response needed? Yes.

OBSERVATION

No. 4-11 Author R. E. Lipinski Date 12/8/83

Description of Item:
The dwg plan is referenced from Column line is in E-W direction only.

References (specific drawings, etc.): Dwg F101562

A. Why is it mentioned? This practice may lead to an error in the field.

B. Why is it not a finding or unresolved item? It does not violate any written procedure or standard. Just a good engineering practice.

C. Is no response needed? yes.

CIDINSKI

OBSERVATION

No. 1-13 Author R. E. Cidinski Date 12/8/83

Description of Item:
Location of RHR Equipment Vault, Platform El. (+) 3'-2" on the seismic model sketch is incorrect.

References (specific drawings, etc.): Calc. set SBSAG-22 PB sh 4 of 2 Rev. 0 (4/7/83)

A. Why is it mentioned? Could lead to generating of ARS at a wrong location.

B. Why is it not a finding or unresolved item? Does not affect the results in this case

C. Is no response needed? Yes.

LIPINSKI 1/18/74

Document Name:
SECTION 4.1 - SEABROOK IDI

Requestor's ID:
EILEEN

Author's Name:
R. Shewmaker

Document Comments:
Design Information

4.1 Design Information

The objective of this portion of the inspection was to determine, used in the on the basis of the material reviewed, if ~~the methods~~, the procedures and methods ~~of~~ design and the design controls which have been used in the Seabrook project, reflect the requirements of NRC regulations, such as General Design Criteria, Regulatory Guides, Standard Review Plan and other refererenced industry codes and standards. ~~Furthermore, having determined~~ Based on the degree of consistency between the rules and regulations ~~on one hand~~ and the actual practice by the applicant and his agents, ~~on the other~~, a determination could be made ~~of~~ if the levels quality assurance and quality control are acceptable.

Pursuing this goal, the team reviewed the organizational structure of the Public Service Company of New Hampshire (~~PSNH~~ Public Service), the design and construction effort delegated to its agent, the Yankee Atomic Electric Company (~~YAEC~~ Yankee Atomic) and the execution of the design by the architect-engineer for the Seabrook plant, United Engineers and Constructors (~~UE&C~~ United Engineers). Particular attention was ~~found to~~ focused on the interfacing between various organizations such as ~~YAEC~~ YAEC and ~~UE&C~~ UE&C and their subcontractors.

In the civil/structural discipline, the applicant committed to comply with the NRC rules and regulations, the General Design Criteria, Regulatory Guides, Standard Review Plan (NUREG-0800) and other documents as well as the appropriate commercial codes and standards. The basic document used in design of the containment structure is the ASME Boiler and Pressure Vessel Code Section ~~IX~~ III,

12/27/83

Division 2, Code for Concrete Reactor Vessels and Containments (Winter 1975 Addenda for containment liner; Winter 1976 Addenda for reinforced concrete), ~~t~~hereinafter referred to as the ASME Code (Ref. 4 —). For other reinforced concrete structures, the ACI-318-71, Building Code Requirements for Reinforced Concrete, Ref 4 — (with Commentary) Ref 4 — was used. Steel structures have been designed in accordance with the AISC, Ref 4 — Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, 1969 Edition (including supplements 1, 2 and 3). For ~~the~~ quality ~~control,~~ requirements the applicant committed to use ANSI N45.2-1974, Quality Assurance Program Requirements for Nuclear Power Plants. Ref 4 — The Final Safety Evaluation Report (FSAR) included all of the pertinent Regulatory Guides as references for the various commitments.

The organization of the Seabrook project in place at the time of the inspection is ~~best~~ illustrated on Figure 1. The Executive Vice President of the PSNH is responsible for all executive functions of the project. He reports directly to the president of the company. The Vice President, Seabrook, (VPS), reports directly to the Executive VP and is in charge of all management functions. Both the Executive Vice President and the Vice President, Seabrook are from the PSNH. Working directly under the VPS are: Director of Quality Assurance; Manager, Start-up Testing; Director of Construction; and Project Manager. These four positions are staffed by the YAEC. There are three additional positions: the Manager Construction Support and the Construction Manager (both of them are from the PSNH) and Vice President of UE&C responsible for design and construction management. The YAEC ~~engineering~~ project group consisting of 35 professionals reports to the project manager and it is ~~headed by~~ subdivided into four groups headed by the following ~~four~~ positions:

a. Assistant project manager of construction

b. Engineering manager

c. Senior project engineer

d. Assistant project manager (licensing and operation)

The Engineering Manager has four lead engineers reporting to him:

a. Systems Lead Engineer

b. Mechanical Lead Engineer

c. Instrumentation and Controls Lead Engineer

d. Electrical Lead Engineer

There are five engineers in the mechanical engineering discipline; three of them are civil/structural and two mechanical.

delete

We interviewed the three engineers who are working in the civil/structural area. We found that all of them are graduate engineers, of them have master degree in civil or structural engineering. of them are registered professional engineers. Their experience range from seven years to nine with most of it in structural engineering related to nuclear plants. During the interviews they demonstrated generally good knowledge of their profession, but their familiarity with NRC rules and regulations was somewhat less than would be expected. There was no evidence that YAEC provides any training in this area or encourages an improvement of their knowledge of the current regulatory positions.

delete

The entire staff working for the project manager consists of 35 professionals. The professional cross section of the civil/structural staff of the YAEC employed at the Seabrook Project is included in Table 4-1 which provides data for a representative cross-section of civil-structural engineers working on the Seabrook project.

In our inspection, considerable attention was given to the interfacing between different ~~officials,~~ personnel and groups within the YAEC organization as well as between the organizations involved, namely YAEC and the UE&C and/or PSNH. It appears that the communication between the UE&C and the YAEC is maintained through the UE&C ~~PM,~~ Project Manager who communicates directly with his counterpart of the YAEC. The YAEC ~~PM~~ Project Manager reports to the VP of Seabrook project who is on the staff to the utility company, the PSNH. The lines of communication are depicted on Figure 1. The inspection team evaluated the documentation of design controls which is used by the YAEC as the basis for the demonstration of design control exercised by YAEC and PSNH over the design~~ers~~ organization for the project.

needs expans + conclus

A review of an audit report conducted by the PSNH on July 26, 1973 at the UE&C offices, Philadelphia, Pennsylvania was conducted. The purpose of this audit, conducted in accordance with the requirements of Yankee QC&A Procedure WQ-115,

Quality Control and Assurance

paragraphs III.A.1 through 8, was mainly to verify disposition of the open items of the previous two internal audits. The report discussed three items identified in the previous audit, conducted on May 15, 1973 ? which ha~~ve~~d not been satisfactorily resolved. No new open items ~~have been found~~ were found during the audit. In ~~the~~ a subsequent letter, dated August 30, 1973, ? UE&C discussed the proposed resolution of the items covered in the subject audit report. ~~An observation has been made~~ The IDI team noted that the referencing of the staff in the audit report has not been made by full name or by their title, ~~name~~ but by their initials alone. ~~We~~ The team found that such identification of personnel makes it extremely difficult or even impossible to trace down the people involved. (refer to possible revision of GAP, QAP, etc to require full name and/or title in audits) (Observation 4-___

The principal documents providing for the implementation of all quality assurance aspects of the Seabrook plant for the Yankee organization are the Project Policies and the Seabrook Quality Assurance (Q/A Manual) (Ref. 4). The Q/A Manual establishes the procedures for the interval and external quality controls of the YAEC such as the scope and frequency of the audits, interface controls, provides guidelines for the review of specific categories of documents, etc. The Project Policies provide guidelines for implementation of the specific phases of the quality assurance system and describe processing of documents such as the Engineering Review Reports (ERR's), filing of documents, handling of engineering documents etc.

Both the Project Policies and the Q/A Manual are under the direct responsibility of the Project Manager (PM). The PM is responsible to assure that both the Project Policies and the Q/A Manual are in agreement. In case of a conflict between these two documents the Q/A Manual takes precedence. The Project

Policies are reviewed and updated periodically to reflect the current modes of operation and design.

Those receiving an engineering review are - - - -

Specifications are the documents developed for specific tasks involved in design of the Seabrook plant. They are developed by the UE&C and forwarded to the YAEC PM for review and approval. They are also partially reviewed on pre-selected basis by the Quality Assurance Department (QAD) of the YAEC and the document resulting from the review is called Engineering Review Report (ERR). The ERR's are filed with in the ~~YAEC~~ Yankee organization in a separate filing system.

Once a specification has been developed ~~and~~, review and approved, The UE&C provides YAEC with the list of the prospective bidders and recommends those bidders who appear to be technically acceptable. After proposals are received YAEC selects the winning bidder from the list provided by the UE&C, usually on the basis of the lowest price. The authority of approval of the specifications is with the Project Manager. Specifications are updated when there is a change in the purchase order and their change require review and approval of YAEC. In order to assure that the specifications are up to date, YAEC conducts interdisciplinary meetings which are, on the average, every two weeks.

Following are our specific comments resulting from review of some of the documents provided by the YAEC staff.

Q/A Procedure 3.3 "Review Procedure" Rev. 8 - Date 3/30/79 (Ref. 4 ___

The Procedure provides guidelines for the review of specific categories of documents. Specifically the documents covered by this procedure are:

Engineering Specifications, Engineering drawings, purchase documents and QA/QC Program, Manual and Procedures.

The documents to be reviewed by ~~the~~ YAEC are developed by the agents, such as UE&C or subcontractors and submitted to YAEC Project Office for review. The Project Office is responsible to establish the appropriate reviewer (s). Review of Project Policy #1 (PP-1) Ref. 4 reveals that the reviewer is "determined by Section 3.0 of the Seabrook Station ~~Q/A~~ Quality Assurance Manual and Subsection 17.1 of the Seabrook FSAR.

When Q/A Manual Section 3.0 was reviewed the criteria for selection of a reviewer could not be found which is a discrepancy from PP-1.

The Procedure is vague in the area of resolution of conflicting comments originated by the reviewers. The only statement that could be found is that if the disagreement could not be settled amongst the reviewers it is referred to the higher management. There are no specific steps or the responsibility to be taken to obtain a satisfactory resolution.

The Procedure contains specific guidelines (provided in the Appendices) for preparation of the review of the documents covered by the Procedure.

United Engineers and Constructors, Inc. UE&C is organized into several operating divisions with the nuclear power work in the United States being performed in the Power Division under the direction of a Vice President. One of the managers reporting to him is the Manager of Power Engineering. Power

Engineering is then subdivided by four technical disciplines each with a chief engineer as the technical leader for a given discipline. UE&C defines four specific disciplines: structural, electrical, instrumentation and control and power. The first three are self-explanatory whereas the fourth requires some explanation. Included with the Chief Engineer of Power's group are the technical disciplines of power systems, piping engineering, process engineering, mechanical engineering, nuclear engineering and fluid/hydraulic engineering. The engineering personnel involved on a given project such as the Seabrook Project all report technically to one of these four discipline chief engineers. Some may serve on a specialist staff or in a special group under the chief engineer of that discipline supporting a project. While others may be within the project group under a supervising discipline engineer or other engineering supervisor who reports to a project engineering manager. The staff groups and personnel become involved in project work only at the request of the project engineering personnel. Based on the team's information this concept has been rather constant within the firm for a number of years.

The Seabrook Project functions within this framework in the following manner. The Project Manager apparently reports to the Vice President of the Power Division, just as does the Manager of Power Engineering. In the course of the Seabrook Project there have been numerous changes in the functional organization for the project as well as changes in personnel. The team found some in tracing the organizational changes as well as how responsibilities shifted and were transferred from one group or individual to another. Documentation was obtained in the organizational area, to indicate the overall project organization since 1976. Numerous changes were implemented about the time the team's effort began, adding another change to the list. The team found that the organizational charts obtained in the background study in October were even out of date by the beginning of November when the IDI team began, its inspection.

Reporting directly to the Project Manager until sometime after March of 1981 was the Project Engineering Manager. There also existed at least one Assistant Project Engineering Manager. The Supervising Structural Engineer, called a supervising discipline engineer (SDE), reported through an assistant project engineer to the Project Engineering Manager. The SDE for structural was the same individual from the beginning of the project until August of 1982 when his assistant became the SDE. During the period of heavy involvement in design for the basic structures the structural group in projects was aligned by structure in that the Containment Shell, for example, had a designated Cognizant Engineer as the lead structural design engineer for that building. A significant number of engineers were assigned in these building groups. As that phase of the project drew to a close the structural personnel have also been formed into specific task oriented efforts such as the Beam Verification Program. The Cognizant Engineers assigned by building still exist, but have smaller groups and may also now have responsibilities for several buildings. Another change that grew over the life of the design evolution was the importance of site related engineering efforts. Up through March of 1981 there was a liaison Engineer assigned to the field to perform the site liaison to the home office engineering organization. That function was performed under the supervision of the one Project Engineering Manager for Seabrook. In March of 1981 a separate organization was created under the direction of the Project Engineering Manager (Site) as opposed to the previous position under the Project Engineering Manager for the Project. By January of 1983 four separate Project Engineering Managers positions were in existence in the home office with some 1100 personnel in the groups. Additionally, nearly another 1000 were at the site under the control of the Project Engineering Manager for Site Engineering. [No less than six different groups exist working in the structural discipline in different chains of command with three at the site and in the home office. A separate structural group has been set up in the ome office in the Site Support Engineering Group to interface with the field Site Engineering group so as to minimize impacts on the project Structural group. The implications of this organization will be mentioned later in the report in addressing interfaces for design.]

The team also spent considerable time, out of necessity, in order to try to understand the hierarchy of the multitude of in-house procedures utilized by UE&C so that a proper assessment of what was being done in the project's design and the control of the design process could be made. Figure 4.____ presents an overall view of the hierarchy that exists for the Seabrook Project with regard to home office engineering and design. In actuality, 4 to 6 layers of documents and procedures precede what might be considered to be an engineering calculation. This is some what further complicated by the fact that in many specific areas, different staff groups have developed and use modified procedures where latitude exists under a more general parent procedure. The result is a great deal of variation in documents when one begins to review, for example, calculation packages and the associated control sheets.

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As a result of the team's review of the various project documents, such as the Project Manual of Procedures, the General Engineering and Design Procedures, several findings and observations were made. The team first reviewed QA-3 from the QA Manual which is the UE&C corporate level document which addresses the regulatory requirements.

Continue on hand written page 5

1/16/84

Document Name:

SECTION 4.2 - SEABROOK IDI

Requestor's ID:

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Static and Dynamic Analyses

4.2 ~~Static and~~ Dynamic Analyses

The objective of this portion of the inspection was to examine the adequacy and coordination of analysis, design, and the resulting floor response spectra for the Tank Farm Area which houses the Refueling Water Storage Tank (RWST) and the Spray Additive Tank (SAT).

The team also reviewed the interdisciplinary process leading to the design of the attachments to the containment liner supporting ducts, pipes and electrical equipment, Calculation Set No. CS-22, (Reference 4. —) as well as the calculations pertaining to the subject of the Tank Farm.

The dynamic analyses of the Tank Farm was performed by the Structural Analysis Group (SAG) in order to determine the seismic forces needed for the design of structural elements such as the structural steel beams and bracing and the reinforced concrete walls and slabs. This analysis also led to the development of amplified response spectra which were used for seismic qualification~~s~~ of equipment, ~~as~~ analysis of piping systems, and for design of structural steel beams.

The Tank Farm Structure is essentially composed of a lower reinforced concrete box-like structure and an upper braced structural steel frame with a reinforced concrete roof slab and metal siding. The mathematical model consists of lumped masses connected by massless springs. This type of model is commonly referred to as a stick model. The calculations used for the development of the mathematical model are contained in UE&C Calculation No. SB SAG-5WB (Reference 4.41).

The stiffness of the structural steel frame was based entirely on a shear type response in that the nodes were in general restrained from rotation about the horizontal axes. The calculations of the area and the bending moment of inertia were calculated consistent with the rotational constraints imposed on the model. While the combination of area and bending moment of inertia were consistent with overall shear stiffness, individually the properties were not consistent with the actual structure. The rotational constraints imposed also, in effect, eliminated overall bending from any consideration. This approximation could result in a significant overestimation of the stiffness of the structural steel framing.

The stiffness of the reinforced concrete portion of the building was considered by UE&C as a combination of shear stiffness and overall bending stiffness. Therefore, instead of summing up the rectangular cross sectional area of walls oriented in the direction of inter~~n~~est, UE&C considered each wall separately in determining the shear deformation. This shear deformation of each wall is composed of pure shear displacements as well as bening characterized as a guided cantilever with a moment of inertia based upon the rectangular shape. The sum~~a~~ of the shear stiffness of each wall is calculated, so that an area and a bending moment of inertia of the stick is determined consistent with the shear stiffness. The problem with this method is that if indeed both shear stiffness and overall bending stiffness were important, the method would underestimate the overall bending stiffness particularly since flange effects are not considered. UE&C made computer runs during the week of December 5, 1983 while the inspection way in-progress which indicated that the model was not sensitive to errors in the moment of inertia.

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In calculating the stiffness of the structural steel bracing, UE&C assumed that all X-bracing was composed of angles 4"x4"x3/4". In fact, the bracing consists of substantially larger members as indicated in UE&C Drawings F-111824 and F-111825 (Reference 4.32).

There is approximately __ feet of fill concrete under the Refueling Water Storage Tank and the Spray Additive Tank. A three inch gap is provided between the fill concrete including the mat and the south wall of the Primary Auxiliary Building (PAB) as shown on UE&C Drawing ~~9763-~~F-111818 (Reference 4.32). A concrete curb is placed on the top surface of joint as shown in Detail 111819DD, UE&C Drawing ~~9763-~~F111819 (Reference 4.32). This joint is shown along the east edge of the fill concrete only. A field visit indicated no differences with the requirements of the UE&C Drawings (Reference 4.32). The mathematical model described in Calculation No. SB SAG-5WB (Reference 4.41) does not account for the stiffening effect of the fill concrete.

The neglect of overall bending used in the development of the stiffness of the stick model were not approximations which significantly simplified calculations, but which might be troublesome and therefore, must be independently justified.

Personnel stated the Tank Farm mathematical model was unique and no other mathematical models were prepared in such a way. Additionally, it was stated that the usual practice of SAG is to prepare a static structural model and with the aid of a computer program, appropriate stiffness properties are calculated without the need for the approximations such as those used in the

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Tank Farm model. The team had insufficient time to confirm that the Tank Farm Structure is an isolated case; however, the team has no reason to doubt the validity of that statement. Because of discrepancies between the assumptions used in the development of the mathematical model and the actual Tank Farm Structure, new calculations and computer ~~runs~~ analysis are required. It is the team's finding that the Tank Farm mathematical model should be recalculated incorporating effects of overall bending and the actual structural configuration (Finding 4.____).

The interfacing between different disciplines is illustrated by Figure ____. It shows the major steps taken during the process and is self-explanatory. It should be pointed out that all transmittals of the amplified response spectra (~~ARS~~) from one discipline to another is taking place through the Coordinator of Seismic Design (CSD). We were informed that the introduction of this position as the focal point of coordination of interdisciplinary effort improved the design procedure in a great measure and has prevented the use of obsolete or inapplicable results of seismic analyses. We found an instance of such a lack of coordination in the past in case of use of results of the input to the SHELL I computer program (Finding 4-7). ~~The subject of seismic analysis will be discussed later, in the section dealing with design of the containment.~~ The current system of control of seismic design is based on ~~follows the administrative procedure~~ (AP-36), "Control of Seismic Design" (Reference 4. ___) which was introduced in May of 1980 and appears to be effective. In the process of reviewing Calculation No. CS-22 (Reference 4. ___) several observations have been made. (Observations 4.1, 4.2 and 4.3). In case of Observation 4.1, reversal of the horizontal leg of the angle could introduce an additional eccentricity, which would cause a torsional moment

Findings @ End of ¶ F4-7 not developed here enough

Won't that here

These should be incl here Do as separate ¶'s.

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in the plate and therefore increase in the stresses. We pursued our inspection further, and review of the shop drawing revealed that the detailer placed the angle in question with the vertical leg at the center of the plate, thus eliminating any eccentricity which might take place due to the erroneous sketch on Sheet 98. Observations 4.2 and 4.3 have been brought to the attention of the design office as examples of lack of proper care in preparation of calculations and checking and would not have a major bearing on the adequacy of the design.

We reviewed the basic assumptions of the seismic analysis of the containment
contained in the Standard Review Plan Section 3.7 (Ref:
structure from the point of view of the regulatory requirements and found them acceptable. The containment shell has been represented as a lumped mass (stick) model fixed at elevation -30 ft. The shell and the internals including polar crane have been uncoupled for the purpose of the final analysis comple
Calculation No. (Reference 4: ___)
(SBSAG-4CS4). The analysis assumed that the liner is not a resisting structural element, but its mass has been included in the lumped masses of the model. Since the shell is essentially axisymmetric, and its center of mass and center of rotation coincide, the torsion due to the geometry of the structure has not been considered. The accidental torsion due to seismic force applied at an eccentricity of 5 percent of the mean diameter of the containment cylinder was considered and its effect on the stresses of the rebars has been found to be negligible (less than 2 percent increase). We agreed with the considerations made for torsion.

"Seismic Analysis of Containment Structure" (SBSAG-4C: Ref ___

In the case of the internal structures, they have been modeled as a series of concentrated weights, located at their respective centers of mass. These weight centers have been located at specific elevations, which in most cases is at the top of the respective slabs. The weights representing the slabs have been connected by weightless, elastic beams representing structural components between the elevations of the concentrated weights.

Since there are no existing earthquake records pertinent to the Seabrook site the seismic input has been defined in the Seabrook FSAR, Section 3.7, Ref. 4 — at the bedrock in form of the design response spectra for the operating basis earthquake (OBE) and the safe shutdown earthquake (SSE) in compliance with Regulatory Guide 1.60. The duration of the earthquake is estimated in the FSAR at 10 to 15 seconds. The engineers responsible for the seismic analysis stated that all Category I structures are founded on sound bedrock or engineered backfill extending to the backfill. The engineered backfill consists of either fill concrete, backfill concrete, offsite borrow tunnel cuttings or sound cement. ? Furthermore, the type of engineered backfill used under all seismic Category I structures as stated in the Seabrook FSAR, Section 3.7 (Ref. is fill concrete, with an exception of safety-related electrical duct banks, electrical manholes and the service water pipes which were founded on off-site borrow or tunnel cuttings. Both the time history and the response spectrum analyses were performed for the OBE and the SSE conditions Seabrook FSAR, Section 3.7 (Ref 4. —). The critical damping ratios used for the containment structure are those of 4 and 7 percent for the OBE and for the SSE respectively, consistent with the recommendation of Regulatory guide 1.61 (Ref —)

The structural response has been determined "Seismic Analysis of Containment Structure" (SB SAG-4CS4), Ref. 4 — using the response spectrum modal analysis method. The total response of the structure was calculated by superposition of the responses of each mode by the square root of the sum of the squares (SRSS) method.

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We reviewed the process by which the basic data pertinent to the design of containment have been gathered. In this connection we have noted that several documents such as those pertaining to the design temperature and pressure, for example, memorandum from ~~Tseng to~~ C. W. Tseng to H.E. Flora, dated November 3 1980, Ref 4 — which in the opinion of team members should be controlled, have not been included in the Document Control Center (DCC) serial numbering system and could not be easily retrieved. This matter is described in more detail in Section 1.3. Furthermore, examination of the input for the SHELL I computer program revealed that the information used was incorrectly referenced in the calculations ~~set~~. The following is the result of our further inquiry in this matter.

Seismic forces and moments as used on Sheets 30 through 35 in the Calculation No. CS-15, "Design of Containment Shell and Dome" dated 8/4/75, (Reference 4. ———) were obtained from modified seismic analysis SB space SAG-4CS3 (Reference 4. ———) using decoupled model of the containment shell and critical damping values of 4% for OBE and 7% for SSE. ~~(Reference 4. ———)~~ The preliminary analysis, SBSAG-4CS3, was based on coupled model of the containment shell and critical damping values of 2% for OBE and 5% for SSE. SB space SAG-4CS3 has been superseded by the final seismic analysis SB space SAG-4CS4 (Reference using a decoupled model of the containment shell and critical damping values of 4% for OBE and 7% for SSE ~~(Ref. SAG memo~~, as outlined in memo MM# 5511A dated 3/17/76, (Reference 4 ~~File 3.1.1),~~ Memorandum from ~~Rob~~ J.M. Robinson to K.M. Kalawadia dated October 12, 1979

Although comparison of the SB space SAG-4CS3 and SB space SAG-4CS4 analyses shows that their results are very similar and that the seismic forces and moments used as input for the SHELL I program are conservative, we determined that this is a violation of the ~~Administrative Procedure~~ AP-22, "Calculations", Appendix A (Reference 4. ———) ~~Rev. 4, dated 11/19/74~~ and 10 CFR 50, Appendix B, Section III, "Design Control", dated 8/1/80 (Finding 4.7).

more details needed

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We reviewed the various stages of the static analysis of the containment structure which utilize the results of the static analysis described above. The containment structure (the shell and the dome) has been designed using several computer programs. Some of them such as LESCAL, WILSON I and WILSON II have been documented in the Final Safety Analysis Report (FSAR) Section ____. There were others, however, such as SHELL I and SHELL II which have not been included in the FSAR. This is in violation of the Regulatory Guide 1.70, Section 3.8.1.4, Revision 3, November 1978. ~~and a~~ Although we were ~~have been~~ informed by ~~the~~ UE&C personnel that the use of these computer programs ~~codes~~ was limited, we noted this ~~it~~ as an observation (Observation 4.____).

More detail needed to develop this

The axisymmetric analyses of the containment structure for dead, load, pressure, temperature under both operating and accident conditions were performed using Wilson I computer code. The shell model for the OBE and SSE has been analyzed using Wilson II program. Both the Wilson I and Wilson II use the finite element method. Since the ASME Code does not permit the liner to be used as a structural element, the containment structure has been analyzed and designed without participation of the liner plate. The analysis recognized the fact that under thermal conditions, the liner plate will exert forces in the concrete section which constrains the liner growth. In order to generate proper design forces for the concrete section, liner stiffness has been included in the Wilson I model but excluded from integration of stresses to obtain section forces and moments. The analysis recognized the fact that the cracking pattern will vary under different loading conditions. In order to simplify the design, the individual loads have been combined linearly despite the difference in cracking. The peak pressure and peak temperature have been assumed to occur simultaneously for the design of concrete section. We agreed with this approach.

In the analysis the input for the SHELL I and SHELL II programs have been obtained from the lump-mass analysis which used the STARDYNE computer code and model described above. The SHELL I and SHELL II programs converted the forces and moments obtained from the STARDYNE analysis into the effective membrane forces and in plane shears and adds them up algebracially.

The square root of the sum of squares is applied to determine the combined effects of three orthogonal components of earthquake ground motion, including two horizontal and one vertical motions. Due to the symmetry of the structure, the maximum meridional and the maximum in plane shears will occur at the same location.

The design loads computed by SHELL I and SHELL II were used as input to program LESCAL, Version 1.5, which is used to calculate the stress and strains in reinforcing bars and/or concrete per ASME B&PV Code, Section III, Division 2.

Summary & Conclusions

INTERDISCIPLINARY PROCESS OF ANALYSIS OF PIPING ANCHORS

SH 1/2

STRUCTURAL DISCIPLINE OR CSD REQUESTS SAG TO DEVELOP ARS AT CERTAIN LOCATION

SAG GENERATES ARS AND TRANSMITS TO CSD

CSD DISTRIBUTES ARS TO STAFF GROUPS & DISCIPLINE LEADERS (ADV. COPIES IMMEDIATELY CONTROLLED REVISION: COPY APPROX EVERY 6 MONTHS THROUGH DCC

NEW ANALYSIS

Nuclear/Mechanical prepares Iso with exact location of pipe supports. Consults PSG, if necessary, to help locate suppts.

Piping in coordination with Nuclear/Mechanical prepares work request package for MAG analysis.

MAG selects exact ARS (no assumptions permitted), performs analysis and sends to Piping.

Piping prepares Work Request for PSC support design. And designate ASME safety class

and prepares shop dwgs for pipe supports

PSC designs supports and sends to Piping and Fabricator. Seal in Div.1, Subsect. NF. (for ASME supports)

1B

1A

REANALYSIS

Piping performs ARS verification. If results are unfavorable, Piping sends verification package to ARS Review Task Force.

Task Force reviews ARS problems, removes conservatism, recommends alternate solutions for using reduced ARS and asks Piping to close-out ARS verification. If not possible, asks Piping to authorize reanalysis.

Piping either (i) closes out ARS verification or (ii) requests MAG reanalysis.

MAG performs reanalysis and sends to Piping.

Piping requests PSC to redesign supports.

1C

ANALYSIS OF PIPING ANCHORS (CTD).

SH 2/2

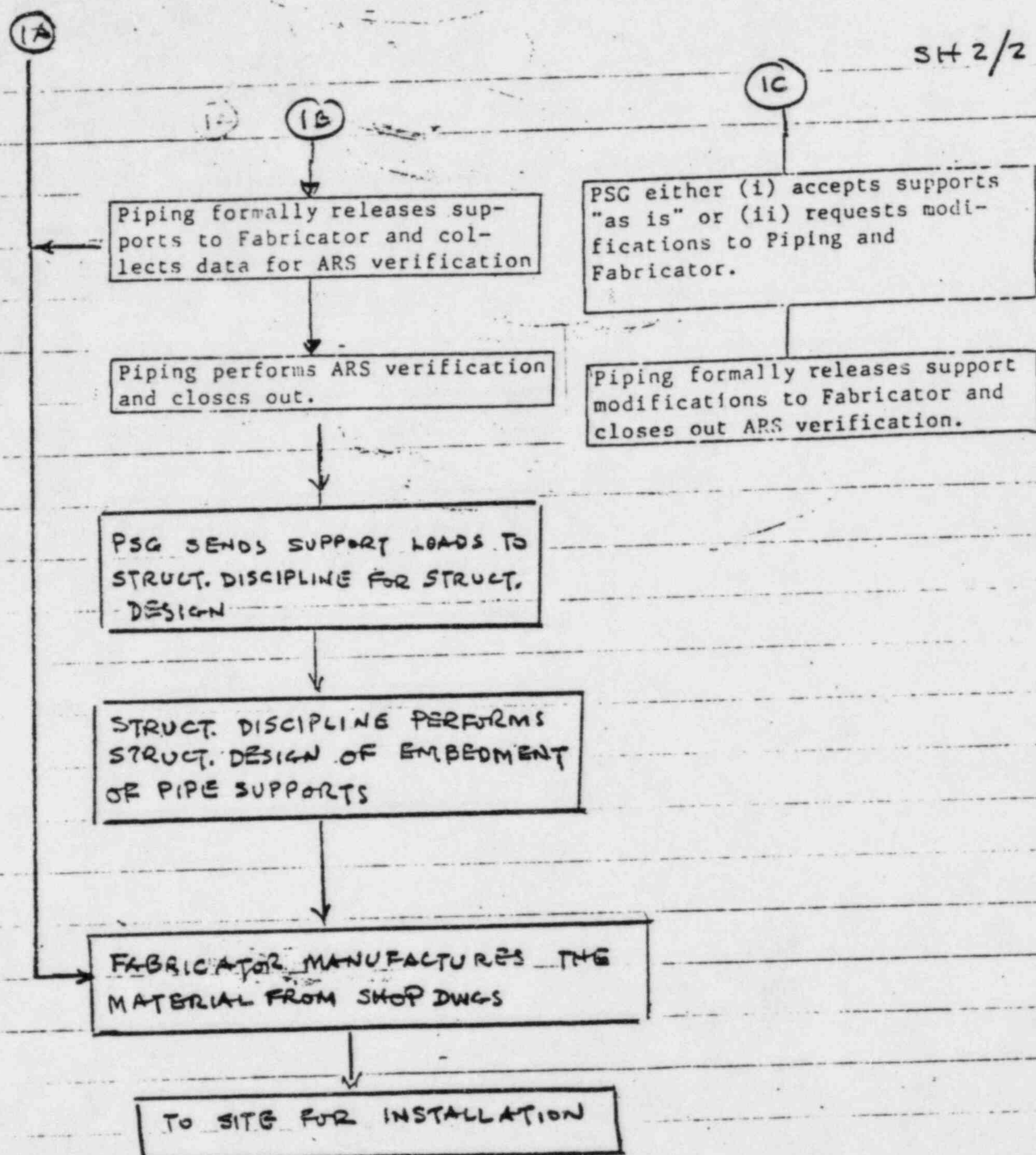

FIG. ______

SOURCE: Internal Memo #14091A, dated 8/9/83
from D.H. Rhoads and H.C. Grau

1/17/84

Document Name:
SECTION 4.3 - SEABROOK IDI

Requestor's ID:
EILEEN

Author's Name:
R. Lipinski

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Design of Structural Elements

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objectives have to be broadened to cover all elements reviewed

4.3 Design of Structural Elements

The objectives of this portion of the inspection were to examine the adequacy and coordination of analysis, design, engineering drawings, shop drawings and construction of structural elements located in Category I structures which are associated with the containment spray system. The structural element which was selected as an example was the recirculation sump screen structure.

The containment recirculation sump screens and collects the water available for supplying the residual heat removal, containment spray safety injection and high head charging pumps during the recirculation mode of operation following an accident. There are two completely independent sumps located in the containment, symmetric about an azimuth of 270°, with the top of concrete at elevation -26'. Heavy particles are prevented from reaching the sumps by sloping the surrounding floor away from the sumps and two screens (one is coarse and considered a trash rack with 1 inch x 3-11/16 inch openings and the other is the fine screen with 8x8 openings per inch) prevent foreign matter of 0.097 inches or greater from passing through.

?

Both the trash rack and the fine screen are attached vertically to the steel framing. The structure itself consists of a framework of structural steel members extending from elevation -26' to elevation -20½'. Each frame is on three elevations, within the limits stated above, and has the area of 9'-6" x 18'-6".

what are 3 elevations

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We reviewed the design calculations for the screen structure which are contained in the Design Screen For Recirculation Sump Calculation No. CI-2 (Reference 4.____). The structure was designed for the load combination of the dead load, live load and the OBE as one of those required by the FSAR. The computation contained a statement that the equation used was the controlling load combination equation, but there was no comparative analysis or any evidence that both earthquakes (OBE and SSE) have been considered. Additionally, the effects of thermal expansion of the beams had not been taken into account. During the inspection, the temperature was accounted for in Revision 1 to the calculations. This was after the structural steel ~~has~~ had been installed. The drawing pertinent to this structure, Drawing F-101486, Containment Steel, Recirculation Sump Screen Details dated October 27, 1978 (Reference 4._____) was released for construction of embedded anchor plates on September 29, 1978 and for structural steel construction on January 21, 1980. We concluded that consideration of both of the earthquake loads, OBE and SSE should be evidenced in the design and that omission of this load is violation of the "Structural Design Criteria" SD-66, Table 5.4-~~1~~2(?), Rev. 0, dated October 19, 1976 (Reference 4.____) (Finding 4-11). During our inspection, Revision 2 was added (dated November 25, 1983) which included an explanatory note that the amplified response spectra tables have been consulted and it appears that the original design was conservative.

Rev. 1 JZS noted to be 11/29/85, how does this wash w/Rev 2 '83 of

Examination of Detail 101486M on Drawing F-101486 (Reference 4.____) revealed that the bent plate connector had not been placed centrally with respect to the structural ~~member (6/2)~~ Channel to which it is bolted and was moved toward the upper flange of the channel. This was inconsistent with the analysis, which assumed that the connector would be placed so that the center of the bolts on the connecting plate would coincide with the center of gravity of the channel. We verified that the eccentricity between centroid of the bolts and of the channel as described above has been transferred on to the shop drawing Gives Drg # E1001 and E1002 dated April 2 198 and during our trip to the site, we found out that installation was consistent with the drawing. Since the members are subject to the movement along their longitudinal axes due to thermal conditions, such a displacement of the connector from the centroidal axis of the beam introduces eccentricity which will result in increased stresses at the connecting plates. This was noted as a finding. (Finding 4-4).

The cognizant design engineer performed additional calculations during the inspection to account for ~~this~~ the above condition and determined that the resulting stresses are within the code allowables and, therefore, the structure as built is adequate. The additional calculation sheet has not been listed in the Calculation Revision Control Sheet of Revision 2 which was reviewed by the team. This is contrary to AP-22, "Calculations", but since the work was done after the inspection's ~~time window~~ design review cut-off date this is noted as an observation (Observation 4-3).

While inspecting the annular steel between the containment shell and the secondary shield in the containment structure, we observed that a number of steel beams framing into the steel plates embedded into the concrete had been modified. The modifications consisted of extending the lower part of the web of the beams and providing plates to accommodate the lower bolt in the plate which had been welded to the embedded plate. Upon examination of the pertinent shop drawings and the engineering drawings we found that this modification had been necessary due to the fact that the embedded plates were installed at the wrong elevation. The plates were installed too low to be compatible with the elevation of the structural steel in the area of the annulus. In our discussion with the cognizant design engineers the modification of the connections was not reflected in the analysis completed using a computer program. We determined this not to be in conformance with the AISC Specification (Reference 4.____) and the Structural Design Criteria, SD-66, Sections 2.1.2 and 6.2.5.1 (Reference 1.3) (Finding 4-13).

We requested that an additional analysis be performed to determine the adequacy of the connections. During the inspection we were informed that a program which will re-evaluate connections modified as described above or in any other way so as to depart from the standard connections contained in the AISC Specification and not ~~taken~~ analyzed via the computer model will be reviewed. This will be done by selecting a representative sample and analyzing the connections in that sample in accordance with the AISC Specification requirements. We were told by the design engineers of UE&C who have been intimately involved in design of the annular area of the containment structural steel that misalignment of the embedded plates with structural beams is widespread in Unit 1. In the case of Unit 2 there was an effort to rectify this situation and to install the plates at the proper elevations thus alleviating problems for the as-built conditions. This was not completely successful and as a result there are cases where beams had to be modified in Unit 2. We also learned that the modifications were not performed in the field, but the beams were modified at the fabricator's facility and shipped to the field ready for installation. In view of the evidence that the design engineers are aware of the need for further analysis of these connections and that further action is under way we did not pursue this matter further.

Another item which is related to this area of containment pertains to the connection of the beams to the columns in the annular steel. Examination of the Cives shop drawings XE112, dated November 11, 1982 revealed that in order to accommodate welds between connecting angles and the beams framing into columns, not perpendicular to the columns, the axis of the beams was shifted by one inch from the centroidal axis of the column. This resulted in an eccentricity with respect to the column, which in turn induced torsion in the column. We have found that this was not accounted for in the analysis completed via a computer program run SB13CI dated October 22, 1981, and that it violates the ~~Committed to by UE&C in General Engineering Design Procedure dated~~ Structural Design Criteria, SD-66 (Reference 1.3) and Section 1.15.3 of the ~~August 2, 1976~~ AISC Specification (Reference 4.____). In our opinion, the effect of torsion induced in the columns is to increase stresses in the members and these stresses should be evaluated to determine the effect on over-all member stresses. We recommended that an appropriate action be taken to assess impact of this eccentricity and an analysis be performed to evaluate the resulting stresses. (Finding 4-19). [Committed to by UE&C in "General Engineering ~~Administrative~~ and Design Procedures, Administrative Procedure 28, dated October 1, 1974]

The Structural Design Criteria, SD-66 (Reference 1.3) is the controlling document for the structural design of reinforced concrete and structural steel. With respect to the design classification of the seismic category of the Tank Farm structural steel considerable confusion was found. Table 3.3-2 lists the Tank Farm structural steel framing as Non-Category I with a requirement that earthquake loading shall be in accordance with the Uniform Building Code with a perplexing note covering manhole covers. ? Furthermore, a requirement for the design for tornado pressure is listed. Paragraph 4.4.2.6.5 of the criteria states that the roof shall be considered expendable and allowed to fail during a tornado. However, Revision 1 to the document, dated November 30, 1982 deleted the Tank

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Farm structural steel from the listing of Non-Category I in Section 3.2 and listed it under Category I in Section 3.1. This leaves the tornado requirement unclear at the present. While it was apparently the intention to change the designation to Category I in November of 1982, ~~it~~ the structure was considered Non-Category I from the original issue date of the criteria document of October 19, 1976. During the time period between October 19, 1976 and November 30, 1982, the calculations for the structural steel, Calculation No. WB-61 (Reference 4.____), were performed without a strict adherence to either Non-Category I or Category I requirements. ~~(Reference 4.____).~~

In the latest revision to the FSAR Table 3.7(B)-22 ~~lists~~ the Tank Farm steel framing over the Refueling Water Storage Tank is listed as Non-Category I with the caveat that it is designed not to collapse under SSE.

For most Category I Structures which are exposed to tornado pressure, Table 3.3-1 in the criteria document requires a design for tornado pressure. This leaves in doubt, the tornado requirements for the Tank Farm structural steel and the associated concrete roof slabs. Calculation No. WB-61 indicates no design for tornado for the structural steel.

The Tank Farm structural steel is Seismic Category I. The calculations and drawings are all classified as Category I which is the design intent at this time. The design load combinations listed in Calculation No. WB-61, Sheet 10 of 79, dated September 28, 1978 (Reference 4.____) omits load combinations containing the SSE. This violates SD-66, Structural Design Criteria, Table 5.4-2 (Reference 1.3) (Finding 4-6)

UE&C stated that the OBE load combination always controls for the design of the structural steel beams, and that this statement with a justification will be incorporated into the structural design calculations.

A structural steel beam, Mark B9, located on the El. 81' roof along Column Line 0.5 was designed for dead loads, live loads, and seismic OBE loads in Calculation No. WB-61, sheet 17 of 79, checked September 28, 1978 (Reference 4.34). Later a redesign was made to add the sag rod loads to the dead loads, live loads, and seismic OBE loads (Sheets 9I and 9J of 79, checked November 3, 1979). The original calculation (WB-61, Sheet 17 of 79, checked on September 28, 1976) was not voided as required by GEDP-0005, "Procedure for Preparation, Documentation and Control of Structural Calculations," Paragraph IID, Revision 0, May 21, 1974 (Reference 4.____). Subsequently, another calculation was made (WB-61, Appendix A, Sheet 10 of 16, Rev. 3, checked on June 17, 1981) which added a pipe support load, but neglected the sag rod loads.

Again the previous calculation was not voided. The SSE pipe support load was incorrectly combined with beam OBE loading and designed for SEE allowable stresses. The neglected loads and the combining of OBE and SSE violates SD-66, Structural Design Criteria, Rev. 1, (Reference 1.3) and was noted as a finding (Finding 4-8).

The fact that there was some confusion over whether or not the structural steel was Seismic Category I probably led to the type of problems described above. It is the team's understanding that the beams will be evaluated as Seismic Category I in a systematic application of all load combinations.

The roof slab of the Tank Farm structure was designed as Seismic Category I, although the Supervising Discipline Engineer stated that the roof was Non-Seismic Category I. SD-66, Structural Design Criteria (Reference 1.3) is silent on the matter.

The calculations for the reinforced concrete walls along Column Lines 4.5 and 5.0 are contained on sheets 8 and 9 of 13, UE&C Calculation No. WB-68 (Reference 4.34). The calculations were based upon the method described on page 351 of the "ACI Design Handbook," SP-17(73) (Reference 4.____) in accordance with the strength design method of ACI 318-71. The method is appropriate for reinforced concrete sections subject to combined bending and axial load when the section is controlled by tension. The calculation procedure is described in Flexure Example 3 of ACI SP-17(73) ~~(Reference 4.___)~~ which neglects any compressive reinforcement. The calculations did not indicate an adjustment of the value of Ø. The results of the calculations indicated a requirement for reinforcing less than that which would be required by a correct calculation. The tendency of the designers to provide more reinforcing than actually required by design may mean that sufficient reinforcing is in fact present for the revised calculations. This appears to be a systematic error for the Tank Farm walls and; therefore, the team recommends a review of all the design of reinforced concrete members subject to combined bending and compression. This failure to correctly execute the design in accordance with the design reference was noted as a finding (Finding 4-10).

Bracing within the structural steel framing is provided for resistance to lateral loads such as tornado and earthquake loads. The calculations for the design of bracing are contained in Calculation No. WB-61 (Reference 4.34). Total seismic shear loads were obtained from Calculation No. SB SAG-SWB (Reference 4.41). The loads in the bracing ~~was~~ were established in an approximate manner. The actual distribution is more complex than that assumed; namely, it is dependent upon relative stiffness. However, the determination of the distribution of shear forces is dependent upon a knowledge of the sizes of the bracing and columns which, of course, were initially not known to the designer. Additionally, UE&C did indicate the OBE will control the design of the structural steel beams as opposed to the SSE, but it is not clear that the OBE will control the design of bracing. At this point, a reanalysis and, if necessary a redesign, of the bracing is in order. The team recommends a more accurate determination of shear distribution and a recheck of stresses, based upon the fact that the column and bracing sizes are now known. The bracing in the Tank Farm should be checked with newly calculated seismic forces for both OBE and SSE in accordance in Table 5.4-2 of SD-66 (Reference 1.3). This failure to utilize all required load combinations and actual member properties in the calculations was noted as a finding (Finding 4.~~x~~6)

Introduction needed into Design Changes and Field Changes

At UE&C's headquarters in Philadelphia, a group called Structural Site Support Engineering has been established on the project independent of the project Structural Engineering group to address ~~chan~~ design changes. This group acts in support of and approves the work done by engineering forces (Site Engineering) on site at the Seabrook Plant.

In general, Site Engineering is apprised of a problem encountered during construction. Site Engineering will either propose a solution or will request a solution from Site Support Engineering. The proposed solution will be

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reviewed for approval by Site Support Engineering or an alternative will be provided.

A typical example of this process is Engineering Change Authorization, ECA 01/4217. Several pipe supports were required to penetrate the roof of the Tank Farm at elevation 71'-0". In Rev. A, Site Engineering recommended cutting the concrete by scoring the openings and chipping the concrete. Rev. B added reinforcing steel, cutting and replacement details and steel removal and replacement and Steel WT's tee sections. Revisions continued through Rev. E which incorporated additional details. During this process there was continuing dialogue between the site and the home office.

Site Engineering also prepares calculations. ~~which~~ This effort is now under the control of Field Administration Construction Procedure (FACP) No. 10, original issue was dated 3/11/83 and Revision 1 dated 10/27/83 (Reference 4.____). The majority of calculations concerned misalignments of structural steel connections. The usual case involved a misalignment of bolt holes, which required a replacement connection made ~~with~~ by welding. The welding was designed to provide the equivalent strength of the bolts, even though the actual forces might be less while this resulted in an overly conservative connection, it did eliminate several cycles of communication concerning design load requirements.

YAEC also participated in resolution of ECA's and NCR's which might have serious impact upon the project and which could not be considered routine. Two such issues were being addressed during the early stages of the project.

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In many pipe support details, it is necessary to butt weld a thick plate at right angles to an embedment plate. In approximately 20 cases the right angle plate has pulled out a portion of the embedment plate by lam~~inar~~ellar tearing.

Similar problems occurred previously in welding of annulus steel. The fact that the problem again came up was that there was no welding or material review, nor was there any general communication issued to alert all designers of supports to the problem of lam~~inar~~ellar tearing. The problem has not been resolved, but the tentatively consideration is ~~being given~~ to chang~~ing~~e steel from ASTM A-36 to Lukens Fine Line 516. ~~Both Mr. Ken Williams and Mr. Robert Tucker of YAEC~~ YAEC person are involved in the resolution.

Hilti Bolts are being used in the drift eliminator of the Cooling Towers. Due to corrosion potential, the Hilti bolts are desired in Stainless steel. However, the required length was not available in stainless steel; therefore, a greater length is anticipated. A meeting was scheduled to resolve this matter.

Another concern was raised by A. Cerne of Region I concerning back to back and corner installations. This item was addressed and it was found that for the specific cases there was no negative effect.

The overall assessment of the design controls in the area of design of structural elements indicates that the design utilized the design criteria and provided adequate margins of safety with regard to the code allowable~~s~~ stresses). The staff appeared to consist of experienced engineers thoroughly familiar with sound knowledge of their profession. We do not expect that the neglect additional stresses produced by the modification of the beams (Finding 4-13) or eccentricities of columns (Finding 4.19) will result in a drammatic reduction of the margins with respect to the code allowable. The team concluded that the structural elements examined have adequate capability to resist the expected design loads.

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SECTION 4.4 - SEABROOK IDI

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Author's Name:

G. Harstead

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Design for Supported Mechanical Systems and Components

4.4 Design for Supported Mechanical Systems and Components

The objectives of this portion of the inspection were to examine the coordination between the design of the mechanical components, the support structure, and the design of structural elements. The two tanks selected for review were the Refueling Water Storage Tank (RWST) and the Spray Additive Tank (SAT). Both tanks are part of the containment spray system and are located in the Tank Farm structure.

Both tanks are supported at their bases and are anchored into the fill concrete by means of high strength anchor bolts.

The seismic load for the Spray Additive Tank (SAT) ~~is~~ was obtained by assuming horizontal and vertical accelerations equal to 1.5 times the peak of the ground response spectra. This equivalent static analysis was completed in conformance with the method as provided for in Section 3.7(B).3.1 of the FSAR, but the analysis method was not defined in the procurement specification for the tank. ~~This is very likely a very conservative value and the anchor bolts were conservatively designed. Therefore, in spite of the tall configuration of the tank the tank and supports are very conservatively designed. While the method of seismic analysis is in accordance with the NRC SRP, it was not listed in the specifications.~~

The Refueling Water Storage Tank (RWST) was purchased from Pittsburgh-Des Moines (PDM) under UE&C Specification 9763-006-246-1 (Reference 3.52). PDM prepared design calculations for the RWST (Reference 3.196); however, two errors of omission were noted. One, in calculating the stiffness of the cylinder only the overall bending stiffness was considered, with the shear stiffness being neglected. Two, only the fundamental frequency was calculated, neglecting higher modes.

A reanalysis could indicate greater design seismic loads; however, it appeared that the thickness of the cylinder could accommodate somewhat greater meridional compressive stresses. Also, there appeared to be additional capacity in the anchor bolts. The team does not expect that there would be a requirement for material changes as a result of a reanalysis; however, such a reanalysis is necessary to meet the requirements of the specifications and good engineering practice. (Finding 4-____)

The review of the tank calculations prepared by PDM was the responsibility of the Mechanical Analysis Group (MAG), UE&C. The design responsibility of the anchor bolts was divided between organizations ~~split with~~ PDM specifying the bolt diameter and steel designation and the UE&C Seabrook Project, Structural, was responsible for the design of the embedment length and local reinforcing if required. The number, size, and type of bolts required by PDM was observed in the as-built condition.

The pipe support which was located on the structural steel Beam B-9 discussed in Section 4.3, was relocated so that the support was anchored into the concrete wall located parallel to and adjacent to Column Line E.7 in the Tank Farm instead of being supported by the structural steel beam. The sketches for the relocated pipe support structure were designed and presented on Drawing ~~No. 9763~~-M-8018335, Support No. M/S-1833-RG-04, Sheets 13 through 17, Rev. 5, 8/10/83 (Reference 4.____).

During a field visit, the support was observed. A comparison of the field installation with the design drawings indicated that the several of members were larger than required by the design. The team had no questions relative to these discrepancies in view of the oversized members. By changing the support from the structural steel beam, B-9, to the concrete wall, problems which could be caused in the design of the steel beam were eliminated, however as noted in Section 4.3 a finding was made on this subject.

Summary
& Conclusions
addressing the
elements of Design
Control

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Design for Supported Mechanical Systems and Components

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Author's Name:
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Design for Supported Electrical Systems

4.5 Design for Supported Electrical Systems

The objective of this portion of the inspection was to review selective samples of specific designs related to the structural support of electrical systems in order to assess the interface between the electrical and civil-structural disciplines for design. Specifically, a determination was to be made as to whether:

(1) The licensee's design commitments contained in the FSAR and other relevant documents have been met

(2) Correct design information had been coordinated and complete interfaces made through a logical design process

(3) The completed design was adequate

The inspection in this area was conducted by a review of the lateral cable tray supports being designed by ~~an~~ UE&C engineering design group located just off-site from the Seabrook plant. Organizationally the group is part of the UE&C Site Engineering Group, which is under the supervision of a project engineering manager and a Technical Staff manager. The Group is known as the Cable Tray Bracing Task Group. This Group at the site completes work on the cable tray support systems which are under the technical control of the Mechanical Analysis Group for Electrical and Equipment in the home office. The home office group reports to a different project engineering manager, known as the project system engineering manager.

The home office group is responsible for the development of the detailed design procedures and related guidance and in the current mode of operation, performs the analysis to complete the necessary design for the vertical loads on the tray supports. The site group is then responsible for the analysis and design for the lateral loads which is completed by making necessary modifications to the design which has been completed by the home office. The completed calculations and drawings by the site group are then sent to the home office for final review and the incorporation into the final design documentation, which includes the design for vertical and lateral loads.

The design of cable tray supports for the Seabrook project is governed by the document known as the "Technical Guide for the Design and Analysis of Seismic Category I Cable Tray Support Systems" (Reference 4.____). The team's effort in the area of the cable tray support design included a review of the technical content and details contained in this Guide as well as the execution of the design. The Guide is considered to be a controlled design document for the project on the basis that individual copies of the Guide are assigned to specific individuals by copy number. The development of this technical guide was the responsibility of the Mechanical Analysis Group which is a staff group reporting to the Chief Engineer of Power.

The analysis and design procedures provided in the Guide are the result of combining the results of actual test data for various components or elements of the tray support system with analytical procedures and the use, in many instances, of a bounding type assumption in order to realize a workable design procedure so that each and very design solution is not unique. A review was made of the specific FSAR commitments regarding the design of the cable tray support system. The relevant commitments were noted to be in Sections 1.8, 3.2, 3.7.3, Table 3.7(B)-23, 8.1 and 8.3 of the FSAR. Certain aspects of conformance to these commitments were reviewed and discussed by the NRC's Office of Nuclear Reactor Regulation prior to the team's effort (Reference 4.____). The team's effort was to interface with completed actions by NRR and their understanding of the design execution and to verify that the supports to the trays were indeed designed as Category I structures.

Only general and very limited commitments were found in the FSAR with regard to the manner in which the analysis and design of the cable tray support system would be executed. Note 5 to Table 3.2-1 in the FSAR stated that "qualification of the conduit and cable tray raceways for the Class 1E safety related circuits have been confirmed by analysis, and calculations verify the adequacy of the systems based on the properties of the raceways (including tray where applicable) and support components." In Section 3.7.3 of the FSAR one of the methods of seismic analysis for subsystems noted for the project utilized the cable tray support system as an example of application of the dynamic analysis method technique using the modal response spectrum technique. Diagrams were provided in FSAR Figures 3.7(B)-31 and -32 to illustrate a typical ceiling to floor cable tray support as well as a mathematical model representation which was used in the dynamic analysis. This constituted the majority of the analyses and design details provided in the FSAR. No inconsistencies between the FSAR and the Technical Guide were found during the review. The bases for the design of the Category I cable tray support systems ~~was~~ were judged to be well founded on a combination of test data in two areas and accepted analytical and design processes.

~~which are based on test data in two areas,~~ The first test area dealt with the actual, Static, Biaxial (combined vertical and horizontal) load testing of cable tray sections and the utilization of the resulting load-deflection curves to determine the load capacity at the tray's yield point, the load capacity at the state of local plastic behavior and then the ultimate load capacity. The team did not review the documents related to the actual test program. We did however establish how the allowable cable tray load limits were developed from the test data. UE&C defined the allowable loads on the basis of tray deflections being limited to no more than 12 inches in any direction based on electrical cable deflection limitations. The cable tray tests indicated much lower values for deflection under the loadings, such as under 1 inch at defined yield. Tray testing included the two configurations of trays which would be the most flexible (the 12" and 24" ladder type). These tests, in addition to the load deflection curves, also provided data on the effective member properties which could then be utilized in the structural model for analysis. The simplified structural models integrated the cable trays and the tray support system, consistent with the actual design configuration. These models were then utilized in standard structural analysis techniques to obtain dynamic responses and internal forces for the structural assemblies. Testing was again utilized by UE&C to establish the ultimate load capacity, ~~for~~ under various types of loadings including both levels of seismic, for typical configurations of joints and members. The load capacity of other structural members such as the cold-formed strut material or structural steel was established by the manufacturer's data or by use of existing codes such as the AISC, Specification (Reference 4 ——).

The design criteria for the cable tray support system defines three loading combinations and two stress or behavior levels. The dead weight alone and the dead weight of the tray plus the cable and the OBE loading are to maintain the support system in the elastic range. The dead weight of the tray plus the cable and the SSE loading allows some excursion into the plastic range, yet assures structural integrity. The design philosophy also encompasses the use of the largest yet most flexible cable tray configuration so that the resultant loads into the vertical support members are maximized. The bracing members are used to increase the fundamental frequency of the system and therefore ~~move~~ shift the response away from the peak response region. Damping has been taken as 4% for the OBE and 7% for the SSE which is as provided for in the FSAR.

Section 6.0 of the Guide provides detailed instructions on the execution of the analysis. It was noted that mass points were required to be located no further apart than 36" in order to more accurately reflect the behavior of the tray system which is generally supported at 10 foot spans or less. The various standard configurations are provided as well as the types of permitted lateral bracing and the design details which must be addressed for each type. The various types include the single support transverse bracing, two sided bracing, multiple support transverse bracing and axial bracing. Guidance is also provided on thermal considerations, torsion, buckling as well as welding and attachment to concrete. For situations where the cable tray support system is connected to main building structural elements which have different amplified response spectra, provisions are made for using envelope spectra or by a carry-over type analysis from one response spectra area to another. The dynamic analysis can be completed using a equivalent static load using the peak value with a 1.5 factor or utilize a dynamic analysis both of which ~~is~~ are in accordance with approved NRC methods. Documentation requirements are delineated and standard calculation forms for cable tray supports are provided.

The Appendices to the Technical Guide address in detail the related information necessary to perform the design of cable tray support systems.

The sample calculations selected by the team for review to assess the manner of execution of the design and to assess the adequacy of the resulting design ~~was~~ were a series of calculations related to the lateral support of cable trays in the Control Building. They were prepared by the Cable Tray Bracing Group at the Seabrook site in the Site Engineering organization and transmitted by a memo dated August 2, 1983 from Site Engineering to the home office (Reference 4.____). This submittal contained calculations in the southwest quadrant of the plan for Elevation 21-1/2' in the Control Building as shown on UE&C Drawing F-310449 (Reference 4.____). The calculations included the analysis and design for eleven separate sections of multilevel and multibay cable tray supports. Preliminary calculations for Section SW-3 (Reference 4.____) were selected for review. All assumptions were noted and those which required future verification were so marked such as the assumption that the amplified response spectra are final. This was found to be consistent with the procedures defining the completion, control and documentation for calculations. Specifically those procedures consist of GEDP-0005, "Preparation, Documentation and Control of Calculations" (Reference 4.____) and AP-22, "Calculations" (Reference 4.____). AP-22 takes the corporate design procedures contained in GEDP-0005 and defines in more detail how the intent of GEDP-0005 is to be met for the Seabrook Project. It

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was noted that AP-22, Appendix O which addresses the requirements specific to the Site Engineering group with regards to types of calculations completed, indicates that the Group is authorized to perform support design modifications to electrical systems. The work being completed by this group is in fact modifications to the vertical support system designed in the home office by the Mechanical Analysis Group (MAG) to accommodate lateral loads. With regard to GEDP-0005 it is noted that AP-22 would require the work being done by the Cable Tray Bracing Task Group to follow FACP-10, "Procedure for Site Calculations" (Reference 4.____) except that it is stated that where required individual disciplines may use separate guidelines for calculations.

The references utilized in the calculations, whether specific to the project such as those providing the details, for example of support type vs. the critical vertical and horizontal frequencies of that configuration to those which include standard text books, handbooks and vendor's catalogs on engineering details were provided. Two of the three vendor catalog references utilized for strut material and hardware data utilized in the calculations for Section SW-3 were used in the verification process by the team. No discrepancies were found and the interpretation and application of the data was judged to be correct. It was noted in the calculations that where several individual bents of laterally unconnected support frames are subsequently tied together laterally through braces that UE&C utilizes the square-root of the sum of the squares (SRSS) method to combine lateral loads. The team had no disagreement with this concept. In general there appears to be significant margins in the tray support system due to the simplifying assumptions made to minimize the number of unique designs required. For example, the worst tray cross-section is used, supports are designed in general for 10' spans of trays, in most instances the static load of 1.5 times the peak of the enveloping response spectra is used and the member/joint type selected usually has a capacity significantly greater than required.

The procedures and execution of the design of the cable tray support system for lateral loads were reviewed against the requirements of Section 4, Design Process, Section 5, Interface Control and Section 7, Document Control of ANSI N45.2.11-1974 to which the project is commited (see AP-22, Section 1, p. 1). The design activities were found to be prescribed in specifications, procedures and the Technical Guide for this task. These documents provide adequate control of the design execution to be complete by the individual designers. The design assumptions and design input were clearly defined and the associated calculations clearly identifiable by subject, originator, reviewer and associated dates. The standardized sheets for calculation title sheet, calculation control sheet, table of contents, status of revisions, assumptions and references has resulted in complete and fully adequate calculation packages. The interfaces are well defined and understood as the information flows from the electrical group, MAG and the Site Engineering group. The lines of communication were judged to be well defined and established. The documentation examined proved an excellent example of a package of work completed by Site Engineering, Cable Tray Bracing Group and transmitted to MAG for final review and concurrence as well as integration into the total package of calculations for the cable tray support system.

Based on the team's review of this specific area of engineering and design effort, UE&C's design control appeared to be very good. No findings were made. All licensing design commitments selected for review were reflected in the design documents being utilized for the project. In addition, more detailed design criteria and procedures have been developed and are being utilized on the project. The design process has been quite clearly defined and developed in the Technical Guide for the Design and Analysis of Seismic Category I Cable Tray Support Systems. Correct design inputs and design information have resulted from the systematic application of the Technical Guide based on the team's review. The specific review of Section SW-3 of the cable tray support system in the Control Building ~~was~~ resulted in a determin~~ed~~ation ~~to be~~ that the design was fully adequate. It was apparent that a great deal of engineering effort was expended, including substantial testing where it was apparently determined that actual test data would add to the reliability of the engineering and design process, in the evolution of this design guidance. Whether this was a joint decision by UE&C and YAEC/PSNH or a singular decision, the project is to be comended for a well organized design process for cable tray support systems and one which is adequately controlled based on the team's limited sample.

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SECTION 4.6 - SEABROOK IDI

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EILEEN

Author's Name:
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Design of Supported I&C Systems

4.6 Design of Supported I&C Systems

The objective of this portion of the inspection was to determine for a sample of instrumentation and control systems whether:

(1) ~~the~~ The analysis and design ~~equipment procurement~~ process ~~is~~ was executed in accordance with the appropriate procedures and in conformance with the guidelines contained in the licensee commitments and the Quality Assurance Manual,

(2) ~~c~~Correct design information related to the support of the I&C systems has been coordinated and complete interfaces made in a controlled design process, and

(3) ~~t~~The completed design for supports was adequate.

The equipment selected for this inspection was an instrumentation rack designated as MM-IR-14, located in the equipment vault at approximately elevation 3'-~~2"~~, west of Column Line D and north of Column Line 1.

The purchasing of the equipment such as this rack is controlled by the "Procedure for Purchase of Engineering Equipment" Administrative Procedure (AP) No. 18, Ref. 4 ~~dated May 31, 1974~~. This procedure has been revised several times, the last being Revision 5, dated November 1, 1983 (Reference 4). It describes the procedure for preparation of the suggested bidders list, material requisition, bid analysis approval by the ~~Yankee Atomic Electric Company~~ (YAEC), issuance of purchase order and change orders.

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"Control of Seismic Design" Administrative Procedure ~~#~~36) Ref 4 ——

The provisions of the AP-18 are coordinated with the (AP-36), "~~Control of Seismic Design~~", is~~sued on May 14, 1980~~, the current issue being Revision 2, dated October 14, 1983 (Reference 4 ——). This procedure addresses the control of seismic analysis and seismic design of structures, systems and components and defines the responsibilities of the project personnel and staff groups for the Seabrook project. It also describes the requirements for the development and control of amplified response spectra ~~(ARS)~~ in accordance with General Engineering and Design Procedure (GEDP~~8~~-0012 (Reference 4 ——), except for deviations as identified in "General Engineering and Design Procedures (Seabrook), Administrative Procedure 28 (AP-28) "~~General Engineering and Design Procedure (Seabrook)~~, (Reference 4 —) " Development and Use of Amplified Response Spectra for Seismic Design of Structures and Systems"

From the documents which we have reviewed it appears that the pivot~~ed~~al figure in the interfacing between various disciplines is the Coordinator of Seismic Design (~~CSD~~). His role has been mentioned briefly in Section 4.2 in connection with development of ARS for piping supports. Similarly, in the case of equipment supports, the CSD becomes the nerve center of coordination of the design effort in interfacing between project personnel, S~~tructural Analysis Group~~ (~~SAG~~) SAG, ~~Mechanical Analysis Group~~ (MAG), and ~~Pipe Support Group~~ (PSG). The team judged that introduction of this position in the organization of the staff of UE&C greatly improved coordination of the activities related to the design of structures, systems and components since many separate groups are involved in the complete design process.

In case of MM-~~IR~~-14, the I&C Group issued a Staff Work Request ~~(SWR)~~ to MAG, to revise response spectra in order to incorporate instrumentation ~~radis,~~ racks which included Rack No. 14. MAG responded that the ARS tables are not available and requested the ~~Seismic Design Coordinator~~ (CDS) to originate the ARS for the rack at the specified location. The next action was from CDS to the SAG group requesting that the ARS be generated. Upon receipt of the ARS from the SAG, they were distributed to various disciplines, MAG being one of the recipients. Following the provisions of AP-36, MAG developed the loads at the anchor points which have been used, through the SDC, by the structural discipline in the design of the structural steel framing at the location of the rack. Meanwhile, MAG reviewed the vendors seismic qualification report with respect to specification for the rack and was found to be acceptable.

We verified that the ARS values used by ~~the Mechanical Analysis Group (~~MAG~~)~~ were those provided by ~~the Structural Analysis Group (~~SAG~~)~~ through the ~~Seismic Design Coordinator (SDC)~~ CSD as required by the AP-36. We also verified that the values of the final anchor loads generated by the MAG have been based on the information obtained from the vendor's drawings and that they were used by the structural discipline staff in the design of the structural members.

ED. NOTE May want this p. moved into section 4.2

We reviewed the method of development of the ARS by discussion~~s~~ with the cognizant engineers of ~~the~~ SAG and by reviewing the method as described in the Controlled ARS Tables entitled "Amplified Response Spectra for Seismic Category I Structures" (Reference 4.). These tables undergo controlled updating and distribution in accordance with Administrative Procedure No. 23, "Controlled Documents" (AP-23) (Reference 4.). The various steps illustrating the complex system of interfacing between various groups and project disciplines is shown in Figure ~~X~~ 4.6-1. It illustrates the complexity of the problem and also shows the vital role of the coordinator of seismic design ~~(CSD)~~ in the process. It has been pointed

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containment interior concrete 1/10/84
and not the annular steel
frames.

Finding 4 ——

out previously (~~see Section 4.2~~) that in the past, the lack of the CSD was responsible for use of incorrect seismic amplified response spectra. The team found evidence of such a design deficiency, which occurred as late as in 1979, in the areas of seismic design of safety related components supported by the containment annulus steel frames. By memorandum SBU-31426, dated November 6, 1979 (Reference 4 ——), UE&C reported to the project manager, YAEC, that the amplified response spectra used in the design ~~was~~ were that for of the annular steel frame for it ~~which should have been used~~. It has been also found that the amplified response spectra for the annulus steel frame had "g" values greater than that used in the component design. The same memorandum informed the project manager that in order to ensure that other discrepancies do not exist in the seismic design, an audit would be performed to ensure that the proper amplified response spectra were used of all items on the Seabrook project. In the case of the Seabrook project it appears that a satisfactory design has been achieved without significant changes to the component. We consider the above as an excellent illustration of the importance of good coordination of design effort between various disciplines in a project of the size and complexity of a nuclear plant.

The amplified response spectra (A~~RS~~) are computed by means of a time-history (~~TH~~) seismic analysis. The overall dynamic response of the structure is determined by analyzing a model formed by lumping the mass of the structure and the non-movable equipment. These masses are, in most cases, lumped at the floor ~~level;~~ elevations. The masses are connected by weightless elastic beams which represent the structural members between mass points. Torsion is accounted for by considering the eccentricity betwen the center of mass and the center of rigidity. Floor slabs are assumed to be rigid in their own pla~~c~~ne.

Each structure is analyzed for two horizontal components and one vertical component for OBE and SSE magnitudes of ground motion. ~~and~~ The common response from the three components are combined by the square-root-of-the-sum-of-squares (~~SRSS~~) method.

Local amplification of overall response ~~are~~ is computed by one of the two methods.

In the first method, the slabs, beams and columns are evaluated for a range of frequencies selected for all local frequencies below 33 Hz. An overall stick model is then generated in such a way that at each elevation examined, the summation of the weight of the single-degree-of-freedom (~~SDOF~~) modes and the st~~u~~ick model mode equals the total weight. The single degree of freedom systems, representing the computed range of local frequencies are connected to the overall stick model as if they were all rigid. The stick model (~~including the SDOF's~~) is then analyzed using the ground motion artificial time history as the input forcing function.

The other method consists of performing a dynamic analysis, using finite lements, in sufficient detail to predict local modes of vibration. In this case the input forcing function, at the elevation of the structural element, is the response time history from the overall stick model.

The frequency and time history analyses are performed using the STARDYNE computer program. As a result, the maximum response of a series of SDOF oscillators is obtained, over a range of frequencies and the plot of these values is the amplified response spectrum, which is generated using the SAG058 computer program (Reference 4. ___). The SAG054 computer code is then used to generate ARS tables by enveloping raw curves generated by SAG058 (Reference 4. ___) and spreading the peaks by 10 percent or more in accordance with the requirements of Regulatory Guide 1.122.

We found that the methods of generating the amplified response spectra described above are acceptable.

While reviewing the ~~seismic~~ mathematical model of a stairwell for frame used by SAG to generate the ARS we noted that the location of the platform at approximately elevation 3' ~~4"~~ was incorrect when compared to the structural drawing F-101558, Rev. 6, dated 7/9/82 (Reference 4. ___). Since the model iteself was dimensioned correctly, the relative displacement of the model in relation to the reference points will not affect the results of the SAG's analysis. We found, however, that an observation is in order to point out the apparent lack of attention to the details on the part of the SAG analyst and the checker (Observation 4.19).

ED. expand here to tie into Observation

In our inspection we observed that the "RHR & Cont. Spray Equipment Vault Steel" structural design drawings Nos. F-101558 and F-101562 ~~have~~ had been released for construction on September 28, 1976 and July 6, 1978 (References 4. ___ and 4. ___) respectively and the structural design calculations, Calculation PB-76 "RHR Equipment Vault, Platform El. 3'-2"" have been completed on December 1, 1983 (Reference 4. ___). We requested that the original structural design calculations, from which the above design drawings were prepared and the members fabricated and installed, be presented for inspection. The original design calculations could not be found and we concluded that the absence of such computations constitutes violation of AP No. 22, "Calculations" Section 2.3.1, Revision 5, October 1, 1975 (Reference 4. ___) (Finding 4.20).

Review of the Calculation No. PB-76, Rev. 0, dated December 1, 1983 revealed that when the designer considered different load combination equation involving seismic loads (~~OBE or SSE~~) the live load had been omitted. ~~We considered~~ This ~~to be in~~ is a violation of "Structural Design Criteria" SD-66 Rev. 1, November 30, 1982, Section 4.2.1 and Table 5.4-2 (Reference 4.____). We discussed this matter with the staff of the Structural Discipline. They presented an argument that this is consistent with sound engineering practice since during operation of the plant there will be no load (such as people or material) which could be classified as live load. Furthermore, the footnote pertaining to Table 4.2-1, of SD-66, "Uniformly Distributed Live Load" states that: "Uniformly distributed live load" shall not be considered with seismic load conditions except loads which are marked "Permanent". Examimination of Table 4.2-1 revealed that with two exceptions (150 psf in control building at approximately Elevation (+) 9'-~~6"~~) the only live load listed as "permanent" is snow. In our opinion, such a classification of the live load practically eliminates consideration of live load from structural design in combination with seismic loads. This is contrary to the statement in FSAR Section 3.8.4.3.a.1(b), "live loads" which states that "Live loads are all temporary gravity loads including but not limited to normal snow loads, conventionally distributed and concentrated floor loads, and movable equipment loads, such as cranes and hoists". Additionally, omission of live loads from load combination equations violates the requirements of Section 4.2.1 of the SD-66 which states that "except for the Administration and Service Buildings the minimum live load shall be 100 PSF". We do not object to the statement in the same section of the SD-66 which states that "When actual equipment loads are used, uniformly distributed live loads need not be applied to the area covered by the equipment." In the final analyses the actual equipment loads may be used unless estimated uniformly distributed live loads are greater than the actual loads, in which case the members designed with estimated loads may be revised or left as originally designed". We do, however, find it objectionable to remove live loads from the areas away from the equipment.

We asked the staff if the floor live loads presently are or will be posted in order to prevent an inadvertent overloading on any area and we have been informed that they are not posted now and that such action is not planned for the future. ~~Consequently to the above finding regarding live loads has been filed (Finding 4.23).~~ From the discussions which we had with the UE&C staff we infer that omission of live loads in combination with seismic loads is a wide spread practice and we recommend that in the resolution of this issue an audit be initiated which would assure that the affected structural members are not overstressed when subjected to the load combinations including live and seismic loads. The omission of live loads in combination with seismic loads in floor areas not covered by equipment is considered to be a violation of the structural design criteria (Finding 4.23).

During a tour of the plant, we observed that one leg of the instrumentation rack MM-IR-14 in the Auxiliary Building Equipment Vault at approximately Elevation 3' is resting on a 1/2 inch thick plate instead of the structural member, C10x15.3 as assumed in the design (Calculation PB-76, Rev. 0, dated December 1, 1983, Reference 4). This configuration forms a cantilever with respect to the channel. We concluded that this is contrary to a sound engineering design and recommended that a vertical stiffener plate be provided, welded to the channel, and under the leg of the rack to carry the load to the channel. The reasons for this recommendation are as follows:

a) The ARS have been developed for the supporting structural member not the plate and therefore the dynamic response of the plate supporting the rack will be different from what it has been designed for, and

b) The leg of the rack is situated at the corner of an opening in the plate platform which has been cut out to accommodate vertically ~~running~~ oriented cables. This may be responsible for stress concentration. We reviewed the level of stresses in the plate platform supporting the rack and we found that they are low with respect to the code allowables. For this reason and because the situation just described did not violate any requirements regarding existing codes or procedures we did not consider this to be ~~that filing of~~ a finding ~~would be appropriate~~. We do believe, however, that providing a stiffener plate as described above would improve the design.

In summary, it appears that the process of procurement, and design of supported instrumentation and control systems is well managed and design controls are handled in an effective and efficient way. It would appear from Figure X that the interfacing between different disciplines and staff groups could be more streamlined, but taking into consideration complexity of the problem one can run into a danger of oversimplifying the procedures and bypassing important quality controls which might result in serious inadequacies of design.

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Notes on Figure X

Generation of Anchor Loads

1. I&C requests MAG to provide ARS at a specific location (approximately Elev. 3') for MM-IR-14.

2. The ARS for the MM-IR-14 were not available, therefore MAG requested CSD to generate the ARS.

3. CSD transmitted the request to SAG.

4. SAG generated the ARS and transmitted the information to CSD.

5. CSD distributes the ARS to project discipline and staff groups. Advanced copies immediately, controlled copies approximately every six months.

6. I&C provides ARS to the vendor for preparation of seismic qualification report (SQR).

7. Vendor prepares SQR and submits it to I&C for review.

8. I&C forwards the SQR to MAG for review and approval.

9. MAG notifies I&C of acceptability of the SQR.

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10. MAG generates anchor loads and transmits them to the CSD.

11. CSD transmits the anchor loads to the structural discipline for design/verification of structural members. 4.2

12. Structural discipline prepares the design calculation and the drawings and releases it for fabrication and construction.

K. I&C = Instrumentation and contr
SAG = Structural Analysis Group
MAG = Mechanical Analysis Groups
CSD = Coordinator of Structural Design

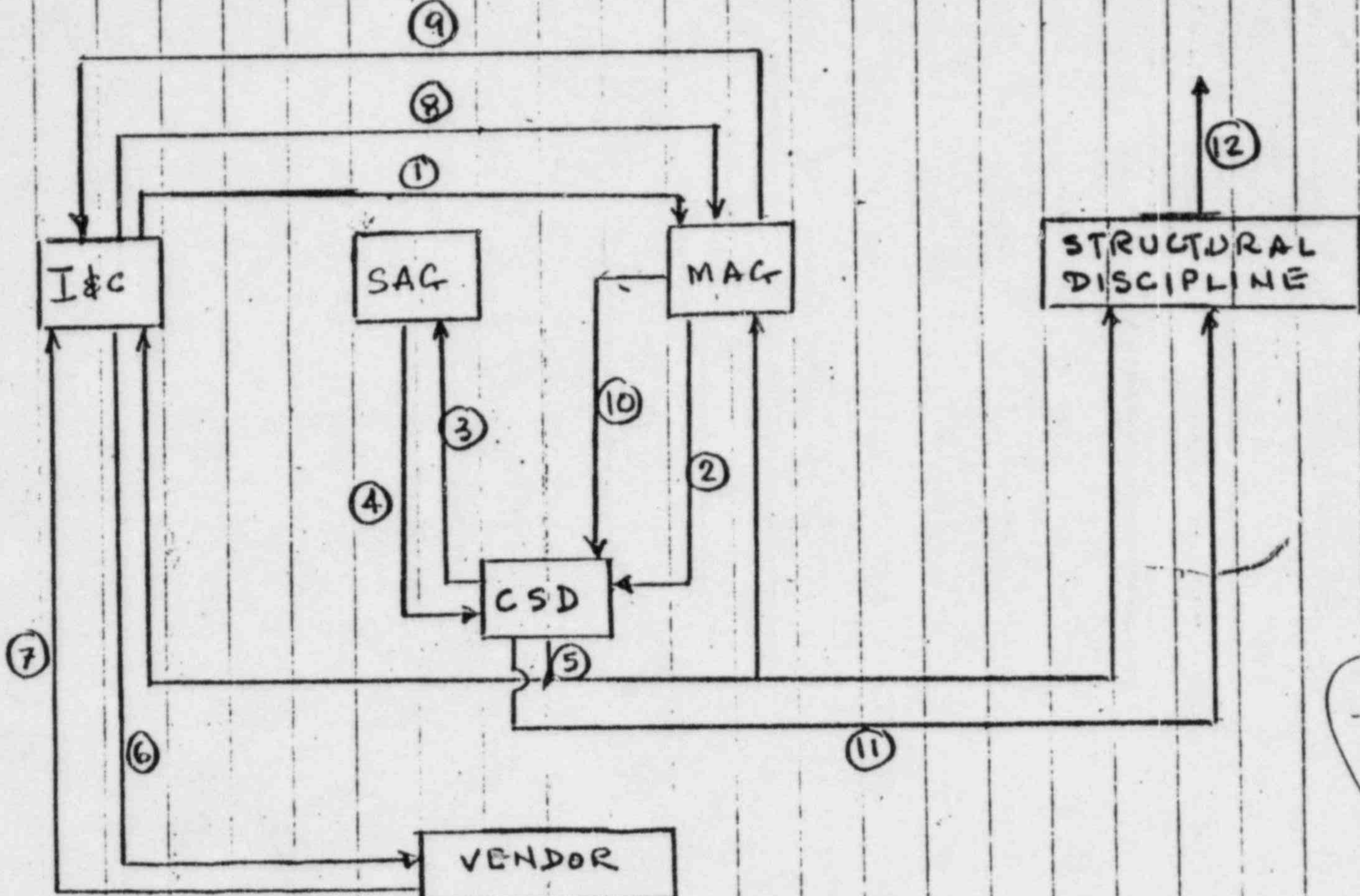

FIG. X
Sh. 1 OF 3

Do not type

4.6

Document Name:
SECTION 4.7 - SEABROOK IDI

Requestor's ID:
EILEEN

Author's Name:
R. ~~Lipinski~~ Shewmaker

Document Comments:
Subcontractors

4.7 Subcontractors Off-Site

The objectives of this portion of the report were to ascertain:

(1) How the licensee's design commitments being implemented by UE&C were being transmitted and used as input for implementation by several off-site contractors.

(2) The level of control maintained by UE&C over the subcontractor as well as the actual performance of the subcontractor.

(3) The manner in which ~~the~~ subcontractors are perform~~ed~~ing ~~and~~ controlled activities impacting the design of the facility.

In order to complete this phase of the inspection effort a selection was made from a list of subcontractors doing work in the design, engineering and services area of the project. The first subcontractor selected was Prof. Ed Burdette (test verification of certain design assumptions) who was chosen on the basis of an example of direct design related services. The second and third subcontractors were selected on the basis of the volume of work as well as the fact that both represented the next step in the design process beyond the basic design engineering effort completed by UE&C. These were William J. Lester, Inc. (structural steel detailing) and Bethlehem Steel Corporation (detailing, furnishing and fabricating reinforcing steel).

Burdette Consulting Contract:

In 1980, United Engineers and Constructors (UE&C) contracted Professor Edwin G. Burdette of University of Tennessee, to perform certain tests to establish the load-displacement relationship of the liner plate anchorage system to be embedded on the concrete containment. The objective of these tests was to demonstrate the adequacy of the liner anchorage system to meet the requirements of the ASME Code, Section III, Division 2. We reviewed the available documents pertinent to the tests provided by UE&C. The test program was administered as a part of the Purchase Order No. H.O. 56971, Change Order No. 1, dated 9/29/80 (Ref.). The Procedure for Containment Liner Anchor Load Test (Ref.), required that the specimens be prepared on the Seabrook plant site using the procedures and material approved for construction of the containment structures and shipped to the University of Tennessee for testing. These specimens consisted of 3'-4' x 3'-0" x 2'-3" high concrete blocks with the liner plate attached to the 3'-4" x 3'-0" top face. The embedded anchors consisted of tees 12 inches long and the two studs, 3/4 inch diameter and 12 inches long. We concluded that the specimens used in the tests adequately represented the containment structure and the liner with its embedment system.

The test procedure required that all measuring and test equipment be calibrated before testing and evidence of calibration be available for review. At our request, we were provided with a Testing Machine Verification Certificate, (Ref.) which stated that the 120,000 lb. capacity machine, belonging to University of Tennessee, had been calibrated and the loading ranges have been found accurate with tolerances ranging from 0.42 to 0.83 percent. The calibration was performed by the Tinius Olsen Testing Machine Company, Inc., of Willow Grove, Pennsylvania on June 10, 1980. The load cells output readings found in the report were based on the load readings from the same testing machine referencing the same calibration date.

We concluded that there was sufficient evidence of adequate quality control and that the tests were conducted with an adequate standard of reliability.

Bethlehem Steel Corporation:

The basis of the subcontracted services and in this case material, to Bethlehem Steel Corporation (Behtlehem) by UE&C was the UE&C document, "Specification for Furnishing, Detailing, Fabricating and Delivering Reinforcing Bars" (Reference 4.   ). This document was issued originally as Rev. 0, 1/24/74 and has undergone ten revisions since that time. A detailed review of the important design information relative to this specification was made by the team with respect to the design commitments of the FSAR and the discussion was noted previously in Section 4.4 of this report. Since the Seabrook project was committed to use the ASME Boiler and Pressure Vessel Code, Section III, Div. 2, the specification imposed stringent requirements for quality assurance. No distinction was made in the specification so that all work and material supplied by Bethlehem was to conform to the ASME Code. The team placed specific emphasis on the manner in which Section CC-2700, Materials Manufacturer's Quality Assurance Programs, were reviewed, accepted and implemented under the requirements of the specification. The rason for this was due to the fact that the Seabrook Project represents the first incorporation of the ASME Code, Div. 2 into a plant proceeding to completion. Bethlehem, prior to the start of the Seabrook project, had addressed 10 CFR 50, Appendix B in a quality assurance manual which was undergoing rework early in 1974.

An early version of the Bethlehem Quality Assurance Manual was submitted with the bid in January of 1974 and subsequently reviewed by UE&C. As a result of this review a series of meetings and discussions ensued in order to obtain conformance with the specification. In addition, to meetings held at UE&C offices on January 23, 1974, meetings and reviews were held ~~on January 20, 1974~~ at the Philadelphia Bar Shop of Bethlehem where a QA Audit check list was used to perform a Facility Survey conducted by a QA Audit Engineer from both YAEC and UE&C. The following day similar discussions and audit activities were held at the Steelton, Pa. facility of Bethlehem.

The results of these discussions and audits were documented by YAEC and UE&C as well as by Bethlehem (References and , respectively). The Bethlehem report highlighted the following items.

(1) Interpretations of quality assurance by YAEC and UE&C is more stringent than any seen to date.

(2) QA Manual submitted with the Bethlehem bid proposal was considered unacceptable in its form at that time because of:

(a) Separation of QA for steel production and detailing/fabricating not clear.

(b) Certain items should be removed from the QA Manual and developed into written quality procedures including such items as testing, instrument calibration, drawing and detailing standards and document checking, review and approval.

(c) Needed improvements in document control.

(d) Needed clarification of stop work authority and chain of command.

(e) Needed clarification on control of non-conforming material and identification of material by heats and control of identification after fabrication

(f) Definitive information on the control of quality in the Engineering Department.

(g) Needed personnel/position descriptions and individuals' qualifications.

(h) Needed changes in the Bethlehem Nonconforming Material Report forms.

The report ended with the following statements.

"J. W. Singleton (YAEC) invited us to visit their facility for general review of any of the Quality Assurance Manuals in their possession as an aid in our preparation of manuals.

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It appears that our present thinking of the Quality Assurance Manual is right on line provided we have documented quality control procedures available such as described above. I believe they have given us some good pointers which should be to our advantage in the future if we implement them now."

Following these efforts Behtlehem continued to work toward achieving an upgraded quality system including a revised QA Manual and a series of quality procedures based on the interfacing which had been taking place between the three major parties on the reinforcing steel. At the same time Bethlehem was providing comments to UE&C on the specification which had been issued for bidding purposes. A series of correspondence was reviewed in the Bethlehem Seabrook project correspondnece file (File Folders 1-4) over the period from January 1974 through the date of the contract, May 15, 1974 to October 25, 1976 when the Bethlehem QA Program for Seabrook 1 and 2, Rev. 2, 9/26/76 was approved for Fabricated Reinforcing. These documents included other audits performed by UE&C at the various locations where Bethlehem was doing or was to perform work on the Seabrook Project. These documents are included as references to this report (References 4.   through 4.   ). The first transmittal of engineering drawings to Bethlehem ~~were~~ was on July 18, 1975 (Reference 4.) and the detailing of ~~reinforcing steel~~ Categ ~~detailing~~ ory I reinforcing steel was authorized by UE&C on June 3, 1976 (Reference 4.   ). It was noted in reviewing the information related to work being processed in the various Bethlehem facilities that the first reinforcing steel shipment was made from Bethlehem's Boston Shop on August 3, 1976 which was prior to the approval of the QA Program by about 3 months.

Explain how & why

In addition to the detailed review of the controls exercised by UE&C over Bethlehem in performance under the contract and the technical and quality requirements of the specification, the team reviewed selected portions of Bethlehem Quality Assurance Manual, the Standard Quality Assurance Program Manual for Fabricated Reinforcing Bars, the Facility Manuals and the Quality Assurance Procedures Manual for Fabricated Reinforcing Bars (References 4. and 4.).

The QA Manual (Steel Plants) provides the statements of quality policy for the entire Steel Operations Group and functions as a single source document. Quality manuals, procedures and instructions at individual plants and shops emanate from this QA Manual. The responsibility for quality programs for the corporation rests with the Office of the Chief Metallurgical Engineer of Steel Operations. As part of the Bethlehem Plant Committee System there is a Corporate Quality Assurance Subcommittee which serves to develop and coordinate quality assurance policy. The Bethlehem QA Manual is in a form so as to address several MIL Standards, ANSI N45.2, ASME B&PV Code, Section III and 10 CFR 50, Appendix B. Section 5 of the Manual includes the specifics of the corporate policy on the quality assurance program as applied to fabricated reinforcing bar. In summary, the following points are addressed in the Manual.

(1) Fabricated Rebar Quality Program is coordinated by the Reinforcing Bar Engineering Group.

(2) The QA Program for Reinforcing Bar Fabricating Shops is consistent at all shops in the country.

(3) The Chief Metallurgist at each plant coordinates reinforcing bar QA policy but at shops (fabrication only) it is addressed by on-site Engineering or a separate quality group.

(4) Audits, final disposition of corrective action and control of records are performed by the Bethlehem Home Office Reinforcing Bar Engineering Group.

(5) The management review for the Fabricated Reinforcing Bar QA Systems is performed by the Corporate QA Coordinator.

The Standard QA Program Manual for Fabricated Reinforcing Bars addresses fifteen of the eighteen criteria of 10 CFR 50, Appendix B, noting that Sections III, IX and XIV which are Design Control; Control of Special Processes, and Inspection, Test and Operating Status respectively, do not apply to the services or products of Bethlehem Steel Corporation. The team did not disagree with the exceptions taken by Bethlehem.? The Manual provides a description of the QA organization and the authorities, responsibilities and duties of persons performing the QA functions. It also sets forth the Bethlehem policies for satisfying the QA Program requirements and references the other Bethlehem procedure manuals which describe, in detail, the procedures and instructions for accomplishing the activity.

The manner in which the QA Program Manual for Fabricated Reinforcing Bars becomes a specific quality document on a project is that during the proposal or bid stage the Standard Manual is submitted as an uncontrolled document and forms the basis for specific project quality assurance items relative to the contract. With contract award the manual is amended, if required, using an appendix to provide conformance with the client's specific project quality assurance program. At that time, the Manual becomes a controlled quality document.

Bethlehem's next level of control consists of a series of Facility Procedure Manuals appropriate for a given activity and a given Bethlehem facility. These address three basic activities: steel production, detailing reinforcing steel and fabrication of reinforcing steel.

The remaining Procedure Manual is known as the Quality Assurance Procedures Manual for Fabricated Reinforcing Bars. This is a standard manual which details the procedures required to implement the QA Program Manual for Fabricated Reinforcing Bars including the monitoring of the work procedures of the facility manuals for detailing and fabricating reinforcing bars.

The team reviewed selected portions of these manuals in order to assess the programmatic aspects of Bethlehem's ~~program~~ quality system and then to assess manner in which Bethlehem has performed and controlled its activities which impacted the design of the Seabrook facility. ~~under their program.~~ The following sections of the Standard Quality Assurance Program Manual for Fabricated Reinforcing Bars were reviewed for conformance to 10 CFR 50, Appendix B for the specific use in reinforcing steel detailing and fabricating activities.

Section	Title	Rev. No.	Date
4	Instructions and Procedures	2	1/1/79
5	Document Control	2	1/1/79
8	Inspection	2	1/1/79
12	Nonconforming Materials	2	1/1/79
13	Corrective Action	2	1/1/79
14	Quality Assurance Records	2	1/1/79
15	Audits	2	1/1/79
16	Special Contract Requirements	2	1/1/79
	including Appendix A, Special Quality Assurance Requirements for Seabrook Station	4	4/26/79

Several items are of note as a result of the review of these manual sections. Section 8.2 related to the Engineering Department requires a scheduled review to be conducted on the current work of each detailer assigned to nuclear projects. The review is conducted to assure conformance to ACI, CRSI, Bethlehem Steel Corporation Standard and the project specifications. This was viewed by the team to reflect Bethlehem's full commitment to a quality system and assuring that the detailing of reinforcing steel is being done as required by the Project documents. In Appendix A the special requirements imposed by UE&C in Section 3.2 of the specification related to Cadweld sleeve criteria fit were reflected.

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The requirements of CC-5340 of the ASME Code regarding visual examination for transverse cracks which were part of the specification were also reflected in the special requirements of Appendix A. With regard to bar testing, Bethlehem included in Appendix A a procedure defining the mechanical testing of reinforcing bar to meet ASTM A615, the ASME Code, Regulatory Guide 1.15, ? and the specification. Also contained in the Appendix is a commentary on the Reinforcing Steel QA program, mainly emphasizing the traceability of material from the time it is produced in the steel mill to the time it is fabricated, shipped, received and stored on-site.

With the Quality Assurance Procedures Manual for Fabricated Reinforcing Bars the following procedures were reviewed.

Procedure	Title	Rev. No.	Date
II	Document Control	3	2/1/79
III	Review of Placing Drawings	3	2/1/79
IV	Inspection	4	2/1/79
VII	Nonconforming Items	3	2/1/79
VIII	Corrective Action	2	2/1/79
X	Audits	4	2/1/79

All of these procedures were noted as being very comprehensive and detailed and provide an excellent tool for the personnel who must execute these procedures as well as those who use them in the review, inspection and audit functions.

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Two additional procedures, which were specifically associated with the work completed for the Seabrook project were reviewed. The first was "Quality Control Procedure for Fabricated Reinforcing Bars for the Bethlehem Plant, Engineering Department, Detailing," Procedure No. I., Rev. 1, 6/1/81 (Reference 4._). The second was the "Quality Control Procedure for Steel Operations For In Plant Shop for Fabricating," Procedure No. 1, Rev. 0, 10/14/77 and the Addendum for Steelton Plant, Rev. 0, 11/28/77 (Reference 4.__). These were noted to be adequate to control the detailing and fabricating work that was done and is still underway.

In addition to reviewing the specifications and manuals documenting quality control and compliance with the pertinent codes and standards, we also reviewed shop drawings, generated at the Bethlehem Steel offices in order to verify their conformance with the design drawings produced by UE&C.

We learned from the Bethlehem staff that the reinforcing steel which ~~have been~~ were detailed at the Bethlehem home office were for the following elements of the containment structures:

(1) Reactor Pit

(2) Containment slab, El. (-)26'

(3) Personnel and equipment hatch

(4) Containment dome - Unit #1 has been completed, Unit #2 is being worked on. Exotic bars (around openings and out of plane bending) are detailed at the Philadelphia office.

(5) Primary shield wall, approximate elevations (-)25' to (-)2'

(6) Containment building slab, El. 0'

Detailing of reinforcing bars for other structures has been done either at the Boston or Philadelphia offices. During our inspection in Bethlehem, Pa., we reviewed some of the drawings pertaining to the reactor pit and the containment dome, Elevation 119', (the spring line) and the apex. ~~The list of drawings which have been reviewed during the inspection is contained in Section 7.4.1 (References 4.__ to 4.__).~~ We ~~have been~~ were informed that the major difference between the Unit 1 and Unit 2 drawings is the fact that in Unit 2, by increasing the length of some of the reinforcing bars, the number of caldweld splices has been reduced. We viewed this as an example of both YAEC and UE&C making improvements in the design details.

Due to complexity of the reinforcing in the congested area of the reactor pit, the detailing was done using a model, which was built by UE&C, showing all the reinforcing steel in actual position. The Bethlehem detailers studied the model and then generated the shop drawings.

While reviewing Bethlehem Drawing No. 017RM31, Rev. 4, dated December 5, 1978 (Reference 4.___) and comparing it with the corresponding UE&C design drawing, Drawing F101402, Rev. 13 dated March 24, 1981 (Reference 4.__), we observed that the spacing of the horizontal stirrups which on the design drawing was 16" apart whereas ~~was shown~~ on the detailed shop drawing the spacing was ~~as~~ 8" apart. The total amount of the reinforcing steel remained unchanged in spite of the change in spacing. The design drawing had not been updated to reflect the change in spacing. The reinforcing steel remained designated in the design drawing as 2x4-#6 @ 16". We found that this is a violation of Administrative Procedure #29, "Document Control - Foreign Print System" Section 8.6.2, Rev. 7, dated April 12, 1983 (Reference 4.__). In all of the drawings reviewed this was the only case where a discrepancy between the design and shop drawing was ~~could be~~ found. This was noted as a finding, but had no generic implications and was judged to be an isolated instance of lack of consistency and to maintain up to date documents (Finding 4-21).

A review was made of the nonconformances issued against two of the shops within the Bethlehem organization which provided some of the fabricated material to the Seabrook facility. NCR's for the Albany Shop for 1982 were examined. Four separate reports had been issued, three of which related to incorrect bends which resulted in scrapping the material and rebending from new bar stock and the fourth being an incorrectly recorded heat number which was corrected. NCR's for the Steelton Shop for 1983 were examined. Eleven separate reports had been issued. Of these eleven, five involved bending errors, three involved cutting tolerances, and one each involved a detailing error, mislabeling and missing bars from a bundle. Based on the size of bar and the tonnage of reinforcing steel involved the team judged the number of non-conformances to be low. In all cases corrective action was taken before any of the non-conforming items had been incorporated into any safety-related structures.

Based on the review completed and the work observed the team concluded that the licensee's design commitments had been clearly transmitted to Bethlehem via the specification and the engineering drawings and details. Letter and meeting communications also served as an important part of the total process of providing design interfacing and design input. Bethlehem was viewed to have in-place a good quality system with appropriate quality standards and procedures. The team's sample review indicated that Bethlehem had also executed these procedures well. A system for the review of shop and placing drawings existed as was being effectively implemented in accordance with the Quality Assurance Procedures Manual. A fully adequate system to document and control the records and design changes, thus assuring that all the latest updated input data was being used for the development of shop and placement drawing exists. The Drawing Record Card, the Transmittal Control Form Letter and the Order Entry Record Card have been the keys to good document and records control. Based on the team's observations it is evident that the Bethlehem audit system has been effective in identifying ~~some~~ random errors and assuring that corrective action has been taken.

As a result of the team's review and observations of the work of Bethlehem Steel Corporation on the Seabrook project it is the conclusion of the team that the necessary elements of design control have been in existence during the detailing and fabricating of the reinforcing steel for the plant structures. Additionally, we have concluded that these controls have been adequately implemented. ~~so as to assure safe structures~~.

1/17/84
& 1/18/84

Document Name:
SECTION 4.8 - SEABROOK IDI

Requestor's ID:
EILEEN

Author's Name:
G. Harstead

Document Comments:
As Built Conditions and Surveys

4.8 As Built Conditions and Surveys

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

(1) How the changes generated in as-built conditions such as structures, systems and component are processed by the UE&C and the contractors.

(2) How the final loads resulting from location of pipe supports, electrical cable trays and ventilating systems, including those not specifically considered in the original design, are verified.

(3) How the drawings and identified supporting documents are updated, maintained and certified, so that the completed work reflects the as-built conditions of the plant for future reference.

The team first reviewed the procedures which were in-place to control this area of plant design and construction. Among the documents which control as-built conditions of structures, systems and components we reviewed those which seem to be the most essential in the process. Those are: Administrative Procedure No. 39, "As-Built Documents", issued on November 17, 1980 (Reference 4.____), Administrative Procedure No. 15, "Changes to Engineering Change Authorization", issued on September 8, 1977, Revision ____ with numerous later revisions (Reference 1.____), Technical Procedure No. 11 (TP-11), "Minimum As-Built Record Drawing Listing, issued on April 29, 1983 (Reference 4.____), Field Administration Construction Procedure, (FACP) No. 10, "Procedure for Field Calculations", issued on March 11, 1983 (Reference 4.____) and ~~FACP~~

1/17/84

4.8-2

move ahead of FACP-10

No. 16 "Project Instruction for Handling UE&C/Contractor Nonconformance and/or Deficiency Reports", Rev. B, dated July 22, 1983, FACP No. 1, (Reference 4.____).

Currently Administrative Procedure No. 15 has 18 revisions since the original issue, the latest being dated August 17, 1983. It describes how questions and changes to design documents, deemed critical to support on-going field activities, are initiated, processed and resolved. It provides the criteria which the proposed changes must meet in order to be approved, the flow charts which describe the sequence by which various site questions are processed and the forms which should accompany questions raised by the contractor. The questions may require an oral response, the response for information response (RFI) or may require an engineering change authorization (ECA), depending on complexity of the problem. The classification regarding oral communication, RFI's and ECA's can be described using the following guidelines:

(1) If the question only requires an explanation or clarification, the oral response is sufficient.

(2) Request for information (RFI) is prepared when an oral response is not sufficient and design documents are not affected which might have been issued by UE&C (site or Home Office) or drawings issued by ~~the~~ a manufacturer or vendor.

(3) When the question/response requires changes (or exceptions) to engineering documents, such as drawings, specifications, or calculations, the contactor submits a proposed ECA.

The ECA's are subdivided further as follows:

(a) On-The-Spot ECA's ~~which~~ may be used to resolve all the items except those involving generic problems and those requiring YAEC approval. Any Minor ECA (see below) may be issued On-The-Spot.

(b) Minor ECA's which are of repetitive in nature, e.g., involving movement and arrangement of sister splices in congested area to clear interferences of reinforced steel, modification of approved formwork or substitution of higher strength bolts than the design requirements, that have been reviewed and concurred with the Home Office Engineering, YAEC and QA as being appropriate for release.

(c) Major ECA's are those which are not classified as minor and in turn they are subdivided into two categories:

1. Major specific case ECA's

2. Major generic case ECA's.

ECA's and RFI's may be revised or voided by modifying and reissuing the ECA/RFI form or, in certain circumstances, by the use of the Continuation Sheet. On the Continuation Sheet the affected documents, ~~are given in~~ ~~which is~~ are a listing on the ECA/RFI form, ~~of all the documents that~~ must be revised or from which an exception is taken as a result of an ECA issue must be provided. ok

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One of the important differences between the RFI's and ECA's is that the RFI's must not include Affected Documents while the ECA's must include them. Thus when an RFI becomes an ECA (when it has been decided that the change requires change of engineering documents) a new ECA/RFI form is issued together with a Continuation Sheet on which all of the Affected Documents must be listed.

Interdisciplinary coordination of all disciplines involved in the ECA is assured by the requirement that all disciplines that are responsible for the documents listed under Affected Documents must review the ECA.

The AP-15 is used together with the AP-39, "As-Built Documents". AP-39 identifies the drawings and other supporting documents to be updated, maintained and certified that the completed work reflects the as-built conditions of the plant. This assures that the documents can be effectively used for engineering reference in the future for various reasons such as future plant operations, start-up testing, maintenance or modifications. The procedure contains a listing of UE&C documents to be revised to reflect as-built conditions as received from the Construction and Start-up departments. Its Attachment No. 2 provides detailed information in that respect and it addresses inspection elements, including piping configuration, location of supports, as-built UE&C construction drawings and as-built tolerances. The procedure provides very detailed and complete information regarding the type of documents which must be revised to reflect the "As-Built" condition. Included in that category are vendor documents which must be revised to reflect the "as shipped" condition of the item. In case of a modification in the field the drawing must state what is "field modified" and provide the reference to the foreign

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print which shows the "as shipped" condition. Any changes should be processed in accordance with AP-15.

may want to turn this over to duBouchet

AP-39 also provides directions to the UE&C design groups such as the Mechanical Analysis Group (MAG) and the Pipe Support Group (PSG) to perform the final configuration verification analysis documentation for pipe stress analysis for ASME Safety Class 1, 2, 3 and B31.1 Critical Piping and NNS-1 Pipe Supports. The data which should be verified are such as the as-built stiffnesses of supports and restraints, attachment points of supports of supports or restraints to the structure, including ARS verification, etc. As-built documents are processed through the Field Office Document Control Center (Field DCC) as shown in Figure 4.8-1. Each contractor has the responsibility to provide the As-built documents. Piping and Pipe Support As-builts are handled through UE&C Power Engineering. The Field DCC records the approximate information and processes it further to the Home Office Document Control Center as shown on the chart. We have been informed that the AP-39 is under review and the future revision, No. 5, is expected to be issued by the end of February, 1984. The reasons for the changes ~~was~~ were not pursued by the team.

~~The procedure~~ AP-39, in Attachment No. 3, contains the types of conditions or changes which do not require as-built information and incorporation into UE&C drawings. In this category, we found the reinforcing steel changes. ~~Again~~ We inquired why an important item like reinforcing steel is not required to be recorded to reflect as-built conditions and we ~~have been~~ were informed that this item applies to the cases when the amount of steel is the same as stated on the design drawings but for some reason, usually because of local interferences, some of the reinforcing bars have been moved to one side or the other. We expressed our opinion that the listing does not restrict the discrepancy between the design and as-built conditions in any way and such a deviation could consist of providing reinforcing bars of smaller cross-sectional area, omission of reinforcement in some area altogehter or ~~otherwise~~ some other change that might impact the des. We did not received a satisfactory explanation regarding this matter and we consider this a serious shortcoming of the procedure. We do agree that there are many field situations where a change in placing of reinforcing bars may be tolerated and even sometimes necessary. We believe, however, that the procedure should qualify this statement to avoid gross deviations from the design requirements which could result in an inferior or inadequate structure.

The details of processing as-built documentation identified in AP-39 are described in the Technical Procedure No. 11 (TP-11), "Minimum As-Built Record Drawing Listing". This procedure was issued on April 29, 1983 and ~~was never~~ has not been revised. It is referenced as Appendix No. 4 in the AP-39 and its purpose is to interpret the technical requirements of AP-39 and to establish "detailed identification of the specific UE&C Construction Drawings and UE&C approved Foreign Prints which shall be 'As-Built' by the appropriate Seabrook Field Organization." Additionally, the purpose of TP-11 is to organize the drawing listing on a Work Package concept to allow effective engineering verification against the design basis condition and subsequent incorporation of the As-built data into the design drawings. The procedure identifies six disciplines and in each of them there are two individuals named as the coordinators: one in the field and one in the home office.

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consider moving 3 instead wing here

Several organizational entities are involved in these programs at UE&C. The beam verification program, which involves a complete check of the structural steel, Site Engineering located at the Seabrook site is responsible to respond to certain ECA's, RFI's and Nonconformance Reports (NCR's). If Site Engineering does not have a proposed solution to offer, the responsibility for resolution of the item is then with Site Support Engineering at the Philadelphia UE&C offices. In some instances the Structural Group in the home office may become involved. YAEC also participates in resolution of these items when there is a potential for a major impact upon the project or they were responsible for the original review on the items or activities involved.

FACP-1 & 10 weren't discussed Why? them?

(1) Structural Steel ~~Program~~

The procedures for this program are described in "Guidelines for Beam Verification", dated September 19, 1983 (Reference 4.____). The beam verification program was established in order to ensure that all the structural steel beams are designed for all the imposed loads. The treatment of live load is in conformance with SD-66 (Reference 1.3), Table 4.2-1. Note 1, to Table 4.2-1 states that uniformly distributed live load shall not be considered with seismic load conditions except those loads which are marked permanent are included in the calculations.

We agree here but have a problem elsewhere - need to resolve

The design of the structural steel beams for the Tank Farm Area as provided in Calculation No. WB-61 (Reference 4.34) was based upon using the uniform snow load which is considered a permanent live load. In this case the procedure in which temporary uniform live loads are replaced by actual loadings was not applied.

Finding?

The beam verification program is ~~subdivided into~~ being executed by two methods; namely, computer and manual calculations. The computer calculations are performed using the STRUDL computer program. The beam to column connections generally are shear type connections which are made by angles welded to the beams web and field bolted to the column or girder. Horizontal forces are taken by means of bracing thus eliminating the need for beam moment connections. The beam to column connections are; therefore, modeled as hinges.

The loadings used are:

(1) dead load (steel and general dead load)

(2) permanent live load (for seismic inertial loads one-half of the snow mass is used)

(3) seismic amplification

(4) pipe support loads and for piping of 4 inch diameter and larger

(5) uniform loads for piping of less than 4 inch diameter

(6) cable tray and bus direct loads conduct loads

we going to say anything about manual calcs and whether all significant loads per (1)-(6) have been considered what about putt this into 4.2 section?

and then state here that the BVP goes back to original ARS curves in the program

The Structural Analysis Group (SAG) has produced Amplified Response Spectra (ARS's) for various elevations of the building. Vertical ARS's were developed which accounted for the vertical response of steel beams. These ARS's are used in order to qualify equipment which may be located on the interior locations. SAG has also directed that the ARS's be used in the design of the steel beams.

4.2

The vertical accelerations are obtained from ARS's. One ARS will determine the acceleration at the support while the other will be used to find the acceleration at mid-span. These vertical acceleration values are developed from the appropriate vertical ARS's by selecting the 50 Hz frequency response for the 4% and 7% equipment damping response curves, for the OBE and SSE, respectively.

The horizontal acceleration values used for beam design are taken from the 33 Hz frequency response for the 4% and 7% equipment damping response curves for OBE and SSE. From these values, a uniform seismic acceleration is established for design.

Because the bottom flange of structural steel is used for the attachment of pipe supports, horizontal loads applied normal to the beam axis can cause torsion in the steel beam. UE&C's procedure calls for checking whether the supported slab remains in contact with the top flange of the steel beam. If the beam were to deflect more than the slab, no capability of transferring torsion to the slab could be assumed.

 1/17/8

The Tank Farm structural steel has not been addressed by the beam verification program as yet. The team would recommend that this be done subsequent to any reanalysis for the seismic loads as described in Section 4.2 and addressed in Finding 4.-17).

(2) Reinforced Concrete

No specific overall program currently exists ot assess the final loads resulting on concrete structures which would encompass pipe supports, equipment, cable trays, and other systems.

Under AP-39 certified As-Built rebar drawings are not required. The footnote in the Attachment 2 of AP-39 states that contractor drawings will be site foreign printed, marked for information and turned over to Home Office Engineering and YAEC ~~Owner~~. The method of monitoring and recording of rebars cut or damaged is described in the Administrative Procedure No. 38, "Cutting Reinforcing Steel in Permanent Concrete Structure", issued September 5, 1980, revised on July 31, 1981 (Reference 4. ____). Our inquiries why the drawings affected by the damaged reinforcing bars are not recorded by the DCC in the field or the Home Office did not produce satisfactory results. As described later, it was found that Site Engineering is maintaining documentation. AP-38 establishes responsibilities of organizations for approval of cutting reinforcing steel during drilling into permanent plant concrete structures.

Procedures for curring reinforcing bars can be divided in two categories:

(a) When Reserve Capacity Forms (the forms which list reinforcing ~~bars~~ steel as required by calculations, those supplied on drawings and the reserve excess of the bars) are available for a given location, and

(b) When such forms are not available.

When a Reserv~~ice~~e Capacity Form for a given area is not available, the approval of all reinforcing steel bar cutting must be reviewed ~~with~~ by the ~~Power Engineering (Home Office)~~ Home Office of UE&C. They check the design calculations to determine if there is an adequate margin available to permit the proposed reinforcing bar cutting. If it is permissible, approval of such a cutting is documented by engineering change notice (ECA) or nonconformance report (NCR). When a Reserve Capacity Form for a given location is available, the Resident Construction Engineering Group assumes the responsibility for approving cutting of reinforcing steel based on the information contained in the Reserve Capacity Form. AP-38 states, in Section 3.1, that when the Resident Construction Engineering Group approves reinforcing steel cutting, these approvals are documented on the Site Approved Change (SAC). We learned that the SAC forms have been since discontinued. ~~and therefore an~~ This was noted as an observation ~~has been filed regarding updating the~~ since Revision 1 of AP-38, dated July 31, 1981 has not been updated (Observation 4-?).

RL Do we have sheet on this?

We have been informed by the UE&C staff that since the time when the SAC form ~~has been~~ was discontinued changes resulting from cutting of reinforcing steel have been treated as EC~~O~~A's.

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May want to add this on page 4.8-1

We reviewed the "Project Reference Manual" (TP-23) Supplemental Information for Design Change Program, (Reference 4. ——) Rev. 1, dated November 28, 1983 (date of Rev. 0 not listed) which contains a list of Minor Change List (Section X). Since the list does not include reinforcing steel cutting, we concluded and concurred with the UE&C staff that these changes must be treated as major ECA's. This classification reinforces our belie~~ve~~f that Attachment No. 3 to AP-39 (listing of types of conditions or changes which do not require as-built information) should eliminate item 1, "Reinforcing Steel Changes" since such changes might result from cutting of steel rebars.

In our inspection we selected few specific cases as the examples by which one could verify how the process of handling the as-built works. In one case, Supplied Material Deficiency Report (SMDR) #357 (Reference 4. ——) was filed by the contractor reporting that a structural steel beam has a tear in toe of flange. The case was processed by the field office and found acceptable. It should be mentioned that according to Rev. 3 of the FACP-1, dated October 4, 1982, processing of the SMDR would have been using the same procedure as for the Nonconformance Report (NCR) and Deficiency Reports (DR). The case discussed here was dated June 4, 1982 and the Revision 2 of the FACP-1 did not require concurrence of the Home Office. The other case, NCR #2584, (Reference 4. ——) was concerning concrete cover over the reinforcing bars, same being too large, some being too small. Similarly to ~~case of the~~ SMDR #357, it was resolved in the field. In both cases an unofficial concurrence of the Home Office was obtained. The third case examined was RFI #593027A (Reference 4. ——) dated June 2, 1982 concerning discrepancy between UE&C Dwg. F101748 (Reference 4. ——) and Cives Dwg. FP15407-13 Sheet E-58 at approximately El evation 66', ~~-6½"~~. Another question on the same RFI was concerning discrepancy between UE&C

(Reference 4. ——) (Reference 4. ——)
Dwg. F101750, and Cives Dwg FP-15407-13, at El. 63½'. In this case the disposition was provided by the Field Office.

(Reference 4. ——)
The last case of as-builts reviewed was ECA 458/2809, ~~dated April 28, 1982~~, concerning vertical bars in line 2.3 wall which caused a bar conjestion. As required by AP-15, the ECA/RFI Form listed the affected document and Home Office concurrence was marked "accepted".

The program which UE&C has embarked upon in order to analyze and control as-built conditions has a lot of good features. The controls documentation, distribution of responsibilities appear to be effective and practical. It is regretable that this program was enacted so late in the development of the plant. We are aware that in the early stages of construction of the plant the control of the as-built conditions was not sa good as could be desired. It is admitted by the UE&C officials as well. In the memorandum dated September 6, 1983, MM-14575A (Reference 4. ——), there is a statement "It is recognized that there are a good number of historic ECAs which, based on the judgment of the engineer at the time, were issued for which there may be no calculations." The project has defined a program to address these historic ECAs and develop calculations for them as necessary"... We think that this is a worthy effort which when completed will contribute to improve confidence in the level of quality control of the plant.

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To continue to review the process for controlling as-built conditions in reinforced concrete the team selected four Engineering Change Authorizations (ECA's) dealing with coring and cutting of reinforcing steel. A series of four ECA's were selected in the Diesel Generator Building for review.

(1) ECA 02/0772D (Reference 4.——) was initiated on (date initiated missing) by the UE&C Area Superintendent. The problem was defined to be an interference of service air lines as installed with the fire wall partitions. The solution was issued November 2, 1982 and included cutting, capping and grouting the existing penetration in the floor at the 51'12" level, core boring two 2" diameter holes, relocating the air lines, air connectors and valves, deleting pipe supports and grouting the lines into cored holes. The affected documents were listed and the backup reference which permitted the cutting of reinforcing was provided. In addition, the requirements for recording and reporting the as-built condition were also provided.. This ECA had been properly reviewed by the Site Review Group and then by the home office where final concurrence was made on May 18, 1983. The field personnel reported the work completed on November 16, 1982 and provided sketches and details of the cutting and the necessary engineering data. One core bore cut no reinforcing and the other cut one #6 bar.

(2) ECA 06/1670B (Reference 4.——) was initiated September 12, 1983 as an On-The-Spot ECA by the Project Manager for GFPS. The core drilling was defined as being required in stair walls C&D to allow for installation of new redundant

fire protection system lines. The request was made for (2)-6 inch diameter cores to be cut through a wall section around the stair-well near Elevation 26'. Approval was given on October 18, 1983 after telephone concurrence with UE&C's home office and the completion of the actions by the Site Review Group on October 17, 1983. It was further stipulated that one piece of reinforcing steel could be cut each way at each face for each core location. In addition, sheets and instructions were provided so that the as-built work would be accomplished in accordance with AP-39 and specific information on actual cuts information would be forwarded to engineering. The completed forms with the as-built information were completed on September 30, 1983 and received by UE&C Site Engineering on October 3, 1983, showed more reinforcing steel cut than allowed. All other aspects of the appropriate procedures had been followed based on the team's review of the information.

3 ~~(4)~~ ECA 59/4010A (Reference 4.) was initiated December 9, 1982 by an engineer from Perini Power. This requested authorization to cut rebar in order to install a Hilti bolt for a surface mounted plate on a floor at Elevation 51½' due to the relocation of the bolt to clear the reinforcing would violate the centerline of bolt to an adjacent embedded plate distance criteria. Permission was granted at the site on December 17, 1982 and home office concurrence was made on February 1, 1983. This allowed cutting of one piece of reinforcing each way, top and bottom and required submittal of data via an attached form after the installation had been completed. The as-built information was submitted by Perini on May 20, 1983 indicating that 1-#7 bar was actually cut. A sketch was provided to establish the

exact location of the cut, identify the affected UE&C drawing and Bethlehem drawing as well as the bar type. No deficiencies were noted by the team.

(5) ECA 73/4572C was initiated December 3, 1982 by a field engineer from Pullman-Higgins. This requested permission to cut reinforcing steel in an area near a blockout through a reinforced concrete wall due to the fact that numerous attempts to locate Hilti bolts among the congested reinforcing had resulted in several abandoned holes. A relocation of the plate for which the Hilti bolts were to anchor required a redesign of the support which was to be welded to the surface mounted plate. The change was completed, reviewed and finally approved on March 23, 1983. The home office engineering concurrence was completed on June 27, 1983. Again the field information as a result of the relocation and possible reinforcing steel cutting was requested for review via the coring/cut reinforcing sheets. The information was provided to Site Engineering on January 14, 1983 showing the necessary information and indicating that 1-#11 and 1-#8 reinforcing steel bar had been cut in the drilling process. The team found no discrepancies in the information.

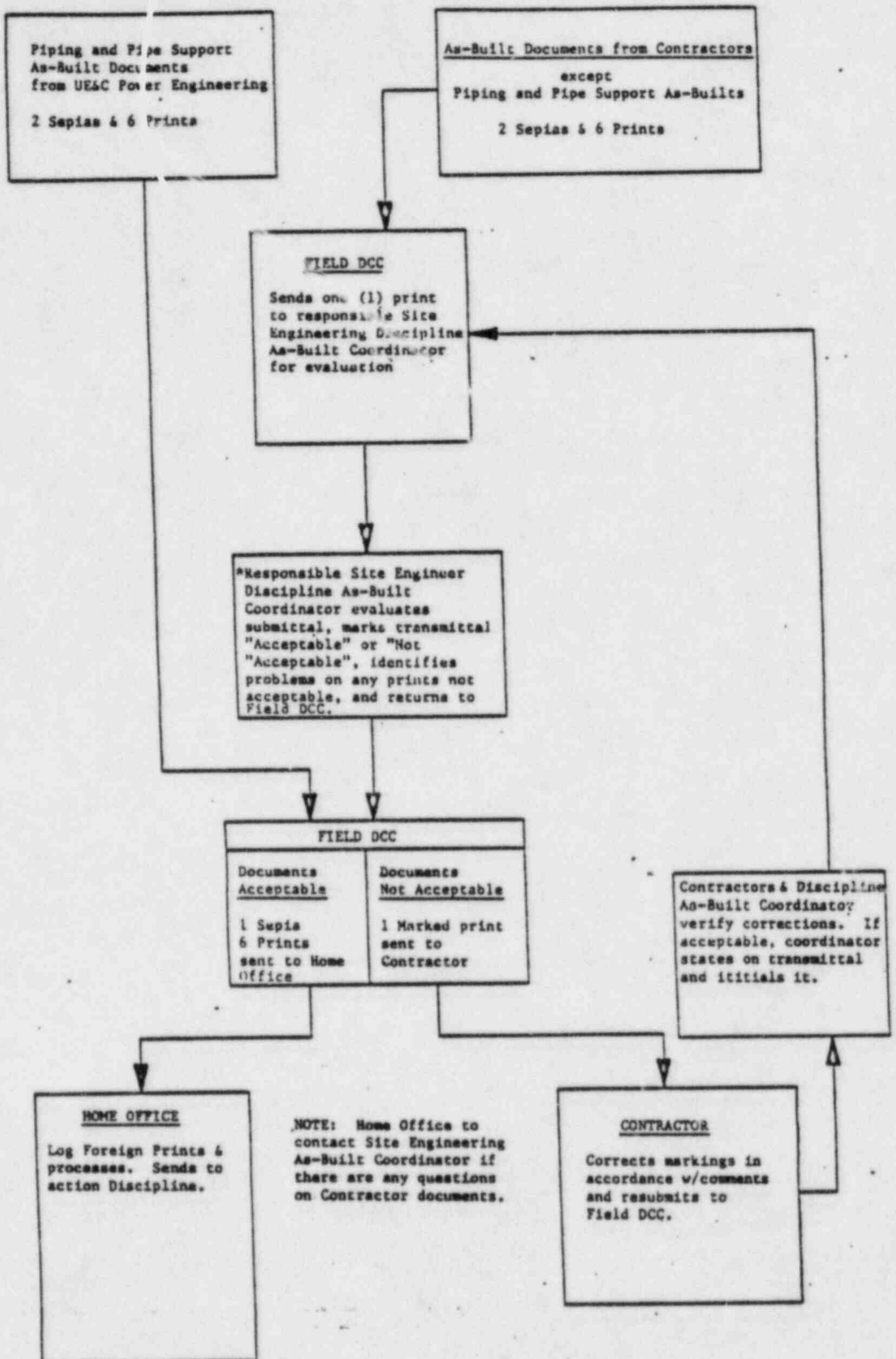
After completion of the review of the information contained in the records related to these ECA's, the team went into the field to verify all information that could be checked given the current completion status in each of the areas. Of particular concern was the information contained in ECA 06/1670B which indicated more reinforcing than permitted had been cut. ~~and~~ The resolution of this was judged to be important in ~~judging~~ assessing the actions on the part of UE&C in response to the data. All locations associated with these ECA's were reviewed in detail, checking dimensions and where possible the insite cut surface if a core were involved except for ECA 59/4010A for which the drilled anchor bolt was sandwiched between panels of fire stop walls at the floor line.

All as-built information which had been sent back to the UE&C Civil/Mechanical Services Engineering Group was field checked and found to be correct. The team then followed up to determine that the information provided was being systematically recorded and utilized. During this field review questions arose on the status of, and apparent incorrect fabrication of support 9276-12G-38 which was associated with ECA 73/4572C. After a review of field records and discussions it was found the support was on "Hold" and the support was known to be incomplete. The incoming cut reinforcing data from the as-built sheets were being logged and then transferred onto reproducibles created from the Bethlehem shop drawings for reinforcing steel so that a permanent, consolidated record of cut reinforcing is being developed. A review of the information relative to the team's concern about additional cut reinforcing resulted in establishing that the cutting permission had not been exceeded. ~~in that~~ The detailed shop drawings indicated the coring was done in a splice zone and that the pairs of cut reinforcing seen in the as-built data represented actually one bar, but since the cut was in the splice zone, both legs had been cut. Similarly, from the detailed shop drawings and information submitted in ECA 73/4572C it was clear that several of the cuts were the ends of supplementary diagonal reinforcing at the corners of the wall blockout for air ducts. The information gathered in this program can be utilized to compare against known margins of reinforcing steel. Where the margins are not sufficient, the procedures require added analysis.

Based on the team's review of the control of cut reinforcing, it was determined that this activity is well controlled by procedures and the appropriate interfaces have been established and function checks against known margins to verify that the original design has not been compromised are made and the necessary documentation has been provided. The Technical Assistance Group under the Lead Civil Engineer of Site Engineering was determined to be executing this operation in a very well controlled manner. No findings were identified.

Need
A B Summary
conclusions

FIELD AS-BUILT FLOW CHART



* This step may be omitted on resubmittals if Discipline As-Built Coordinator has already reviewed and accepted submittal.

FIG 4.8-1

1/6/84

Document Name:
SECTION 4.9 - SEABROOK IDI

Requestor's ID:
EILEEN

Author's Name:
R. Shewmaker

Document Comments:
Conclusions

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4.9 Conclusions

ED. NOTE Need to restate objectives in C-S area and list the elements of design control

UE&C has provided technical guidelines and procedures to be followed in the Seabrook Project. Extensive programs have been put into force in order to ensure that the latest and most accurate information is used in the design of structural members. Great efforts have been made in order to obtain refinements in the vertical ampliciation of beams for the design of the beams themselves as well as seismic qualification of equipment located away from the walls and columns. This refinement results in greater vertical accelerations than would be the case if the beams were assumed to be rigid.

However, UE&C did not account for horizontal torsional effects in the development of ARS. In the case of the PAB, the indications were that 10% represented the torsional effect for locations at the extreme periphery. Normal practice for UE&C was development of the ARS ~~and~~ at the mass center. If the torsional effect is only around 10%, the team is of the opinion that it can be neglected.

Since the team recommends that the Tank Farm dynamic analysis be redone, the team would recommend that additional attention be paid to torsional effects inasmuch as the Tank Farm has little structural symmetry.

Organizationally, the SAG appears to be quite remote from the Seabrook Project, and operates in a passive mode. In other words, SAG will be responsible to respond to requests from the project but not to take initiative on changes in the structural design which may develop. There should be some mechanism whereby the SAG will have an opportunity of making an assessment concerning as-built conditions rather than leaving these assessments entirely to the project. In the case of the Tank Farm, the design of the bracing took place five years ago and the fill concrete under the RWST and SAT was released for construction about four years ago. Up until the time of the IDI these changes which have a direct influence on the dynamic analysis were not acted upon and were unknown to SAG.

SAG also does not appear to be subject to the technical audits required by GEDP-0025 (Reference 1.52). The team recommends that SAG also be subject to technical review. This could be completed by technical personnel who did not do the original work.

From the work observed, it appears that UE&C is conscientious and businesslike in the design of safety related structures and has established procedures, guidelines and organization to meet the requirements of NRC. While many of the programs have not been completed and some analyses and designs must be revised, there is no reasons to believe that the as built structures will be found to be inadequate in light of the exhaustive design efforts currently underway and planned for the immediate future.

1/20/84

Document Name:
SECTION 4.9 - SEABROOK IDI

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EILEEN

Author's Name:
R. Shewmaker

Document Comments:
Conclusions

4.9 Conclusions

The scope and the depth of the inspection was sufficient to reach certain conclusions regarding the design and engineering aspects of the civil-structural discipline and the related safety features of the Seabrook plant. Based on the facts, findings, reviewed correspondence, ~~and~~ other information acquired during this inspection and then we concluded that design and construction of the safety related features pertinent to the civil-structural area are incorporate~~d~~ in a design control process ~~to provide~~ which will assure adequate safety to the public. Our inspection encompassed both the technical design and the procedural aspects of the organizations involved in the development of the plant in order to have a broad perspective of all elements of the design and interdisciplinary coordination effort.

As a result of the inspection we identified twenty-one findings and ____ observations. All of our findings have been discussed with the staff of ~~the~~ UE&C and we have been informed that the appropriate action has been taken to ascertain that there will be no ~~consequences~~ circumstances which might result in unacceptable margins of safety. ~~has been taken.~~ Finding No. ____ which appears to reflect on the across the board applied approach to application of live load in combination with other loads may require further investigation to assure that the structural members have load resisting capability in accordance with the approved regulatory requirements.

There are certain conclusions which appear to be quite obvious as a result of e inspection. In our opinion, interdisciplinary coordination of the design effort suffers from the excessive systematization in terms of procedures and manuals. There is an ~~evidence~~ evident effort to document every phase of design, construction, procurement and verification. This is very plausible and has its merits. The system of traceability, however, is handicapped by such a number of various steps and is so fragmented that it requires a monumental task to synchronize it in order to produce practical results. This is augmented by continuous revisions of various documents which in turn necessitates updating of all relevant procedures so that proper cross-referencing would be effective. An example of the above is "Cutting Reinforcing Steel in Permanent Concrete Structures", Administrative Procedure No. 38 (AP-38) (Reference 4.___), Section 3.1, ~~may be AP-38, Section 3.1, Rev. 1, dated July 31, 1981,~~ which refers to the Site Approved Change ~~(SAC)~~ which has been discontinued (see Observation 4.____).

UE&C has provided technical guidelines and procedures to be followed ~~to~~ for the Seabrook Project. Extensive programs have been put into force in order to ensure that the latest and most accurate information is used in the design of structural members. Great efforts have been made in order to obtain refinements in the vertical ~~amplication~~ amplification of beams for the design of the beams themselves as well as seismic qualification of equipment located away from the walls and columns. This refinement results in greater vertical accelerations than would be the case if the beams were assumed to be rigid.

However, UE&C did not account for horizontal torsional effects in the development of ~~ARS~~ the amplified response spectra. In the case of the ~~PAB~~ primary auxiliary building, the indications were that 10% ~~for~~ represented the torsional effect for locations at the extreme periphery. Normal practice for UE&C was development of the ARS at the mass center. If the torsional effect is only around 10%, the team is of the opinion that it can be neglected.

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Since the team recommends that the Tank Farm ~~dynamic~~ seismic analysis be redone, the team would recommend that additional attention be paid to torsional effects inasmuch as the Tank Farm has little structural symmetry.

Another observation is the apparent compartmentalization of the organization. We realize that the complexity and magnitude of the project necessitates multi-directional effort, but there must be a definite gravitation toward an overview of the entire operation in order to achieve a practical efficiency. An example of this conclusion ~~may be~~ is the case of misuse of the amplified response spectra for the annular structural steel fram~~e~~ing ~~as described in Section 4.6 of this report~~. As we pointed out previously, establish~~ing~~ment of the position of coordination of seismic design improved this situation.

Organizationally, the SAG appears to be quite remote from the Seabrook Project, and operates in a passive mode. In other words, SAG will be responsible to respond to requests from the project but not to take initiative on changes in the structural design which may develop.

The program of as-builts and the final load verification, which we reviewed, appears to be effective and provides adequate design controls. As it has been pointed out in the ~~Section 4.8 of this~~ report, the as-built program should be extended to incorporate the engineering change authorizations which have been issued prior to the commencement of the program. There should be some mechanism whereby the SAG will have an opportunity of making an assessment concerning as-built conditions rather than leaving these assessments entirely to the project. In the case of the Tank Farm, the design of the bracing took place

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five years ago and the fill concrete under the refueling water storage tank ~~RWST~~ and the spray additive tank ~~SAT~~ was released for construction about four years ago. Up until the time of the inspection ~~IDI~~ these changes which have a direct influence on the dynamic analysis were not acted upon and were unknown to SAG.

SAG also does not appear to be subject to the technical audits required by the "Management Level Design Review by Chief Discipline Engineers," General Engineering and Design Procedure 15-0025 (GEDP-0025) (Reference 1.52). The team recommends that SAG also be subject to technical review. This could be completed by technical personnel who did not do the original work.

From the work observed, it appears that UE&C is conscientious and businesslike in the design of safety related structures and has established procedures, guidelines and organization to meet the requirements of NRC. While many of the programs have not been completed and some analyses and designs must be revised, there is no reasons to believe that the as built structures will be found to be inadequate in light of the exhaustive design efforts currently underway and planned for the immediate future.

In final summary, it is our opinion, that there is sufficient evidence that in civil-structural area the design controls are effective to the extent that they provide a reasonable assurance that the safety related structures will have their expected load resisting capability and will perform their design function without undue risk to public safety.

12/27/83

7.4.2 Personnel Interviewed

Name	Title	Organization
Tom M. Cizauskas	Mechanical Lead Engineer ~~(for Civil/Structural and Mechanical Engineering)~~ - Mechanical Group - Engineering Department	YAEC - Seabrook Project
Henry E. Wingate	Assistant Project Manager, Construction Department ~~Supervisor~~	YAEC - Seabrook Project
Jerome J. Wojcik	Structural Engineer, Mechanical Group, Engineering Department	YAEC - Seabrook Project
Robert Tucker	Lead Mechanical Engineer ~~(Civil-Structural)~~ Mechanical Group, Engineering Department	YAEC - Seabrook Project
Donald E. Johnson	Structural Engineer Mechanical Group Engineering Department	YAEC - Seabrook Project
Walter K. Perterson	Supervisor, Engineering/QA Audits	YAEC - QA Department
R. E. Guillette	Supervisor, Construction Quality Assurance Engineering	YAEC - QA Department
Janet Allen	QA Technician	YAEC - QA Department
M. H. Ossing	Staff Engineer for Assistant Project Engineer of Construction	YAEC - Seabrook Project
K. M. Kalawadia	Structural, Supervising Discipline Engineer -	UE&C - Seabrook Project Structural
D. E. Garrigan	Manager, Project QA for Seabrook	UE&C - Reliability and QA Department
V. D. Patel	General Design Supervisor	UE&C - Seabrook Project Structural ~~, Major Cat. I~~ ok
J. K. Cravens	Manager	UE&C - Seabrook Project Engineering Project Controls

Name	Title	Organization
J. J. Connelly	Supervisor	UE&C - Seabrook Project Calculation Control Center (1 of 5)
H. P. Sivertsen	Leader/Liaison SCAT Team Cognizant Engineer	UE&C - Seabrook Project Beam Verification Program and SCAT Team
J. E. Blackman	Assistant Manager, MAG	UE&C - Power Department, Mechanical Analysis Group
E. Skonick	Lead Engineer, EQ/COMP Qualification	UE&C - Power Department, Mechanical Analysis Group
L. C. S. Nascimento	Chief Structural Engineer	UE&C - Power Division
Anil T. Shah	Cognizant Engineer	UE&C - Seabrook Project Structural, Major Cat I
D. K. Ghosh	Cognizant Engineer	UE&C - Seabrook Project Structural, Containment
Pares N. Datta	Design Supervisor, Engineer II	UE&C - Seabrook Project Structural
John A. Mott	Design Engineer	UE&C - Seabrook Project Structural
Om P. Kalani	Manager Structural Supervising Engineer	UE&C - Seabrook Project ~~Manager~~, Pipe Support Group
Richard H. Toland	Manager	UE&C - Structural Department Structural Analysis Group
Noshir C. Karanjia	Seismic Consultant	UE&C - Structural Department Structural Analysis Group
Dipak K. Majumder	Lead Engineer	UE&C - Structural Department Structural Analysis Group
Branko Galunic	Engineer I	UE&C - Structural Department Structural Analysis Group
Z. B. Olszewski	Mechanical Supervising Discipline Engineer	UE&C - Mechanical Analysis Group
M. K. Sanghavi	Lead Pipe Support Engineer	UE&C - Seabrook Project Pipe Support Group

Name	Title	Organization
Girish C. Hatwal	Structural Engineer	UE&C - Seabrook Project Structural
Amar S. Dalawari	Engineer II	UE&C - Seabrook Project Pipe Supports Duct Supports
Thomas F. Clouser	Design Supervisor	UE&C - Seabrook Project Pipe Supports HVAC Supports
J. Alberto Rios	Engineer III	UE&C - Seabrook Project I&C
Al W. Cole	Project Administrator	UE&C - Seabrook Project Project Controls
R. Livingston	Administrator	UE&C - Document Control Center - Seabrook Project
Robert ~~Bob~~ Bosshardt	Administrator III, Lead, Records Control Group	UE&C - Document Control Center - Seabrook Project
D. Melitz	Supervising Structural Engineer	UE&C - Document Control Center, Seabrook Project
G. B. ~~Bud~~ Christina	Administrator	UE&C - Seabrook Project Engineering Project Control
Dexter Olsson	Senior Metallurgical Engineer Corporate QA Manager	Bethlehem Steel Corporation
Michael Bedics	Supervisor, Quality Assurance Reinforcing Bars, Piling and Construction Specialty Sales	Bethlehem Steel Corporation
Clarence Redman	Contract Administrator Reinforcing Bars, Piling and Construction Specialty Sales	Bethlehem Steel Corporation
Dennis Reid	Chief Detailer - Engineering	Bethlehem Steel Corporation
Denny Vassa	Detailer - Engineering	Bethlehem Steel Corporation
N. I. Desai	Engineer I - Structural	UE&C - Field Change Completion Group

7.4.2-4

12/27/83

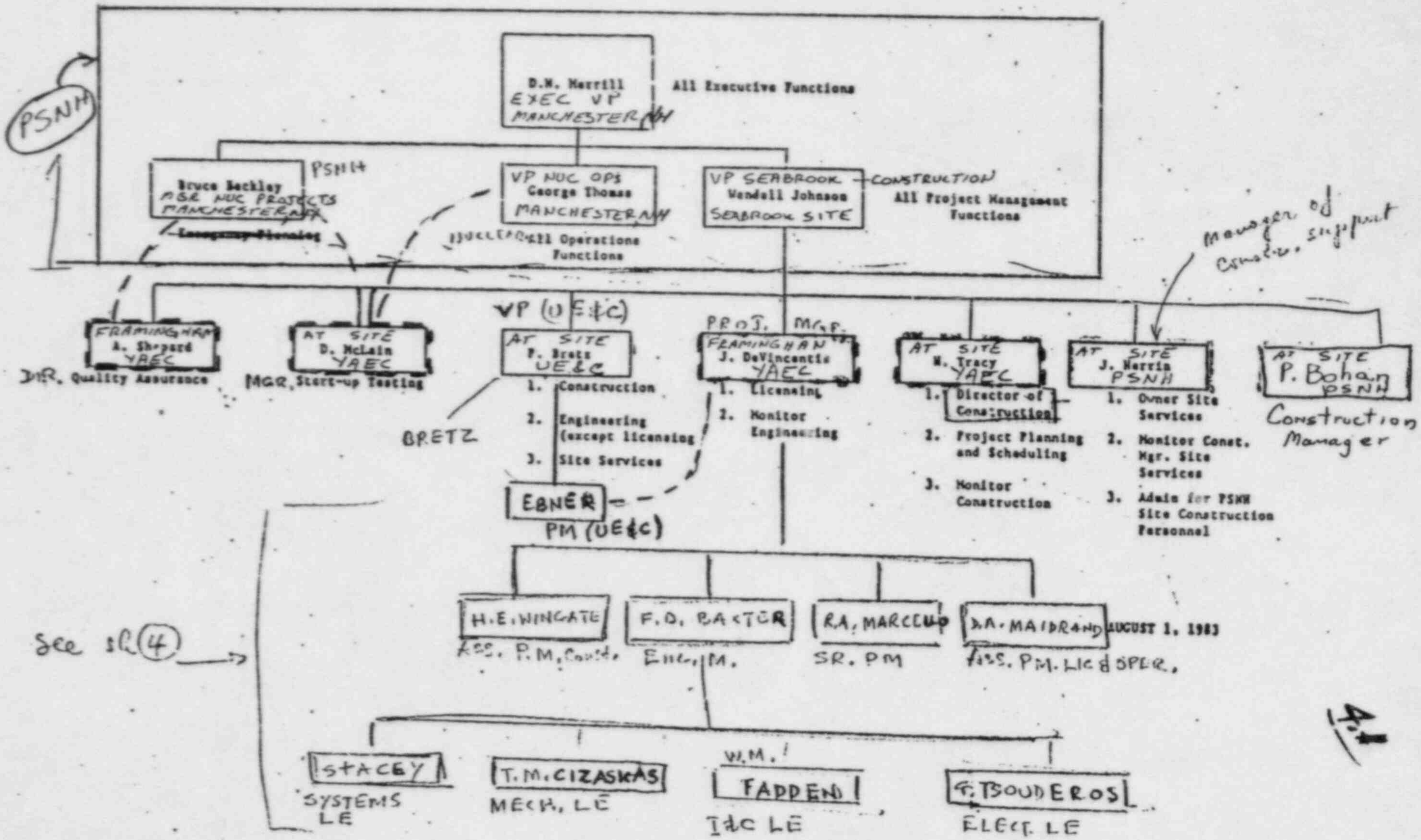
Name	Title	Organization
Rick E. Daniels	Cognizant Engineer for Program Guidelines	UE&C - Beam Verification Program
R. robert N. (Bob) Kuelin	Engineering Manager	UE&C - Field Systems Group Site Engineering
D. ouglas G. (Doug) McClellan	Lead Engineer - Civil/ Structural	UE&C - Civil/Mechanical Services, Site Engineering
R. ichard A. (Dick) Arell	Designer	UE&C - Technical Assistance Group Civil/Structural Engrg. Civil/Mech. Services Site Engineering
C. E. Morales	Draftsman	UE&C - Technical Assistance Group Civil/Structural Engrg. Civil/Mech. Services Site Engineering
R. P. Kosian	Lead Field Engineer	UE&C - Project Field Engineering Group Civil/Structural Engrg. Civil/Mech. Services
S. N. (Ned) Caruso	Lead Engineer	UE&C - Cable Tray Bracing Task Group Site Technical Staff Piping & Supports Site Engineering
Julie Droźd	Seismic Analyst	UE&C - Structural Analysis Group
John Alle	Structural Engineer	UE&C - Structural Analysis Group
Susan Hoyecki	Field Engineer - Civil/ Structural	UE&C - Project Field Engineering Group Civil/Structural Engrg. Civil/Mech. Services Site Engrg.
Robert Shappell	Civil/Structural Engineer	UE&C - Technical Assistance Group Civil/Structural Engrg. Civil/Mech. Services Site Engrg.

12/27/83

7.4.2-5

Name	Title	Organization
J. R. Lindguist	Field Engineer - I&C	UE&C - Project Field Engineering Group I&C I&C Systems Site Engineering
Frank ~~P~~ D adabo	Construction Superintendent Painting Subcontracts	UE&C - Fac. Construction
Colin H. Coles	Design Engineer ~~E2~~ II	UE&C - Seabrook Project Structural

SEABROOK PROJECT
FUNCTIONAL ORGANIZATIONAL CHART - FIG. 1



--- = lines of communication
LE = lead engineer

16

DRAFT #1

A2

1/10/84

Document Name:

SECTION 4 - SEABROOK IDI

Requestor's ID:

EILEEN

Author's Name:

R. Shewmaker

Document Comments:

Civil and Structural

1/10/84

4. CIVIL AND STRUCTURAL

The objectives of this portion of the integrated design inspection were to evaluate the civil and structural engineering practices and technical execution of the design with specific emphasis upon the control of the design and exchange of design information within the project. The team inspected areas defining whether:

(1) Regulatory requirements and design bases as specified in the license application have been correctly translated and satisfied as part of specifications, drawings, and procedures,

(2) Correct design information has been provided both internally and externally to the responsible design organizations including selected off-site subcontractors,

(3) Design engineers had sufficient technical guidance to perform assigned engineering evaluations, and

(4) Design controls, as applied to the original design, have also been applied to design changes, including field changes.

These objectives were accomplished by selecting a sample of structural elements which make up the building structures or are supporting mechanical, electrical, and instrumentation and control systems being reviewed by team members in those specific disciplines. This sampling ~~is~~ was used to assess the interdisciplinary interface design control exercised on the Seabrook 1 project.

1/18/74

Document Name:
SECTION 4.1 - SEABROOK IDI

Requestor's ID:
EILEEN

Author's Name:
R. Shewmaker

Document Comments:
Design Information

F 4-1
F 4-2
F 4-14
F 4-12
F 4-15
F 4-3

O 4-6
O 4-8
O 4-7

4.1 Design Information

The objective of this portion of the inspection was to determine, on the basis of the material reviewed, if ~~the methods,~~ the procedures and methods of design and the design controls which have been used in the Seabrook project, reflect the requirements of NRC regulations, such as General Design Criteria, Regulatory Guides, Standard Review Plan and other referenced industry codes and standards. ~~Furthermore, having determined~~ Based on the degree of consistency between the rules and regulations ~~on one hand~~ and the actual practice by the applicant and his agents, ~~on the other,~~ a determination could be made ~~of~~ if the levels quality assurance and quality control are acceptable.

for 1.3

Pursuing this goal, the team reviewed the organizational structure of the Public Service Company of New Hampshire (PSNH), the design and construction effort delegated to its agent, the Yankee Atomic Electric Company (YAEC) and the execution of the design by the architect-engineer for the Seabrook plant, United Engineers and Constructors (UE&C). Particular attention was ~~found to~~ focused on the interfacing between various organizations such as YAEC and UE&C and their subcontractors. and the flow of information across these interfaces

In the civil/structural discipline, the applicant committed to comply with the NRC rules and regulations, the General Design Criteria, Regulatory Guides, Standard Review Plan (NUREG-0800) and other documents as well as the appropriate commercial codes and standards. The basic document used in design of the containment structure is the ASME Boiler and Pressure Vessel Code Section ~~II~~ III, Division 2, Code for Concrete Reactor Vessels and Containments (Winter 1975 Addenda for containment liner; Winter 1976 Addenda for reinforced concrete), ~~t~~hereinafter referred to as the ASME Code. For other reinforced concrete structures, the ACI-318-71, Building Code Requirements for Reinforced Concrete (with Commentary) was used. Steel structures have been designed in accordance with the AISC, Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, 1969 Edition (including supplements 1, 2 and 3). For ~~the~~ quality ~~control~~ requirements the applicant committed to use ANSI N45.2-1974, Quality Assurance Program Requirements for Nuclear Power Plants. The Final Safety Evaluation Report (FSAR) included all of the pertinent Regulatory Guides. as references for the various commitments.

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The organization of the Seabrook project in place at the time of the inspection is ~~best~~ illustrated on Figure 1. The Executive Vice President of the PSNH is responsible for all executive functions of the project. He reports directly to the president of the company. The Vice President, Seabrook, (VPS), reports directly to the Executive VP and is in charge of all management functions. Both the Executive Vice President and the Vice President, Seabrook are from the PSNH. Working directly under the VPS are: Director of Quality Assurance; Manager, Start-up Testing; Director of Construction; and Project Manager. These four positions are staffed by the YAEC. There are three additional positions: the Manager Construction Support and the Construction Manager (both of them are from the PSNH) and Vice President of UE&C responsible for design and construction management. The YAEC ~~engineering~~ project group consisting of 35 professionals reports to the project manager and it is ~~headed by~~ subdivided into four groups headed by the following ~~four~~ positions:

a. Assistant project manager of construction

b. Engineering manager

c. Senior project engineer

d. Assistant project manager (licensing and operation)

The Engineering Manager has four lead engineers reporting to him:

a. Systems Lead Engineer

b. Mechanical Lead Engineer

c. Instrumentation and Controls Lead Engineer

d. Electrical Lead Engineer

There are five engineers in the mechanical engineering discipline; three of them are civil/structural and two mechanical.

delete

We interviewed the three engineers who are working in the civil/structural area. We found that all of them are graduate engineers, of them have master degree in civil or structural engineering. of them are registered professional engineers. Their experience range from seven years to nine with most of it in structural engineering related to nuclear plants. During delete

the interviews they demonstrated generally good knowledge of their profession, but their familiarity with NRC rules and regulations was somewhat less than would be expected. There was no evidence that YAEC provides any training in this area or encourages an improvement of their knowledge of the current regulatory positions.

The entire staff working for the project manager consists of 35 professionals. The professional cross section of the civil/structural staff of the YAEC employed at the Seabrook Project is included in Table 4-1 which provides data for a representative cross-section of civil-structural engineers working on the Seabrook project.

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In our inspection, considerable attention was given to the interfacing between different ~~officials~~ personnel and groups within the YAEC organization as well as between the organizations involved, namely YAEC and the UE&C and/or PSNH. It appears that the communication between the UE&C and the YAEC is maintained through the UE&C ~~PM~~ Project Manager who communicates directly with his counterpart of the YAEC. The YAEC ~~PM~~ Project Manager reports to the VP of Seabrook project who is on the staff to the utility company, the PSNH. The lines of communication are depicted on Figure 1. The inspection team evaluated the documentation of design controls which is used by the YAEC as the basis for the demonstration of design control exercised by YAEC and PSNH over the ~~designers~~ design organization for the project.

needs expansion & conclusion

?

A review of an audit report conducted by the PSNH on July 26, 1973 at the UE&C offices, Philadelphia, Pennsylvania was conducted. The purpose of this audit, conducted in accordance with the requirements of Yankee QC&A Procedure WQ-115, paragraphs III.A.1 through 8, was mainly to verify disposition of the open items of the previous two internal audits. The report discussed three items identified in the previous audit, conducted on May 15, 1973 ? which ha~~ve~~d not been satisfactorily resolved. No new open items ~~have been found.~~ were found during the audit. In ~~the~~ a subsequent letter, dated August 30, 1973 ?, UE&C discussed the proposed resolution of the items covered in the subject audit report. ~~An observation has been made~~ The IDI team noted that the referencing of the staff in the audit report has not been made by full name or by their title, ~~name~~ but by their initials alone. ~~We~~ The team found that such identification of personnel makes it extremely difficult or even impossible to trace down the people involved. (... to [illegible] GAP, CAP, etc, to [illegible] name and/or title in audits) (Observation 4-____)

The principal documents providing for the implementation of all quality assurance aspects of the Seabrook plant for the Yankee organization are the Project Policies and the Seabrook Quality Assurance (Q/A Manual). The Q/A Manual establishes the procedures for the interval and external quality controls of the YAEC such as the scope and frequency of the audits, interface controls, provides guidelines for the review of specific categories of documents, etc. The Project Policies provide guidelines for implementation of the specific phases of the quality assurance system and describe processing of documents such as the Engineering Review Reports (ERR's), filing of documents, handling of engineering documents etc.

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Both the Project Policies and the Q/A Manual are under the direct responsibility of the Project Manager (PM). The PM is responsible to assure that both the Project Policies and the Q/A Manual are in agreement. In case of a conflict between these two documents the Q/A Manual takes precedence. The Project

Policies are reviewed and updated periodically to reflect the current modes of operation and design.

Those receiving an engineering review are. - - - -

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Specifications are the documents developed for specific tasks involved in design of the Seabrook plant. They are developed by the UE&C and forwarded to the YAEC PM for review and approval. They are also partially reviewed on pre-selected basis by the Quality Assurance Department (QAD) of the YAEC and the document resulting from the review is called Engineering Review Report (ERR). The ERR's are filed with in the ~~YAEC~~ Yankee organization in a separate filing system.

Once a specification has been developed ~~and~~, review and approved, The UE&C provides YAEC with the list of the prospective bidders and recommends those bidders who appear to be technically acceptable. After proposals are received YAEC selects the winning bidder from the list provided by the UE&C, usually on the basis of the lowest price. The authority of approval of the specifications is with the Project Manager. Specifications are updated when there is a change in the purchase order and their change require review and approval of YAEC. In order to assure that the specifications are up to date, YAEC conducts interdisciplinary meetings which are, on the average, every two weeks.

Following are our specific comments resulting from review of some of the documents provided by the YAEC staff.

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Q/A Procedure 3.3 "Review Procedure" Rev. 8 - Date 3/30/79

The Procedure provides guidelines for the review of specific categories of documents. Specifically the documents covered by this procedure are:

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Engineering Specifications, Engineering drawings, purchase documents and QA/QC Program, Manual and Procedures.

The documents to be reviewed by ~~the~~ YAEC are developed by the agents, such as UE&C or subcontractors and submitted to YAEC Project Office for review. The Project Office is responsible to establish the appropriate reviewer (s). Review of Project Policy #1 (PP-1) reveals that the reviewer is "determined by Section 3.0 of the Seabrook Station Q/A Manual and Subsection 17.1 of the Seabrook SAR.

When Q/A Manual Section 3.0 was reviewed the criteria for selection of a reviewer could not be found which is a discrepancy from PP-1.

The Procedure is vague in the area of resolution of conflicting comments originated by the reviewers. The only statement that could be found is that if the disagreement could not be settled amongst the reviewers it is referred to the higher management. There are no specific steps or the responsibility to be taken to obtain a satisfactory resolution.

The Procedure contains specific guidelines (provided in the Appendices) for preparation of the review of the documents covered by the Procedure.

United Engineers and Constructors, Inc. (UE&C) is organized into several operating divisions with the nuclear power work in the United States being performed in the Power Division under the direction of a Vice President. One of the managers reporting to him is the Manager of Power Engineering. Power 1.3

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Engineering is then subdivided by four technical disciplines each with a chief engineer as the technical leader for a given discipline. UE&C defines four specific disciplines: structural, electrical, instrumentation and control and power. The first three are self-explanatory whereas the fourth requires some explanation. Included with the Chief Engineer of Power's group are the technical disciplines of power systems, piping engineering, process engineering, mechanical engineering, nuclear engineering and fluid/hydraulic engineering. The engineering personnel involved on a given project such as the Seabrook Project all report technically to one of these four discipline chief engineers. Some may serve on a specialist staff or in a special group under the chief engineer of that discipline supporting a project. While others may be within the project group under a supervising discipline engineer or other engineering supervisor who reports to a project engineering manager. The staff groups and personnel become involved in project work only at the request of the project engineering personnel. Based on the team's information this concept has been rather constant within the firm for a number of years.

The Seabrook Project functions within this framework in the following manner. The Project Manager apparently reports to the Vice President of the Power Division, just as does the Manager of Power Engineering. In the course of the Seabrook Project there have been numerous changes in the functional organization for the project as well as changes in personnel. The team found some in tracing the organizational changes as well as how responsibilities shifted and were transferred from one group or individual to another. Documentation was obtained in the organizational area, to indicate the overall project organization since 1976. Numerous changes were implemented about the time the team's

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effort began, adding another change to the list. The team found that the organizational charts obtained in the background study in October were even out of date by the beginning of November when the IDI team began, its inspection.

Reporting directly to the Project Manager until sometime after March of 1981 was the Project Engineering Manager. There also existed at least one Assistant Project Engineering Manager. The Supervising Structural Engineer, called a supervising discipline engineer (SDE), reported through an assistant project engineer to the Project Engineering Manager. The SDE for structural was the same individual from the beginning of the project until August of 1982 when his assistant became the SDE. During the period of heavy involvement in design for the basic structures the structural group in projects was aligned by structure in that the Containment Shell, for example, had a designated Cognizant Engineer as the lead structural design engineer for that building. A significant number of engineers were assigned in these building groups. As that phase of the project drew to a close the structural personnel have also been formed into specific task oriented efforts such as the Beam Verification Program. The Cognizant Engineers assigned by building still exist, but have smaller groups and may also now have responsibilities for several buildings. Another change that grew over the life of the design evolution was the importance of site related engineering efforts. Up through March of 1981 there was a liaison Engineer assigned to the field to perform the site liaison to the home office engineering organization. That function was performed under the supervision of the one Project Engineering Manager for Seabrook. In March of 1981 a separate organization was created under the direction of the Project Engineering Manager (Site) as opposed to the previous

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position under the Project Engineering Manager for the Project. By January of 1983 four separate Project Engineering Managers positions were in existence in the home office with some 1100 personnel in the groups. Additionally, nearly another 1000 were at the site under the control of the Project Engineering Manager for Site Engineering. [No less than six different groups exist working in the structural discipline in different chains of command with three at the site and in the home office. A separate structural group has been set up in the ome office in the Site Support Engineering Group to interface with the field Site Engineering group so as to minimize impacts on the project Structural group. The implications of this organization will be mentioned later in the report in addressing interfaces for design.]

The team also spent considerable time, out of necessity, in order to try to understand the hierarchy of the multitude of in-house procedures utilized by UE&C so that a proper assessment of what was being done in the project's design and the control of the design process could be made. Figure 4.____ presents an overall view of the hierarchy that exists for the Seabrook Project with regard to home office engineering and design. In actuality, 4 to 6 layers of documents and procedures precede what might be considered to be an engineering calculation. This is some what further complicated by the fact that in many specific areas, different staff groups have developed and use modified procedures where latitude exists under a more general parent procedure. The result is a great deal of variation in documents when one begins to review, for example, calculation packages and the associated control sheets.

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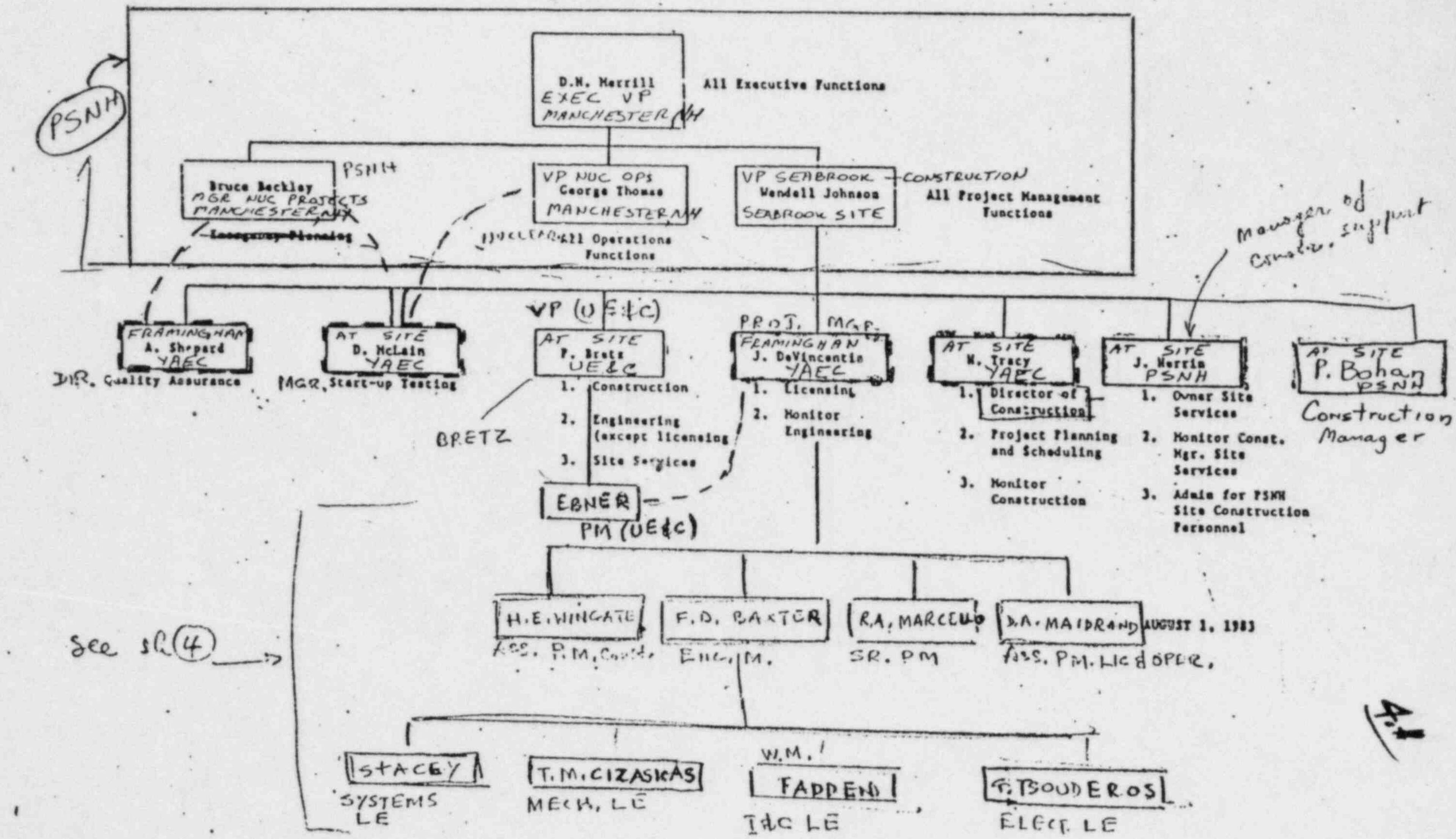
As a result of the team's review of the various project documents, such as the Project Manual of Procedures, the General Engineering and Design Procedures, several findings and observations were made. The team first reviewed QA-3 from the QA Manual which is the UE&C corporate level document which addresses the regulatory requirements.

Continue on hand written page 5

SEABROOK PROJECT

FUNCTIONAL ORGANIZATIONAL CHART - FIG. 1



- - - = lines of communication

LE = lead engineer

(6)

1/16/84

Document Name:

SECTION 4.2 - SEABROOK IDI

Requestor's ID:

EILEEN

Author's Name:

G. Harstead

Document Comments:

Static and Dynamic Analyses

Ending 4-13
" 4-17

O p. 4.2-8
4 was F4-7

Seismic Analysis
4.2 ~~Static and Dynamic~~ Analyses

Objectives must be broadened to address Tank Farm, containment etc. — any Cat I structure for static/dynamic analysis

The objective of this portion of the inspection was to examine the adequacy and coordination of analysis, design, and the resulting floor response spectra for the Tank Farm Area which houses the Refueling Water Storage Tank (RWST) and the Spray Additive Tank (SAT).

The team also reviewed the interdisciplinary process leading to the seismic design of the attachments to the containment liner supporting ducts, pipes and electrical equipment, Calculation No. CS-22, (Reference 4. —) as well as the calculations pertaining to the subject of the Tank Farm.

move to 4.3

The dynamic analyses of the Tank Farm was performed by the Structural Analysis Group (SAG) in order to determine the seismic forces needed for the design of structural elements such as the structural steel beams and bracing and the reinforced concrete walls and slabs. This analysis also led to the development of amplified response spectra which were used for seismic qualification~~s~~ of equipment, ~~as~~ analysis of piping systems, and for design of structural steel beams.

The Tank Farm Structure is essentially composed of a lower reinforced concrete box-like structure and an upper braced structural steel frame with a reinforced concrete roof slab and metal siding. The mathematical model consists of lumped masses connected by massless springs. This type of model is commonly referred to as a stick model. The calculations used for the development of the mathematical model are contained in UE&C Calculation No. SB SAG-5WB (Reference 4.41).

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shld move after concrete to p.4.2-4

The stiffness of the structural steel frame was based entirely on a shear type response in that the nodes were in general restrained from rotation about the horizontal axes. The calculations of the area and the bending moment of inertia were calculated consistent with the rotational constraints imposed on the model. While the combination of area and bending moment of inertia were consistent with overall shear stiffness, individually the properties were not consistent with the actual structure. The rotational constraints imposed also, in effect, eliminated overall bending from any consideration. This approximation could result in a significant overestimation of the stiffness of the structural steel framing.

The stiffness of the reinforced concrete portion of the building was considered by UE&C as a combination of shear stiffness and overall bending stiffness. Therefore, instead of summing up the rectangular cross sectional area of walls oriented in the direction of interest, UE&C considered each wall separately in determining the shear deformation. This shear deformation of each wall is composed of pure shear displacements as well as bening characterized as a guided cantilever with a moment of inertia based upon the rectangular shape. The sum of the shear stiffness of each wall is calculated, so that an area and a bending moment of inertia of the stick is determined consistent with the shear stiffness. The problem with this method is that if indeed both shear stiffness and overall bending stiffness were important, the method would underestimate the overall bending stiffness particularly since flange effects are not considered. UE&C made computer runs during the week of December 5, 1983 while the inspection was in-progress which indicated that the model was not sensitive to errors in the moment of inertia.

Finding 4-18 ? also see p 4.2-4

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Should go to p.4.2-2

In calculating the stiffness of the structural steel bracing, UE&C assumed that all X-bracing was composed of angles 4"x4"x3/4". In fact, the bracing consists of substantially larger members as indicated in UE&C Drawings F-111824 and F-111825 (Reference 4.32).

There is approximately __ feet of fill concrete under the Refueling Water Storage Tank and the Spray Additive Tank. A three inch gap is provided between the fill concrete including the mat and the south wall of the Primary Auxiliary Building (PAB) as shown on UE&C Drawing ~~9763-~~F-111818 (Reference 4.32). A concrete curb is placed on the top surface of joint as shown in Detail 111819DD, UE&C Drawing ~~9763-~~F111819 (Reference 4.32). This joint is shown along the east edge of the fill concrete only. A field visit indicated no differences with the requirements of the UE&C Drawings (Reference 4.32). The mathematical model described in Calculation No. SB SAG-5WB (Reference 4.41) does not account for the stiffening effect of the fill concrete.

The neglect of overall bending used in the development of the stiffness of the stick model were not approximations which significantly simplified calculations, but which might be troublesome and therefore, must be independently justified.

Personnel stated the Tank Farm mathematical model was unique and no other mathematical models were prepared in such a way. Additionally, it was stated that the usual practice of SAG is to prepare a static structural model and with the aid of a computer program, appropriate stiffness properties are calculated without the need for the approximations such as those used in the

Tank Farm model. The team had insufficient time to confirm that the Tank Farm Structure is an isolated case; however, the team has no reason to doubt the validity of that statement. Because of discrepancies between the assumptions used in the development of the mathematical model and the actual Tank Farm Structure, new calculations and computer ~~runs~~ analysis are required. It is the team's finding that the Tank Farm mathematical model should be recalculated incorporating effects of overall bending and the actual structural configuration (Finding 4-18).

Finding 4-17

The interfacing between different disciplines is illustrated by Figure ____. It shows the major steps taken during the process and is self-explanatory. It should be pointed out that all transmittals of the amplified response spectra (ARS) from one discipline to another is taking place through the Coordinator of Seismic Design (CSD). We were informed that the introduction of this position as the focal point of coordination of interdisciplinary effort improved the design procedure in a great measure and has prevented the use of obsolete or inapplicable results of seismic analyses. We found an instance of such a lack of coordination in the past in case of use of results of the input to the SHELL I computer program (Finding 4-7). ~~The subject of seismic analysis will be discussed later, in the section dealing with design of the containment.~~ The current system of control of seismic design is based on ~~follows the administrative procedure~~ AP-36, "Control of Seismic Design" (Reference 4. ——) which was introduced in May of 1980 and appears to be effective. In the process of reviewing Calculation No. CS-22 (Reference 4. ——) several observations have been made. (Observations 4.1, 4.2 and 4.3). In case of Observation 4.1, reversal of the horizontal leg of the angle could introduce an additional eccentricity, which would cause a torsional moment

Findings @ End of 2 ¶ F4-7 not developed here enough

won't that here

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in the plate and therefore increase in the stresses. We pursued our inspection further, and review of the shop drawing revealed that the detailer placed the angle in question with the vertical leg at the center of the plate, thus eliminating any eccentricity which might take place due to the erroneous sketch on Sheet 98. Observations 4.2 and 4.3 have been brought to the attention of the design office as examples of lack of proper care in preparation of calculations and checking and would not have a major bearing on the adequacy of the design. to Sec. 4.3

We reviewed the basic assumptions of the seismic analysis of the containment structure from the point of view of the regulatory requirements and found them acceptable. The containment shell has been represented as a lumped mass (stick) model fixed at elevation -30 ft. The shell and the internals including polar crane have been uncoupled for the purpose of the final analysis complete, Calculation No. (SBSAG-4CS4) (Reference 4. ____). The analysis assumed that the liner is not a resisting structural element, but its mass has been included in the lumped masses of the model. Since the shell is essentially axisymmetric, and its center of mass and center of rotation coincide, the torsion due to the geometry of the structure has not been considered. The accidental torsion due to seismic force applied at an eccentricity of 5 percent of the mean diameter of the containment cylinder was considered and its effect on the stresses of the rebars has been found to be negligible (less than 2 percent increase). We agreed with the considerations made for torsion. to Sec. 4.3

In the case of the internal structures, they have been modeled as a series of concentrated weights, located at their respective centers of mass. These weight centers have been located at specific elevations, which in most cases is at the top of the respective slabs. The weights representing the slabs have been connected by weightless, elastic beams representing structural components between the elevations of the concentrated weights.

Since there are no existing earthquake records pertinent to the Seabrook site the seismic input has been defined at the bedrock in form of tne design response spectra for the operating basis earthquake (OBE) and the safe shutdown earthquake (SSE) in compliance with Regulatory Guide 1.60. The duration of the earthquake is estimated at 10 to 15 seconds. The engineers responsible for the seismic analysis stated that all Category I structures are founded on sound bedrock or engineered backfill extending to the backfill. The engineered backfill consists of either fill concrete, backfill concrete, offsite borrow tunnel cuttings or sound cement. Furthermore, the type of engineered backfill used under all seismic Category I structures is fill concrete, with an exception of safety-related electrical duct banks, electrical manholes and the service water pipes which were founded on off-site borrow or tunnel cuttings. Both the time history and the response spectrum analyses were performed for the OBE and the SSE conditions. The critical damping ratios used for the containment structure are those of 4 and 7 percent for the OBE and for the SSE respectively.

Rewrite for 4.1 how as FSAR commitments were put into effect

The structural response has been determined using the response spectrum modal analysis method. The total response of the structure was calculated by superposition of the responses of each mode by the square root of the sum of the squares (SRSS) method.

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We reviewed the process by which the basic data pertinent to the design of containment have been gathered. In this connection we have noted that several documents such as those pertaining to the design temperature and pressure, which in the opinion of team members should be controlled, have not been included in the Document Control Center (DCC) serial numbering system and could not be easily retrieved. This matter is described in more detail in Section ____. Furthermore, examination of the input for the SHELL I computer program revealed that the information used was incorrectly referenced in the calculations ~~set~~. The following is the result of our further inquiry in this matter.

Will go to Sec. 4.1 [illegible]

to 4.3

Seismic forces and moments as used on Sheets 30 through 35 in the Calculation No. CS-15, dated 8/4/75, (Reference 4. ______) were obtained from modified seismic analysis SB SAG-4CS3 (Reference 4. ______) using decoupled model of the containment shell and critical damping values of 4% for OBE and 7% for SSE. The preliminary analysis, SBSAG-4CS3, ~~(Reference 4. ______)~~ was based on coupled model of the containment shell and critical damping values of 2% for OBE and 5% for SSE. SB SAG-4CS3 has been superseded by the final seismic analysis SB SAG-4CS4 (Reference) using a decoupled model of the containment shell and critical damping values of 4% for OBE and 7% for SSE ~~(Ref. SAG memo~~, as outlined in a memo dated 3/17/76 ~~(Ref.~~ (Reference 4. ______ ~~File 3.1.1)~~.

to 4.3

Although comparison of the SB SAG-4CS3 and SB SAG-4CS4 analyses shows that their results are very similar and that the seismic forces and moments used as input for the SHELL I program are conservative, we determined that this is a violation of the ~~Administrative Procedure~~ AP-22, "Calculations", Appendix A (Reference 4. ______) ~~Rev. 4, dated 11/19/74~~ and 10 CFR 50, Appendix B, Section III, "Design Control", dated 8/1/80 (Finding 4.7).

to 4.3

more details needed

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We reviewed the various stages of the static analysis of the containment structure which utilize the results of the ~~static~~ seismic analysis described above. The containment structure (the shell and the dome) has been designed using several computer programs. Some of them such as LESCAL, WILSON I and WILSON II have been documented in the Final Safety Analysis Report (FSAR) Section ______. There were others, however, such as SHELL I and SHELL II which have not been included in the FSAR. This is in violation of the Regulatory Guide 1.70, Section 3.8.1.4, Revision 3, November 1978. ~~and a~~ Although we ~~have been~~ were informed by ~~the~~ UE&C personnel that the use of these ~~codes~~ computer programs was limited, we noted ~~it~~ this as an observation (Observation 4.___).

More detail needed to develop this

4.3

The axisymmetric analyses of the containment structure for dead, load, pressure, temperature under both operating and accident conditions were performed using Wilson I computer code. The shell model for the OBE and SSE has been analyzed using Wilson II program. Both the Wilson I and Wilson II use the finite element method. Since the ASME Code does not permit the liner to be used as a structural element, the containment structure has been analyzed and designed without participation of the liner plate. The analysis recognized the fact that under thermal conditions, the liner plate will exert forces in the concrete section which constrains the liner growth. In order to generate proper design forces for the concrete section, liner stiffness has been included in the Wilson I model but excluded from integration of stresses to obtain section forces and moments. The analysis recognized the fact that the cracking pattern will vary under different loading conditions. In order to simplify the design, the individual loads have been combined linearly despite the difference in cracking. The peak pressure and peak temperature have been assumed to occur simultaneously for the design of concrete section. We agreed with this approach.

In the analysis the input for the SHELL I and SHELL II programs have been obtained from the lump-mass analysis which used the STARDYNE computer code and model described above. The SHELL I and SHELL II programs converted the forces and moments obtained from the STARDYNE analysis into the effective membrane forces and in plane shears and adds them up algebracially. 4.3

4.2

The square root of the sum of squares is applied to determine the combined effects of three orthogonal components of earthquake ground motion, including two horizontal and one vertical motions. Due to the symmetry of the structure, the maximum meridional and the maximum in plane shears will occur at the same location. move to bottom of page 4.2-7

4.3

The design loads computed by SHELL I and SHELL II were used as input to program LESCAL, Version 1.5, which is used to calculate the stress and strains in reinforcing bars and/or concrete per ASME B&PV Code, Section III, Division 2. 4.3

Summary & Conclusions

INTERDISCIPLINARY PROCESS OF ANALYSIS OF PIPING ANCHORS

SH 1/2

STRUCTURAL DISCIPLINE OR CSD REQUESTS SAG TO DEVELOP ARS AT CERTAIN LOCATION

↓

SAG GENERATES ARS AND TRANSMITS TO CSD

↓

CSD DISTRIBUTES ARS TO STAFF GROUPS & DISCIPLINE LEADERS (ADV. COPIES IMMEDIATELY CONTROLLED REVISION: COPY APPROX EVERY 6 MONTHS THROUGH DCC

↓

NEW ANALYSIS

Nuclear/Mechanical prepares Iso with exact location of pipe supports. Consults PSC, if necessary, to help locate suppts.

↓

Piping in coordination with Nuclear/Mechanical prepares work request package for MAG analysis.

↓

MAG selects exact ARS (no assumptions permitted), performs analysis and sends to Piping.

↓

Piping prepares Work Request for PSC support design. And designates ASME safety class

and prepares shop dwgs for pipe supports

↓

PSC designs supports and sends to Piping and Fabricator. Sect III Div 1, Subsect. NF (for ASME supports)

↓

1B

1A

REANALYSIS

Piping performs ARS verification. If results are unfavorable, Piping sends verification package to ARS Review Task Force.

↓

Task Force reviews ARS problems, removes conservatism, recommends alternate solutions for using reduced ARS and asks Piping to close-out ARS verification. If not possible, asks Piping to authorize reanalysis.

↓

Piping either (i) closes out ARS verification or (ii) requests MAC reanalysis.

↓

MAG performs reanalysis and sends to Piping.

↓

Piping requests PSC to redesign supports.

↓

1C

ANALYSIS OF PIPING ANCHORS (CTD).

SH 2/2

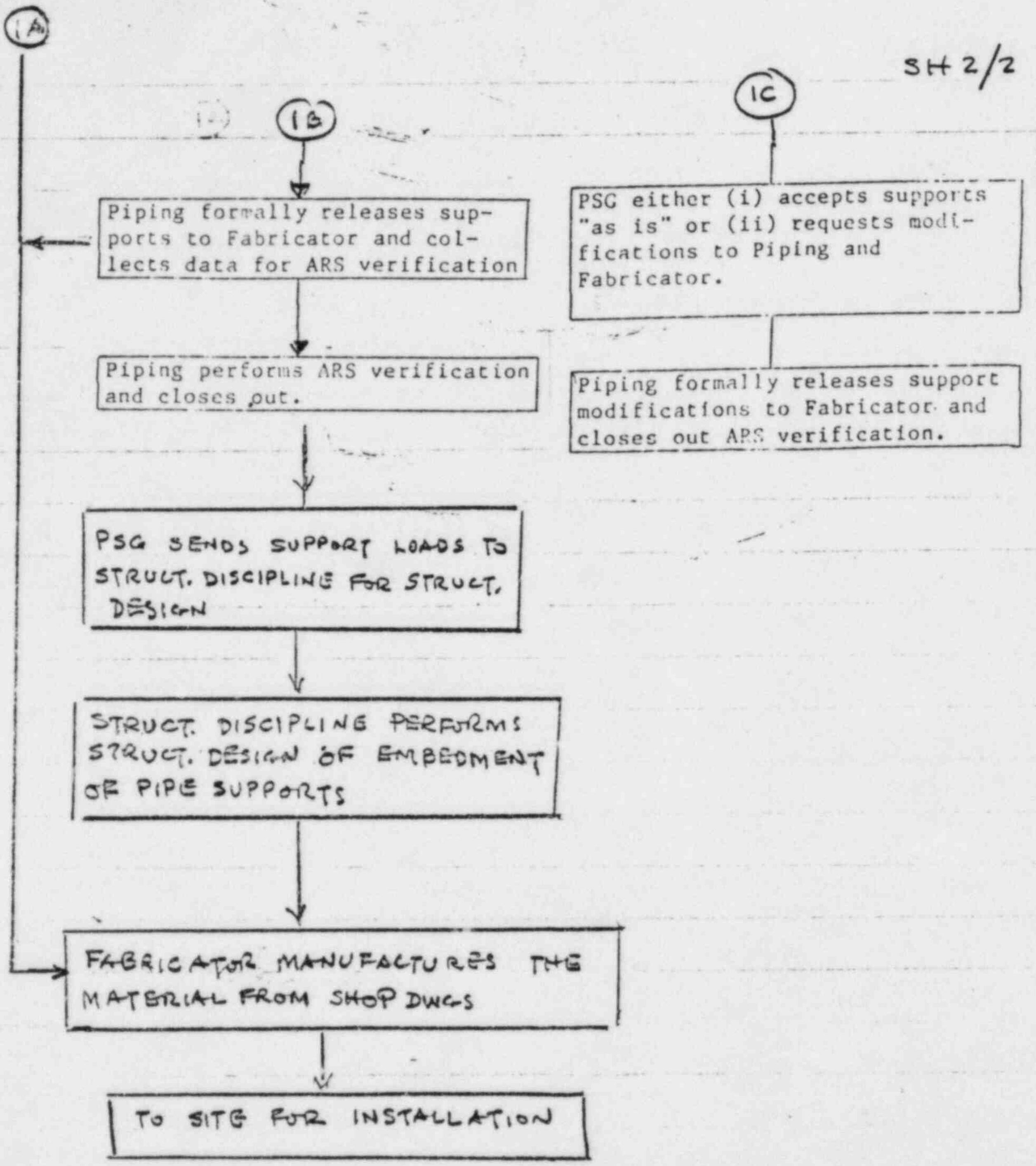

FIG. ______

SOURCE: Internal Memo #14091A, dated 8/9/83 from D.H. Rhoads and H.C. Gran

1/17/84

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SECTION 4.3 - SEABROOK IDI

Requestor's ID:
EILEEN

Author's Name:
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Design of Structural Elements

F 4-11 O 4-3

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4.3 Design of Structural Elements

objectives have to be broadened to cover all elements reviewed

The objectives of this portion of the inspection were to examine the adequacy and coordination of analysis, design, engineering drawings, shop drawings and construction of structural elements located in Category I structures which are associated with the containment spray system. The structural element which was selected as an example was the recirculation sump screen structure.

The containment recirculation sump screens and collects the water available for supplying the residual heat removal, containment spray safety injection and high head charging pumps during the recirculation mode of operation following an accident. There are two completely independent sumps located in the containment, symmetric about an azimuth of 270°, with the top of concrete at elevation -26'. Heavy particles are prevented from reaching the sumps by sloping the surrounding floor away from the sumps and two screens (one is coarse and considered a trash rack with 1 inch x 3-11/16 inch openings and the other is the fine screen with 8x8 openings per inch) prevent foreign matter of 0.097 inches or greater from passing through.

?

Both the trash rack and the fine screen are attached vertically to the steel framing. The structure itself consists of a framework of structural steel members extending from elevation -26' to elevation -20½'. Each frame is on three elevations, within the limits stated above, and has the area of 9'-6" x 18'-6".

what are 3 elevations ?

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We reviewed the design calculations for the screen structure which are contained in the Calculation No. CI-2 (Reference 4.____). The structure was designed for the load combination of the dead load, live load and the OBE as one of those required by the FSAR. The computation contained a statement that the equation used was the controlling load combination equation, but there was no comparative analysis or any evidence that both earthquakes (OBE and SSE) have been considered. Additionally, the effects of thermal expansion of the beams had not been taken into account. During the inspection, the temperature was accounted for in Revision 1 to the calculations. This was after the structural steel ~~has~~ had been installed. The drawing pertinent to this structure, Drawing F-101486, (Reference 4._____) was released for construction of embedded anchor plates on September 29, 1978 and for structural steel construction on January 21, 1980. We concluded that consideration of both of the earthquake loads, OBE and SSE should be evidenced in the design and that omission of this load is violation of the "Structural Design Criteria" SD-66, Table 5.4-1(?), Rev. 0, dated October 19, 1976 (Reference 4.____) (Finding 4-11). During our inspection, Revision 2 was added (dated November 25, 1983) which included an explanatory note that the amplified response spectra tab[illegible] have been consulted and it appears that the original design was c[illegible]e.

Rev.1 was noted to be 11/29/83, how does this wash w/Rev 2 of 11/25/83

Sump Screen Steel

Examination of Detail 101486M on Drawing F-101486 (Reference 4.____) revealed that the bent plate connector had not been placed centrally with respect to the structural member ~~(C12)~~ 2 channel to which it is bolted and was moved toward the upper flange of the channel. This was inconsistent with the analysis, which assumed that the connector would be placed so that the center of the bolts on the connecting plate would coincide with the center of gravity of the channel. We verified that the eccentricity between centroid of the bolts and of the channel as described above has been transferred on to the shop drawing and during our trip to the site, we found out that installation was consistent with the drawing. Since the members are subject to the movement along their longitudinal axes due to thermal conditions, such a displacement of the connector from the centroidal axis of the beam introduces eccentricity which will result in increased stresses at the connecting plates. This was noted as a finding. (Finding 4-4).

The cognizant design engineer performed additional calculations during the inspection to account for ~~this~~ the above condition and determined that the resulting stresses are within the code allowables and, therefore, the structure as built is adequate. The additional calculation sheet has not been listed in the Calculation Revision Control Sheet of Revision 2 which was reviewed by the team. This is contrary to AP-22, "Calculations", but since the work was done after the inspection's ~~time window~~ design review cut-off date this is noted as an observation (Observation 4-3).

While inspecting the annular steel between the containment shell and the secondary shield in the containment structure, we observed that a number of steel beams framing into the steel plates embedded into the concrete had been modified. The modifications consisted of extending the lower part of the web of the beams and providing plates to accommodate the lower bolt in the plate which had been welded to the embedded plate. Upon examination of the pertinent shop drawings and the engineering drawings we found that this modification had been necessary due to the fact that the embedded plates were installed at the wrong elevation. The plates were installed too low to be compatible with the elevation of the structural steel in the area of the annulus. In our discussion with the cognizant design engineers the modification of the connections was not reflected in the analysis completed using a computer program. We determined this not to be in conformance with the AISC Specification (Reference 4.____) and the Structural Design Criteria, SD-66, Sections 2.1.2 and 6.2.5.1 (Reference 1.3) (Finding 4-13).

We requested that an additional analysis be performed to determine the adequacy of the connections. During the inspection we were informed that a program which will re-evaluate connections modified as described above or in any other way so as to depart from the standard connections contained in the AISC Specification and not ~~taken~~ analyzed via the computer model will be reviewed. This will be done by selecting a representative sample and analyzing the connections in that sample in accordance with the AISC Specification requirements. We were told by the design engineers of UE&C who have been intimately involved in design of the annular area of the containment structural steel that misalignment of the embedded plates with structural beams is widespread in Unit 1. In the case of Unit 2 there was an effort to rectify this situation and to install the plates at the proper elevations thus alleviating problems for the as-built conditions. This was not completely successful and as a result there are cases where beams had to be modified in Unit 2. We also learned that the modifications were not performed in the field, but the beams were modified at the fabricator's facility and shipped to the field ready for installation. In view of the evidence that the design engineers are aware of the need for further analysis of these connections and that further action is under way we did not pursue this matter further.

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Another item which is related to this area of containment pertains to the connection of the beams to the columns in the annular steel. Examination of the shop drawings revealed that in order to accommodate welds between connecting angles and the beams framing into columns, not perpendicular to the columns, the axis of the beams was shifted by one inch from the centroidal axis of the column. This resulted in an eccentricity with respect to the column, which in turn induced torsion in the column. We have found that this was not accounted for in the analysis completed via a computer program and that it violates the Structural Design Criteria, SD-66 (Reference 1.3) and Section 1.15.3 of the AISC Specification (Reference 4.____). In our opinion, the effect of torsion induced in the columns is to increase stresses in the members and these stresses should be evaluated to determine the effect on over-all member stresses. We recommended that an appropriate action be taken to assess impact of this eccentricity and an analysis be performed to evaluate the resulting stresses. (Finding 4-19).

to 4.1

The Structural Design Criteria, SD-66 (Reference 1.3) is the controlling document for the structural design of reinforced concrete and structural steel. With respect to the design classification of the seismic category of the Tank Farm structural steel considerable confusion was found. Table 3.3-2 lists the Tank Farm structural steel framing as Non-Category I with a requirement that earthquake loading shall be in accordance with the Uniform Building Code with a perplexing note covering manhole covers. Furthermore, a requirement for the design for tornado pressure is listed. Paragraph 4.4.2.6.5 of the criteria states that the roof shall be considered expendable and allowed to fail during a tornado. However, Revision 1 to the document, dated November 30, 1982 deleted the Tank

to 4.1

Farm structural steel from the listing of Non-Category I in Section 3.2 and listed it under Category I in Section 3.1. This leaves the tornado requirement unclear at the present. While it was apparently the intention to change the designation to Category I in November of 1982, ~~it~~ the structure was considered Non-Category I from the original issue date of the criteria document of October 19, 1976. During the time period between October 19, 1976 and November 30, 1982, the calculations for the structural steel, Calculation No. WB-61 (Reference 4.____), were performed without a strict adherence to either Non-Category I or Category I requirements. ~~(Reference 4.____).~~

In the latest revision to the FSAR Table 3.7(B)-22 ~~lists~~ the Tank Farm steel framing over the Refueling Water Storage Tank is listed as Non-Category I with the caveat that it is designed not to collapse under SSE.

For most Category I Structures which are exposed to tornado pressure, Table 3.3-1 in the criteria document requires a design for tornado pressure. This leaves in doubt, the tornado requirements for the Tank Farm structural steel and the associated concrete roof slabs. Calculation No. WB-61 indicates no design for tornado for the structural steel.

The Tank Farm structural steel is Seismic Category I. The calculations and drawings are all classified as Category I which is the design intent at this time. The design load combinations listed in Calculation No. WB-61, Sheet 10 of 79, dated September 28, 1978 (Reference 4.____) omits load combinations containing the SSE. This violates SD-66, Structural Design Criteria, Table 5.4-2 (Reference 1.3) (Finding 4-6)

UE&C stated that the OBE load combination always controls for the design of the structural steel beams, and that this statement with a justification will be incorporated into the structural design calculations.

A structural steel beam, Mark B9, located on the El. 81' roof along Column Line 0.5 was designed for dead loads, live loads, and seismic OBE loads in Calculation No. WB-61, sheet 17 of 79, checked September 28, 1978 (Reference 4.34). Later a redesign was made to add the sag rod loads to the dead loads, live loads, and seismic OBE loads (Sheets 9I and 9J of 79, checked November 3, 1979). The original calculation (WB-61, Sheet 17 of 79, checked on September 28, 1976) was not voided as required by GEDP-0005, "Procedure for Preparation, Documentation and Control of Structural Calculations," Paragraph IID, Revision 0, May 21, 1974 (Reference 4.____). Subsequently, another calculation was made (WB-61, Appendix A, Sheet 10 of 16, Rev. 3, checked on June 17, 1981) which added a pipe support load, but neglected the sag rod loads.

Again the previous calculation was not voided. The SSE pipe support load was incorrectly combined with beam OBE loading and designed for SEE allowable stresses. The neglected loads and the combining of OBE and SSE violates SD-66, Structural Design Criteria, Rev. 1, (Reference 1.3) and was noted as a finding (Finding 4-8).

The fact that there was some confusion over whether or not the structural steel was Seismic Category I probably led to the type of problems described above. It is the team's understanding that the beams will be evaluated as Seismic Category I in a systematic application of all load combinations.

4.1

Consider deletion

The roof slab of the Tank Farm structure was designed as Seismic Category I, although the Supervising Discipline Engineer stated that the roof was Non-Seismic Category I. SD-66, Structural Design Criteria (Reference 1.3) is silent on the matter.

The calculations for the reinforced concrete walls along Column Lines 4.5 and 5.0 are contained on sheets 8 and 9 of 13, UE&C Calculation No. WB-68 (Reference 4.34). The calculations were based upon the method described on page 351 of the "ACI Design Handbook," SP-17(73) (Reference 4.____) in accordance with the strength design method of ACI 318-71. The method is appropriate for reinforced concrete sections subject to combined bending and axial load when the section is controlled by tension. The calculation procedure is described in Flexure Example 3 of ACI SP-17(73) ~~(Reference 4.____)~~ which neglects any compressive reinforcement. The calculations did not indicate an adjustment of the value of Ø. The results of the calculations indicated a requirement for reinforcing less than that which would be required by a correct calculation. The tendency of the designers to provide more reinforcing than actually required by design may mean that sufficient reinforcing is in fact present for the revised calculations. This appears to be a systematic error for the Tank Farm walls and; therefore, the team recommends a review of all the design of reinforced concrete members subject to combined bending and compression. This failure to correctly execute the design in accordance with the design reference was noted as a finding (Finding 4-10).

Bracing within the structural steel framing is provided for resistance to lateral loads such as tornado and earthquake loads. The calculations for the design of

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bracing are contained in Calculation No. WB-61 (Reference 4.34). Total seismic shear loads were obtained from Calculation No. SB SAG-SWB (Reference 4.41). The loads in the bracing ~~was~~ were established in an approximate manner. The actual distribution is more complex than that assumed; namely, it is dependent upon relative stiffness. However, the determination of the distribution of shear forces is dependent upon a knowledge of the sizes of the bracing and columns which, of course, were initially not known to the designer. Additionally, UE&C did indicate the OBE will control the design of the structural steel beams as opposed to the SSE, but it is not clear that the OBE will control the design of bracing. At this point, a reanalysis and, if necessary a redesign, of the bracing is in order. The team recommends a more accurate determination of shear distribution and a recheck of stresses, based upon the fact that the column and bracing sizes are now known. The bracing in the Tank Farm should be checked with newly calculated seismic forces for both OBE and SSE in accordance in Table 5.4-2 of SD-66 (Reference 1.3). This failure to utilize all required load combinations and actual member properties in the calculations was noted as a finding (Finding 4-6)

Introduction needed into Design Changes and Field Changes

At UE&C's headquarters in Philadelphia, a group called Structural Site Support Engineering has been established on the project independent of the project Structural Engineering group to address ~~chan~~ design changes. This group acts in support of and approves the work done by engineering forces (Site Engineering) on site at the Seabrook Plant.

1.3 to 4.1

In general, Site Engineering is apprised of a problem encountered during construction. Site Engineering will either propose a solution or will request a solution from Site Support Engineering. The proposed solution will be

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1.3

reviewed for approval by Site Support Engineering or an alternative will be provided.

A typical example of this process is Engineering Change Authorization, ECA 01/4217. Several pipe supports were required to penetrate the roof of the Tank Farm at elevation 71'-0". In Rev. A, Site Engineering recommended cutting the concrete by scoring the openings and chipping the concrete. Rev. B added reinforcing steel, cutting and replacement details and steel removal and replacement and Steel WT's tee sections. Revisions continued through Rev. E which incorporated additional details. During this process there was continuing dialogue between the site and the home office. move to 4.8

Site Engineering also prepares calculations. ~~which~~ This effort is now under the control of Field Administration Construction Procedure (FACP) No. 10, original issue was dated 3/11/83 and Revision 1 dated 10/27/83 (Reference 4.____). The majority of calculations concerned misalignments of structural steel connections. The usual case involved a misalignment of bolt holes, which required a replacement connection made ~~with~~ by welding. The welding was designed to provide the equivalent strength of the bolts, even though the actual forces might be less while this resulted in an overly conservative connection, it did eliminate several cycles of communication concerning design load requirements.

YAEC also participated in resolution of ECA's and NCR's which might have serious impact upon the project and which could not be considered routine. Two such issues were being addressed during the early stages of the project.

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In many pipe support details, it is necessary to butt weld a thick plate at right angles to an embedment plate. In approximately 20 cases the right angle plate has pulled out a portion of the embedment plate by lam~~inar~~ellar tearing.

Similar problems occurred previously in welding of annulus steel. The fact that the problem again came up was that there was no welding or material review, nor was there any general communication issued to alert all designers of supports to the problem of lam~~inar~~ellar tearing. The problem has not been resolved, but the tentatively consideration is ~~being given~~ to change ~~ing~~ steel from ASTM A-36 to Lukens Fine Line 516. ~~Both Mr. Ken Williams and Mr. Robert Tucker of YAEC~~ YAEC personne are involved in the resolution.

Hilti Bolts are being used in the drift eliminator of the Cooling Towers. Due to corrosion potential, the Hilti bolts are desired in Stainless steel. However, the required length was not available in stainless steel; therefore, a greater length is anticipated. A meeting was scheduled to resolve this matter.

Another concern was raised by A. Cerne of Region I concerning back to back and corner installations. This item was addressed and it was found that for the specific cases there was no negative effect.

The overall assessment of the design controls in the area of design of structural elements indicates that the design utilized the design criteria and provided adequate margins of safety with regard to the code allowables. The staff appeared to consist of experienced engineers thoroughly familiar with sound knowledge of their profession. We do not expect that the neglect additional stresses produced by the modification of the beams (Finding 4-13) or eccentricities of columns (Finding 4.19) will result in a drammatic reduction of the margins with respect to the code allowable. The team concluded that the structural elements examined have adequate capability to resist the expected design loads.

1/16/84

Document Name:

SECTION 4.4 - SEABROOK IDI

Requestor's ID:

EILEEN

Author's Name:

G. Harstead

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Design for Supported Mechanical Systems and Components

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4.4 Design for Supported Mechanical Systems and Components

The objectives of this portion of the inspection were to examine the coordination between the design of the mechanical components, the support structure, and the design of structural elements. The two tanks selected for review were the Refueling Water Storage Tank (RWST) and the Spray Additive Tank (SAT). Both tanks are part of the containment spray system and are located in the Tank Farm structure.

Both tanks are supported at their bases and are anchored into the fill concrete by means of high strength anchor bolts.

The seismic load for the Spray Additive Tank (SAT) ~~is~~ was obtained by assuming horizontal and vertical accelerations equal to 1.5 times the peak of the ground response spectra. This equivalent static analysis was completed in conformance with the method as provided for in Section 3.7(B).3.1 of the FSAR, but the analysis method was not defined in the procurement specification for the tank. ~~This is very likely a very conservative value and the anchor bolts were conservatively designed. Therefore, in spite of the tall configuration of the tank the tank and supports are very conservatively designed. While the method of seismic analysis is in accordance with the NRC SRP, it was not listed in the specifications.~~

The Refueling Water Storage Tank (RWST) was purchased from Pittsburgh-Des Moines (PDM) under UE&C Specification 9763-006-246-1 (Reference 3.52). PDM prepared design calculations for the RWST (Reference 3.196); however, two errors of omission were noted. One, in calculating the stiffness of the cylinder only the overall bending stiffness was considered, with the shear stiffness being neglected. Two, only the fundamental frequency was calculated, neglecting higher modes.

A reanalysis could indicate greater design seismic loads; however, it appeared that the thickness of the cylinder could accommodate somewhat greater meridional compressive stresses. Also, there appeared to be additional capacity in the anchor bolts. The team does not expect that there would be a requirement for material changes as a result of a reanalysis; however, such a reanalysis is necessary to meet the requirements of the specifications and good engineering practice. (Finding 4-16)

The review of the tank calculations prepared by PDM was the responsibility of the Mechanical Analysis Group (MAG), UE&C. The design responsibility of the anchor bolts was divided between organizations ~~split with~~ PDM specifying the bolt diameter and steel designation and the UE&C Seabrook Project, Structural, was responsible for the design of the embedment length and local reinforcing if required. The number, size, and type of bolts required by PDM was observed in the as-built condition.

The pipe support which was located on the structural steel Beam B-9 discussed in Section 4.3, was relocated so that the support was anchored into the concrete wall located parallel to and adjacent to Column Line E.7 in the Tank Farm instead of being supported by the structural steel beam. The sketches for the relocated pipe support structure were designed and presented on Drawing ~~No.~~ 97[illegible]-M-8018335, Support No. M/S-1833-RG-04, Sheets 13 through 17, Rev. 5, 8/10/83 (Reference 4.____).

During a field visit, the support was observed. A comparison of the field installation with the design drawings indicated that the several of members were larger than required by the design. The team had no questions relative

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to these discrepancies in view of the oversized members. By changing the support from the structural steel beam, B-9, to the concrete wall, problems which could be caused in the design of the steel beam were eliminated, however as noted in Section 4.3 a finding was made on this subject.

Summary & Conclusions addressing the elements of Design Control

1/16/84

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SECTION 4.5 - SEABROOK IDI

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Author's Name:
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Document Comments:
Design for Supported Electrical Systems

4.5 Design for Supported Electrical Systems

The objective of this portion of the inspection was to review selective samples of specific designs related to the structural support of electrical systems in order to assess the interface between the electrical and civil-structural disciplines for design. Specifically, a determination was to be made as to whether:

(1) The licensee's design commitments contained in the FSAR and other relevant documents have been met

(2) Correct design information had been coordinated and complete interfaces made through a logical design process

(3) The completed design was adequate

The inspection in this area was conducted by a review of the lateral cable tray supports being designed by ~~an~~ UE&C engineering design group located just off-site from the Seabrook plant. Organizationally the group is part of the UE&C Site Engineering Group, which is under the supervision of a project engineering manager and a Technical Staff manager. The Group is known as the Cable Tray Bracing Task Group. This Group at the site completes work on the cable tray support systems which are under the technical control of the Mechanical Analysis Group for Electrical and Equipment in the home office. The home office group reports to a different project engineering manager, known as the project system engineering manager.

The home office group is responsible for the development of the detailed design procedures and related guidance and in the current mode of operation, performs the analysis to complete the necessary design for the vertical loads on the tray supports. The site group is then responsible for the analysis and design for the lateral loads which is completed by making necessary modifications to the design which has been completed by the home office. The completed calculations and drawings by the site group are then sent to the home office for final review and the incorporation into the final design documentation, which includes the desjgn for vertical and lateral loads.

The design of cable tray supports for the Seabrook project is governed by the document known as the "Technical Guide for the Design and Analysis of Seismic Category I Cable Tray Support Systems" (Reference 4.____). The team's effort in the area of the cable tray support design included a review of the technical content and details contained in this Guide as well as the execution of the design. The Guide is considered to be a controlled design document for the project on the basis that individual copies of the Guide are assigned to specific individuals by copy number. The development of this technical guide was the responsibility of the Mechanical Analysis Group which is a staff group reporting to the Chief Engineer of Power.

The analysis and design procedures provided in the Guide are the result of combining the results of actual test data for various components or elements of the tray support system with analytical procedures and the use, in many instances, of a bounding type assumption in order to realize a workable design procedure so that each and very design solution is not unique. A review was made of the specific FSAR commitments regarding the design of the cable tray support system. The relevant commitments were noted to be in Sections 1.8, 3.2, 3.7.3, Table 3.7(B)-23, 8.1 and 8.3 of the FSAR. Certain aspects of conformance to these commitments were reviewed and discussed by the NRC's Office of Nuclear Reactor Regulation prior to the team's effort (Reference 4.____). The team's effort was to interface with completed actions by NRR and their understanding of the design execution and to verify that the supports to the trays were indeed designed as Category I structures.

Only general and very limited commitments were found in the FSAR with regard to the manner in which the analysis and design of the cable tray support system would be executed. Note 5 to Table 3.2-1 in the FSAR stated that "qualification of the conduit and cable tray raceways for the Class 1E safety related circuits have been confirmed by analysis, and calculations verify the adequacy of the systems based on the properties of the raceways (including tray where applicable) and support components." In Section 3.7.3 of the FSAR one of the methods of seismic analysis for subsystems noted for the project utilized the cable tray support system as an example of application of the dynamic analysis method technique using the modal response spectrum technique. Diagrams were provided in FSAR Figures 3.7(B)-31 and -32 to illustrate a typical ceiling to floor cable tray support as well as a mathematical model representation which was used in the dynamic analysis. This constituted the majority of the analyses and design details provided in the FSAR. No inconsistencies between the FSAR and the Technical Guide were found during the review. The bases for the design of the Category I cable tray support systems ~~was~~ were judged to be well founded on a combination of test data in two areas and accepted analytical and design processes.

~~which are based on test data in two areas.~~ The first test area dealt with the actual, Static, Biaxial (combined vertical and horizontal) load testing of cable tray sections and the utilization of the resulting load-deflection curves to determine the load capacity at the tray's yield point, the load capacity at the state of local plastic behavior and then the ultimate load capacity. The team did not review the documents related to the actual test program. We did however establish how the allowable cable tray load limits were developed from the test data. UE&C defined the allowable loads on the basis of tray deflections being limited to no more than 12 inches in any direction based on electrical cable deflection limitations. The cable tray tests indicated much lower values for deflection under the loadings, such as under 1 inch at defined yield. Tray testing included the two configurations of trays which would be the most flexible (the 12" and 24" ladder type). These tests, in addition to the load deflection curves, also provided data on the effective member properties which could then be utilized in the structural model for analysis. The simplified structural models integrated the cable trays and the tray support system, consistent with the actual design configuration. These models were then utilized in standard structural analysis techniques to obtain dynamic responses and internal forces for the structural assemblies. Testing was again utilized by UE&C to establish the ultimate load capacity, ~~for~~ under various types of loadings including both levels of seismic, for typical configurations of joints and members. The load capacity of other structural members such as the cold-formed strut material or structural steel was established by the manufacturer's data or by use of existing codes such as the AISC, Specification (Reference 4. ——).

The design criteria for the cable tray support system defines three loading combinations and two stress or behavior levels. The dead weight alone and the dead weight of the tray plus the cable and the OBE loading are to maintain the support system in the elastic range. The dead weight of the tray plus the cable and the SSE loading allows some excursion into the plastic range, yet assures structural integrity. The design philosophy also encompasses the use of the largest yet most flexible cable tray configuration so that the resultant loads into the vertical support members are maximized. The bracing members are used to increase the fundamental frequency of the system and therefore ~~move~~ shift the response away from the peak response region. Damping has been taken as 4% for the OBE and 7% for the SSE which is as provided for in the FSAR.

Section 6.0 of the Guide provides detailed instructions on the execution of the analysis. It was noted that mass points were required to be located no further apart than 36" in order to more accurately reflect the behavior of the tray system which is generally supported at 10 foot spans or less. The various standard configurations are provided as well as the types of permitted lateral bracing and the design details which must be addressed for each type. The various types include the single support transverse bracing, two sided bracing, multiple support transverse bracing and axial bracing. Guidance is also provided on thermal considerations, torsion, buckling as well as welding and attachment to concrete. For situations where the cable tray support system is connected to main building structural elements which have different amplified response spectra, provisions are made for using envelope spectra or by a carry-over type analysis from one response spectra area to another. The dynamic analysis can be completed using a equivalent static load using the peak value

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with a 1.5 factor or utilize a dynamic analysis both of which ~~is~~ are in accordance with approved NRC methods. Documentation requirements are delineated and standard calculation forms for cable tray supports are provided.

The Appendices to the Technical Guide address in detail the related information necessary to perform the design of cable tray support systems.

The sample calculations selected by the team for review to assess the manner of execution of the design and to assess the adequacy of the resulting design ~~was~~ were a series of calculations related to the lateral support of cable trays in the Control Building. They were prepared by the Cable Tray Bracing Group at the Seabrook site in the Site Engineering organization and transmitted by a memo dated August 2, 1983 from Site Engineering to the home office (Reference 4.____). This submittal contained calculations in the southwest quadrant of the plan for Elevation 21 1/2' in the Control Building as shown on UE&C Drawing F-310449 (Reference 4.____). The calculations included the analysis and design for eleven separate sections of multilevel and multibay cable tray supports. Preliminary calculations for Section SW-3 (Reference 4.____) were selected for review. All assumptions were noted and those which required future verification were so marked such as the assumption that the amplified response spectra are final. This was found to be consistent with the procedures defining the completion, control and documentation for calculations. Specifically those procedures consist of GEDP-0005, "Preparation, Documentation and Control of Calculations" (Reference 4.____) and AP-22, "Calculations" (Reference 4.____). AP-22 takes the corporate design procedures contained in GEDP-0005 and defines in more detail how the intent of GEDP-0005 is to be met for the Seabrook Project. It was noted that AP-22, Appendix O which addresses the requirements specific to the Site Engineering group with regards to types of calculations completed, indicates that the Group is authorized to perform support design modifications to electrical systems. The work being completed by this group is in fact modifications to the vertical support system designed in the home office by the Mechanical Analysis Group (MAG) to accommodate lateral loads. With regard to GEDP-0005 it is noted that AP-22 would require the work being done by the Cable Tray Bracing Task Group to follow FACP-10, "Procedure for Site Calculations" (Reference 4.____) except that it is stated that where required individual disciplines may use separate guidelines for calculations.

The references utilized in the calculations, whether specific to the project such as those providing the details, for example of support type vs. the critical vertical and horizontal frequencies of that configuration to those which include standard text books, handbooks and vendor's catalogs on engineering details were provided. Two of the three vendor catalog references utilized for strut material and hardware data utilized in the calculations for Section SW-3 were used in the verification process by the team. No discrepancies were found and the interpretation and application of the data was judged to be correct. It was noted in the calculations that where several individual bents of laterally unconnected support frames are subsequently tied togehter laterally through braces that UE&C utilizes the square-root of the sum of the squares (SRSS) method to combine lateral loads. The team had no disagreement with this concept. In general there appears to be significant margins in the tray support system due to the simplifying assumptions made to minimize the number of unique designs required. For example, the worst tray cross-section is used, supports are designed in general for 10' spans of trays, in most instances the static load of 1.5 times the peak of the enveloping response spectra is used and the member/joint type selected usually has a capacity significantly greater than required.

The procedures and execution of the design of the cable tray support system for lateral loads were reviewed against the requirements of Section 4, Design Process, Section 5, Interface Control and Section 7, Document Control of ANSI N45.2.11-1974 (Reference 4 _____) to which the project is commited (see AP-22, Section 1, p. 1). The design activities were found to be prescribed in specifications, procedures and the Technical Guide for this task. These documents provide adequate control of the design execution to be complete by the individual designers. The design assumptions and design input were clearly defined and the associated calculations clearly identifiable by subject, originator, reviewer and associated dates. The standardized sheets for calculation title sheet, calculation control sheet, table of contents, status of revisions, assumptions and references has resulted in complete and fully adequate calculation packages. The interfaces are well defined and understood as the information flows from the electrical group, MAG and the Site Engineering group. The lines of communication were judged to be well defined and established. The documentation examined proved an excellent example of a package of work completed by Site Engineering, Cable Tray Bracing Group and transmitted to MAG for final review and concurrence as well as integration into the total package of calculations for the cable tray support system.

Based on the team's review of this specific area of engineering and design effort, UE&C's design control appeared to be very good. No findings were made. All licensing design commitments selected for review were reflected in the design documents being utilized for the project. In addition, more detailed design criteria and procedures have been developed and are being utilized on the project. The design process has been quite clearly defined and developed in the Technical Guide for the Design and Analysis of Seismic Category I Cable Tray Support Systems. Correct design inputs and design information have resulted from the systematic application of the Technical Guide based on the team's review. The specific review of Section SW-3 of the cable tray support system in the Control Building ~~was~~ resulted in a determin~~ed~~ation ~~to be~~ that the design was fully adequate. It was apparent that a great deal of engineering effort was expended, including substantial testing where it was apparently determined that actual test data would add to the reliability of the engineering and design process in the evolution of this design guidance. Whether this was a joint decision by UE&C and YAEC/PSNH or a singular decision, the project is to be comended for a well organized design process for cable tray support systems and one which is adequately controlled based on the team's limited sample.

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Design of Supported I&C Systems

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F 4-23

4.6 Design of Supported I&C Systems

The objective of this portion of the inspection was to determine for a sample of instrumentation and control systems whether:

(1) The ~~equipment procurement~~ analysis and design process ~~is~~ was executed in accordance with the appropriate procedures and in conformance with the guidelines contained in the licensee commitments and the Quality Assurance Manual,

(2) Correct design information related to the support of the I&C systems has been coordinated and complete interfaces made in a controlled design process, and

(3) The completed design for supports was adequate.

The equipment selected for this inspection was an instrumentation rack designated as MM-IR-14, located in the equipment vault at approximately elevation 3'~~-2"~~, west of Column Line D and north of Column Line 1.

The purchasing of the equipment such as this rack is controlled by the Administrative Procedure (AP) No. 18, dated May 31, 1974. This procedure has been revised several times, the last being Revision 5, dated November 1, 1983 (Reference 4.13). It describes the procedure for preparation of the suggested bidders list, material requisition, bid analysis approval by the Yankee Atomic Electric Company (YAEC), issuance of purchase order and change orders.

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The provisions of the AP-18 are coordinated with the AP-36, "Control of Seismic Design", issued on May 14, 1980, the current issue being Revision 2, dated October 14, 1983 (Reference 4 ——). This procedure addresses the control of seismic analysis and seismic design of structures, systems and components and defines the responsibilities of the project personnel and staff groups for the Seabrook project. It also describes the requirements for the development and control of amplified response spectra (ARS) in accordance with General Engineering and Design Procedure (GEDP)-0012 (Reference 4 ——), except for deviations as identified in AP-2 8, "General Engineering and Design Procedure (Seabrook), (Reference)

move to 4.2

From the documents which we have reviewed it appears that the ~~pivoted~~ pivotal figure in the interfacing between various disciplines is the Coordinator of Seismic Design (CSD). His role has been mentioned briefly in Section 4.2 in connection with development of ARS for piping supports. Similarly, in the case of equipment supports, the CSD becomes the nerve center of coordination of the design effort in interfacing between project personnel, Structural Analysis Group (SAG), Mechanical Analysis Group (MAG), and Pipe Support Group (PSG). The team judged that introduction of this position in the organization of the staff of UE&C greatly improved coordination of the activities related to the design of structures, systems and components since many separate groups are involved in the complete design process.

In case of MM-IR-14, the I&C Group issued a Staff Work Request (SWR) to MAG, to revise response spectra in order to incorporate instrumentation ~~radis,~~ racks which included Rack No. 14. MAG responded that the ARS tables are not available and requested the Seismic Design Coordinator (CDS) to originate the ARS for the rack at the specified location. The next action was from CDS to the SAG group requesting that the ARS be generated. Upon receipt of the ARS from the SAG, they were distributed to various disciplines, MAG being one of the recipients. Following the provisions of AP-36, MAG developed the loads at the anchor points which have been used, through the SDC, by the structural discipline in the design of the structural steel framing at the location of the rack. Meanwhile, MAG reviewed the vendors seismic qualification report with respect to specification for the rack and was found to be acceptable.

We verified that the ARS values used by ~~the Mechanical Analysis Group~~ (MAG) were those provided by ~~the Structural Analysis Group~~ (SAG) through the ~~Seismic Design Coordinator~~ (SDC) as required by the AP-36. We also verified that the values of the final anchor loads generated by the MAG have been based on the information obtained from the vendor's drawings and that they were used by the structural discipline staff in the design of the structural members.

ED. NOTE may want this p. moved into section 4.2

We reviewed the method of development of the ARS by discussion~~s~~ with the cognizant engineers of ~~the~~ SAG and by reviewing the method as described in the Controlled ARS Tables entitled "Amplified Response Spectra for Seismic Category I Structures" (Reference 4.———). These tables undergo controlled updating and distribution in accordance with Administrative Procedure No. 23, "Controlled Documents" (Reference 4.———). The various steps illustrating the complex system of interfacing between various groups and project disciplines is shown in Figure X. It illustrates the complexity of the problem and also shows the vital role of the coordinator of seismic design ~~(CSD)~~ in the process. It has been pointed

move to 4.2

out previously (see Section 4.2) that in the past, the lack of the CSD was responsible for use of incorrect seismic amplified response spectra. The team found evidence of such a design deficiency, which occurred as late as in 1979, in the areas of seismic design of safety related components supported by the containment annulus steel frames. By memorandum SBU-31426, dated November 6, 1979 (Reference 4 ____), UE&C reported to the project manager, YAEC, that the amplified response spectra used in the design was that for the annular steel frame which should have been used. It has been also found that the amplified response spectra for the annulus steel frame had "g" values greater than that used in the component design. The same memorandum informed the project manager that in order to ensure that other discrepancies do not exist in the seismic design, an audit would be performed to ensure that the proper amplified response spectra were used of all items on the Seabrook project. In the case of the Seabrook project it appears that a satisfactory design has been achieved without significant changes to the component. We consider the above as an excellent illustration of the importance of good coordination of design effort between various disciplines in a project of the size and complexity of a nuclear plant.

The amplified response spectra (ARS) are computed by means of a time-history ~~(TH)~~ seismic analysis. The overall dynamic response of the structure is determined by analyzing a model formed by lumping the mass of the structure and the non-movable equipment. These masses are, in most cases, lumped at the floor ~~level,~~ elevations. The masses are connected by weightless elastic beams which represent the structural members between mass points. Torsion is accounted for by considering the eccentricity betwen the center of mass and the center of rigidity. Floor slabs are assumed to be rigid in their own plane.

Each structure is analyzed for two horizontal components and one vertical component for OBE and SSE magnitudes of ground motion. ~~and~~ The common response from the three components are combined by the square-root-of-the-sum-of-squares (SRSS) method.

Local amplification of overall response ~~are~~ is computed by one of the two methods.

In the first method, the slabs, beams and columns are evaluated for a range of frequencies selected for all local frequencies below 33 Hz. An overall stick model is then generated in such a way that at each elevation examined, the summation of the weight of the single-degree-of-freedom (SDOF) modes and the stick model mode equals the total weight. The single degree of freedom systems, representing the computed range of local frequencies are connected to the overall stick model as if they were all rigid. The stick model (including the SDOF's) is then analyzed using the ground motion artificial time history as the input forcing function.

The other method consists of performing a dynamic analysis, using finite lements, in sufficie t detail to predict local modes of vibration. In this case the input forcing function, at the elevation of the structural element, is the response time history from the overall stick model.

The frequency and time history analyses are performed using the STARDYNE computer program. As a result, the maximum response of a series of SDOF oscillators is obtained, over a range of frequencies and the plot of these values is the amplified response spectrum, which is generated using the SAG058 computer program (Reference 4. ____). The SAG054 computer code is then used to generate ARS tables by enveloping raw curves generated by SAG058 (Reference 4. ____) and spreading the peaks by 10 percent or more in accordance with the requirements of Regulatory Guide 1.122.

We found that the methods of generating the amplified response spectra described above are acceptable.

While reviewing the ~~seismic~~ mathematical model of a stairwell of the floor frame used by SAG to generate the ARS we noted that the location of the platform at approximately elevation 3' ~~4"~~ was incorrect when compared to the structural drawing F-101558, Rev. 6, dated 7/9/82 (Reference 4. ____). Since the model iteself was dimensioned correctly, the relative displacement of the model in relation to the reference points will not affect the results of the SAG's analysis. We found, however, that an observation is in order to point out the apparent lack of attention to the details on the part of the SAG analyst and the checker (Observation 4.~~19~~ 4.13).

ED. expand here to tie into Observation

In our inspection we observed that the structural design drawings Nos. F-101558 and F-101562 have been released for construction on September 28, 1976 and July 6, 1978 (References 4. ____ and 4. ____) respectively and the structural design calculations, Calculation PB-76 have been completed on December 1, 1983 (Reference 4. ____). We requested that the original structural design calculations, from which the above design drawings were prepared and the members fabricated and installed, be presented for inspection. The original design calculations could not be found and we concluded that the absence of such computations constitutes violation of AP No. 22, "Calculations" Section 2.3.1, Revision 5, October 1, 1975 (Reference 4. ____) (Finding 4.20).

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to 4.1

Review of the Calculation No. PB-76, Rev. 0, dated December 1, 1983 revealed that when the designer considered different load combination equation involving seismic loads (OBE or SSE) the live load had been omitted. We considered this to be in violation of "Structural Design Criteria" SD-66 Rev. 1, November 30, 1982, Section 4.2.1 and Table 5.4-2 (Reference 4.). We discussed this matter with the staff of the Structural Discipline. They presented an argument that this is consistent with sound engineering practice since during operation of the plant there will be no load (such as people or material) which could be classified as live load. Furthermore, the footnote pertaining to Table 4.2-1, of SD-66, "Uniformly Distributed Live Load" states that: "Uniformly distributed live load" shall not be considered with seismic load conditions except loads which are marked "Permanent". Examimination of Table 4.2-1 revealed that with two exceptions (150 psf in control building at approximately Elevation (+) 9'~~-6"~~) the only live load listed as "permanent" is snow. In our opinion, such a classification of the live load practically eliminates consideration of live load from structural design in combination with seismic loads. This is contrary to the statement in FSAR Section 3.8.4.3.a.1(b), "live loads" which states that "Live loads are all temporary gravity loads including but not limited to normal snow loads, conventionally distributed and concentrated floor loads, and movable equipment loads, such as cranes and hoists". Additionally, omission of live loads from load combination equations violates the requirements of Section 4.2.1 of the SD-66 which states that "except for the Administration and Service Buildings the minimum live load shall be 100 PSF". We do not object to the statement in the same section of the SD-66 which states that "When actual equipment loads are used, uniformly distributed live loads need not be applied to the area covered by the equipment." In the final analyses the actual equipment loads may be used unless estimated uniformly distributed live loads are greater than the actual loads, in which case the members designed with estimated loads may be revised or left as originally designed". We do, however, find it objectionable to remove live loads from the areas away from the equipment.

We asked the staff if the floor live loads presently are or will be posted in order to prevent an inadvertent overloading on any area and we have been informed that they are not posted now and that such action is not planned for the future. ~~Consequently to the above finding regarding live loads has been filed (Finding 4.23).~~ From the discussions which we had with the UE&C staff we infer that omission of live loads in combination with seismic loads is a wide spread practice and we recommend that in the resolution of this issue an audit be initiated which would assure that the affected structural members are not overstressed when subjected to the load combinations including live and seismic loads. The omission of live loads in combination with seismic loads in floor areas not covered by equipment is considered to be a violation of the structural design criteria (Finding 4.23).

During a tour of the plant, we observed that one leg of the instrumentation rack MM-IR-14 in the Auxiliary Building Equipment Vault at approximately Elevation 3' is resting on a 1/2 inch thick plate instead of the structural member, C10x15.3 as assumed in the design (Calculation PB-76, Rev. 0, dated December 1, 1983, Reference 4). This configuration forms a cantilever with respect to the channel. We concluded that this is contrary to a sound engineering design and recommended that a vertical stiffener plate be provided, welded to the channel, and under the leg of the rack to carry the load to the channel. The reasons for this recommendation are as follows:

a) The ARS have been developed for the supporting structural member not the plate and therefore the dynamic response of the plate supporting the rack will be different from what it has been designed for, and

b) The leg of the rack is situated at the corner of an opening in the plate platform which has been cut out to accommodate vertically ~~running~~ oriented cables. This may be responsible for stress concentration. We reviewed the level of stresses in the plate platform supporting the rack and we found that they are low with respect to the code allowables. For this reason and because the situation just described did not violate any requirements regarding existing codes or procedures we did not consider ~~that filing of~~ this to be a finding ~~would be appropriate~~. We do believe, however, that providing a stiffener plate as described above would improve the design.

In summary, it appears that the process of procurement, and design of supported instrumentation and control systems is well managed and design controls are handled in an effective and efficient way. It would appear from Figure X that the interfacing between different disciplines and staff groups could be more streamlined, but taking into consideration complexity of the problem one can run into a danger of oversimplifying the procedures and bypassing important quality controls which might result in serious inadequacies of design.

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Notes on Figure X

Generation of Anchor Loads

1. I&C requests MAG to provide ARS at a specific location (approximately Elev. 3') for MM-IR-14.

2. The ARS for the MM-IR-14 were not available, therefore MAG requested CSD to generate the ARS.

3. CSD transmitted the request to SAG.

4. SAG generated the ARS and transmitted the information to CSD.

5. CSD distributes the ARS to project discipline and staff groups. Advanced copies immediately, controlled copies approximately every six months.

6. I&C provides ARS to the vendor for preparation of seismic qualification report (SQR).

To d.?

7. Vendor prepares SQR and submits it to I&C for review.

8. I&C forwards the SQR to MAG for review and approval.

9. MAG notifies I&C of acceptability of the SQR.

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10. MAG generates anchor loads and transmits them to the CSD.

11. CSD transmits the anchor loads to the structural discipline for design/verification of structural members.

12. Structural discipline prepares the design calculation and the drawings and releases it for fabrication and construction.

To 4.2

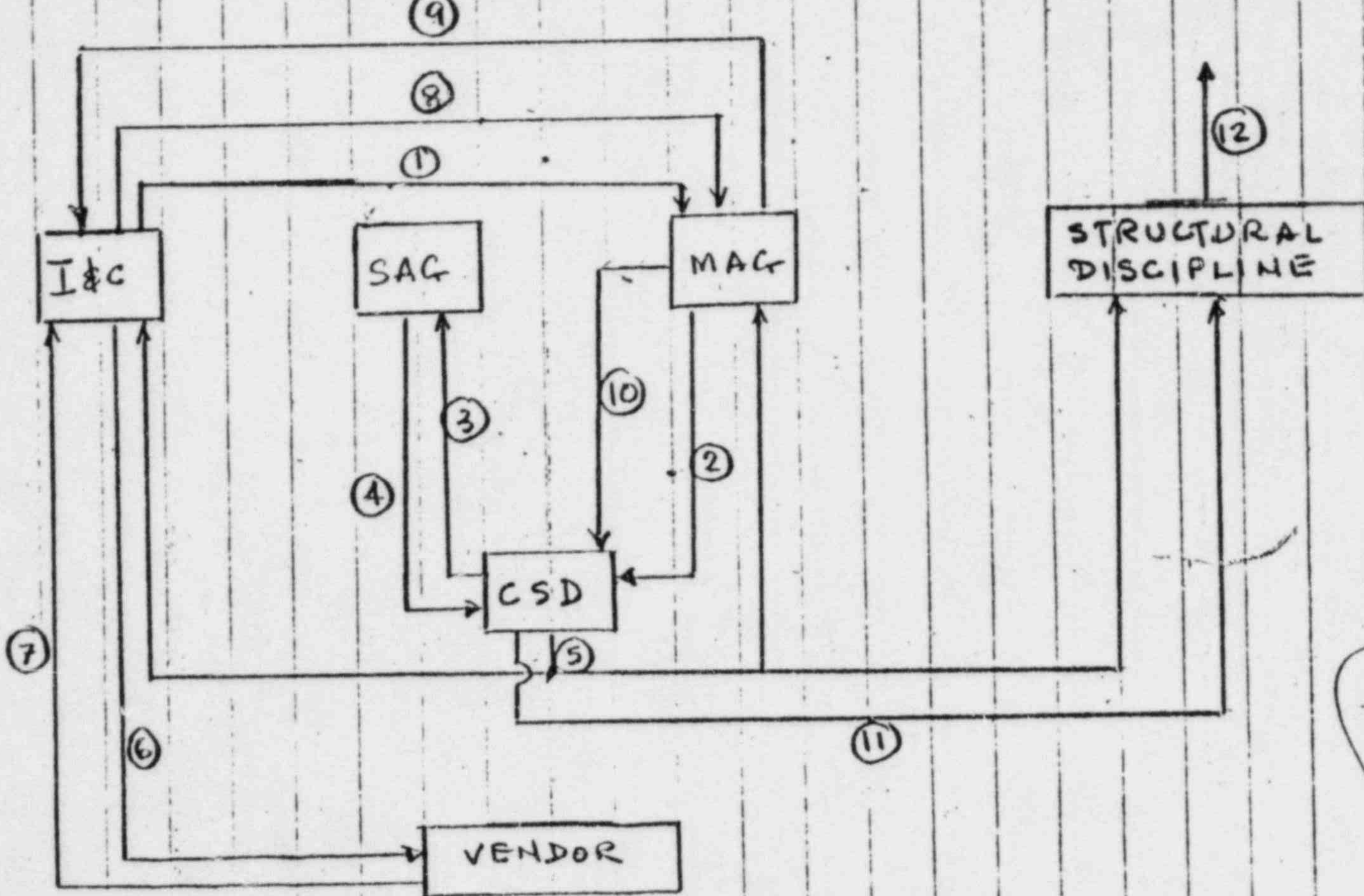

FIG. X

Sh. 1 OF 3

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4.6

to 4.2

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Document Name:
SECTION 4.7 - SEABROOK IDI

Requestor's ID:
EILEEN

Author's Name:
R. Shewmaker

Document Comments:
Subcontractors

F 4-21

4.7 Subcontractors Off-Site

The objectives of this portion of the report were to ascertain:

(1) How the licensee's design commitments being implemented by UE&C were being transmitted and used as input for implementation by several off-site contractors.

(2) The level of control maintained by UE&C over the subcontractor as well as the actual performance of the subcontractor.

(3) The manner in which the subcontractor performed and controlled activities impacting the design of the facility.

In order to complete this phase of the inspection effort a selection was made from a list of subcontractors doing work in the design, engineering and services area of the project. The first subcontractor selected was Prof. Ed Burdette (test verification of certain design assumptions) who was chosen on the basis of an example of direct design related services. The second and third subcontractors were selected on the basis of the volume of work as well as the fact that both represented the next step in the design process beyond the basic design engineering effort completed by UE&C. These were William J. Lester, Inc. (structural steel detailing) and Bethlehem Steel Corporation (detailing, furnishing and fabricating reinforcing steel).

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4.7-2

Burdette Consulting Contract:

In 1980, United Engineers and Constructors (UE&C) contracted Professor Edwin G. Burdette of University of Tennessee, to perform certain tests to establish the load-displacement relationship of the liner plate anchorage system to be embedded on the concrete containment. The objective of these tests was to demonstrate the adequacy of the liner anchorage system to meet the requirements of the ASME Code, Section III, Division 2. We reviewed the available documents pertinent to the tests provided by UE&C. The test program was administered as a part of the Purchase Order No. H.O. 56971, Change Order No. 1, dated 9/29/80 (Ref.). The Procedure for Containment Liner Anchor Load Test (Ref.), required that the specimens be prepared on the Seabrook plant site using the procedures and material approved for construction of the containment structures and shipped to the University of Tennessee for testing. These specimens consisted of 3'-4' x 3'-0" x 2'-3" high concrete blocks with the liner plate attached to the 3'-4" x 3'-0" top face. The embedded anchors consisted of tees 12 inches long and the two studs, 3/4 inch diameter and 12 inches long. We concluded that the specimens used in the tests adequately represented the containment structure and the liner with its embedment system.

The test procedure required that all measuring and test equipment be calibrated before testing and evidence of calibration be available for review. At our request, we were provided with a Testing Machine Verification Certificate, (Ref.) which stated that the 120,000 lb. capacity machine, belonging to University of Tennessee, had been calibrated and the loading ranges have been found accurate with tolerances ranging from 0.42 to 0.83 percent. The calibration was performed by the Tinius Olsen Testing Machine Company, Inc., of Willow Grove, Pennsylvania on June 10, 1980. The load cells output readings found in the report were based on the load readings from the same testing machine referencing the same calibration date.

— Burdette pitying factor test

We concluded that there was sufficient evidence of adequate quality control and that the tests were conducted with an adequate standard of reliability.

Bethlehem Steel Corporation:

The basis of the subcontracted services and in this case material, to Bethlehem Steel Corporation (Behtlehem) by UE&C was the UE&C document, "Specification for Furnishing, Detailing, Fabricating and Delivering Reinforcing Bars" (Reference 4.). This document was issued originally as Rev. 0, 1/24/74 and has undergone ten revisions since that time. A detailed review of the important design information relative to this specification was made by the team with respect to the design commitments of the FSAR and the discussion was noted previously in Section 4.4 of this report. Since the Seabrook project was committed to use the ASME Boiler and Pressure Vessel Code, Section III, Div. 2, the specification imposed stringent requirements for quality assurance. No distinction was made in the specification so that all work and material supplied by Bethlehem was to conform to the ASME Code. The team placed specific emphasis on the manner in which Section CC-2700, Materials Manufacturer's Quality Assurance Programs, were reviewed, accepted and implemented under the requirements of the specification. The rason for this was due to the fact that the Seabrook Project represents the first incorporation

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of the ASME Code, Div. 2 into a plant proceeding to completion. Bethlehem, prior to the start of the Seabrook project, had addressed 10 CFR 50, Appendix B in a quality assurance manual which was undergoing rework early in 1974.

An early version of the Bethlehem Quality Assurance Manual was submitted with the bid in January of 1974 and subsequently reviewed by UE&C. As a result of this review a series of meetings and discussions ensued in order to obtain conformance with the specification. In addition, to meetings held at UE&C ~~on January 23, 1974~~ offices on January 23, 1974, meetings and reviews were held at the Philadelphia Bar Shop of Bethlehem where a QA Audit check list was used to perform a Facility Survey conducted by a QA Audit Engineer from both YAEC and UE&C. The following day similar discussions and audit activities were held at the Steelton, Pa. facility of Bethlehem.

The results of these discussions and audits were documented by YAEC and UE&C as well as by Bethlehem (References and , respectively). The Bethlehem report highlighted the following items.

(1) Interpretations of quality assurance by YAEC and UE&C is more stringent than any seen to date.

(2) QA Manual submitted with the Bethlehem bid proposal was considered unacceptable in its form at that time because of:

(a) Separation of QA for steel production and detailing/fabricating not clear.

(b) Certain items should be removed from the QA Manual and developed into written quality procedures including such items as testing, instrument calibration, drawing and detailing standards and document checking, review and approval.

(c) Needed improvements in document control.

(d) Needed clarification of stop work authority and chain of command.

(e) Needed clarification on control of non-conforming material and identification of material by heats and control of identification after fabrication

(f) Definitive information on the control of quality in the Engineering Department.

(g) Needed personnel/position descriptions and individuals' qualifications.

(h) Needed changes in the Bethlehem Nonconforming Material Report forms.

The report ended with the following statements.

"J. W. Singleton (YAEC) invited us to visit their facility for general review of any of the Quality Assurance Manuals in their possession as an aid in our preparation of manuals.

It appears that our present thinking of the Quality Assurance Manual is right on line provided we have documented quality control procedures available such as described above. I believe they have given us some good pointers which should be to our advantage in the future if we implement them now."

Following these efforts Behtlehem continued to work toward achieving an upgraded quality system including a revised QA Manual and a series of quality procedures based on the interfacing which had been taking place between the three major parties on the reinforcing steel. At the same time Bethlehem was providing comments to UE&C on the specification which had been issued for bidding purposes. A series of correspondence was reviewed in the Bethlehem Seabrook project correspondnece file (File Folders 1-4) over the period from January 1974 through the date of the contract, May 15, 1974 to October 25, 1976 when the Bethlehem QA Program for Seabrook 1 and 2, Rev. 2, 9/26/76 was approved for Fabricated Reinforcing. These documents included other audits performed by UE&C at the various locations where Bethlehem was doing or was to perform work on the Seabrook Project. These documents are included as references to this report (References 4.   through 4.   ). The first transmittal of engineering drawings to Bethlehem ~~were~~ was on July 18, 1975 (Reference 4.   ) and the detailing of Categ~~detailing~~ory I reinforcing steel was authorized by UE&C on June 3, 1976 (Reference 4.   ). It was noted in reviewing the information related to work being processed in the various Bethlehem facilities that the first reinforcing steel shipment was made from Bethlehem's Boston Shop on August 3, 1976 which was prior to the approval of the QA Program by about 3 months.

Explain how & why

In addition to the detailed review of the controls exercised by UE&C over Bethlehem in performance under the contract and the technical and quality requirements of the specification, the team reviewed selected portions of Bethlehem Quality Assurance Manual, the Standard Quality Assurance Program Manual for Fabricated Reinforcing Bars, the Facility Manuals and the Quality Assurance Procedures Manual for Fabricated Reinforcing Bars (References 4. and 4.   ).

The QA Manual (Steel Plants) provides the statements of quality policy for the entire Steel Operations Group and functions as a single source document. . Quality manuals, procedures and instructions at individual plants and shops emanate from this QA Manual. The responsibility for quality programs for the corporation rests with the Office of the Chief Metallurgical Engineer of Steel Operations. As part of the Bethlehem Plant Committee System there is a Corporate Quality Assurance Subcommittee which serves to develop and coordinate quality assurance policy. The Bethlehem QA Manual is in a form so as to address several MIL Standards, ANSI N45.2, ASME B&PV Code, Section III and 10 CFR 50, Appendix B. Section 5 of the Manual includes the specifics of the corporate policy on the quality assurance program as applied to fabricated reinforcing bar. In summary, the following points are addressed in the Manual.

(1) Fabricated Rebar Quality Program is coordinated by the Reinforcing Bar Engineering Group.

(2) The QA Program for Reinforcing Bar Fabricating Shops is consistent at all shops in the country.

(3) The Chief Metallurgist at each plant coordinates reinforcing bar QA policy but at shops (fabrication only) it is addressed by on-site Engineering or a separate quality group.

(4) Audits, final disposition of corrective action and control of records are performed by the Bethlehem Home Office Reinforcing Bar Engineering Group.

(5) The management review for the Fabricated Reinforcing Bar QA Systems is performed by the Corporate QA Coordinator.

The Standard QA Program Manual for Fabricated Reinforcing Bars addresses fifteen of the eighteen criteria of 10 CFR 50, Appendix B, noting that Sections III, IX and XIV which are Design Control, Control of Special Processes, and Inspection, Test and Operating Status respectively, do not apply to the services or products of Bethlehem Steel Corporation. The team did not disagree with the exceptions taken by Bethlehem. The Manual provides a description of the QA organization and the authorities, responsibilities and duties of persons performing the QA functions. It also sets forth the Bethlehem policies for satisfying the QA Program requirements and references the other Bethlehem procedure manuals which describe, in detail, the procedures and instructions for accomplishing the activity.

explain why?

The manner in which the QA Program Manual for Fabricated Reinforcing Bars becomes a specific quality document on a project is that during the proposal or bid stage the Standard Manual is submitted as an uncontrolled document and forms the basis for specific project quality assurance items relative to the contract. With contract award the manual is amended, if required, using an appendix to provide conformance with the client's specific project quality assurance program. At that time, the Manual becomes a controlled quality document.

Bethlehem's next level of control consists of a series of Facility Procedure Manuals appropriate for a given activity and a given Bethlehem facility. These address three basic activities: steel production, detailing reinforcing steel and fabrication of reinforcing steel.

The remaining Procedure Manual is known as the Quality Assurance Procedures Manual for Fabricated Reinforcing Bars. This is a standard manual which details the procedures required to implement the QA Program Manual for Fabricated Reinforcing Bars including the monitoring of the work procedures of the facility manuals for detailing and fabricating reinforcing bars.

The team reviewed selected portions of these manuals in order to assess the programmatic aspects of Bethlehem's ~~program~~ quality system and then to assess manner in which Bethlehem has performed and controlled its activities which impacted the design of the Seabrook facility ~~under their program.~~ The following sections of the Standard Quality Assurance Program Manual for Fabricated Reinforcing Bars were

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reviewed for conformance to 10 CFR 50, Appendix B for the specific use in reinforcing steel detailing and fabricating activities.

Section	Title	Rev. No.	Date
4	Instructions and Procedures	2	1/1/79
5	Document Control	2	1/1/79
8	Inspection	2	1/1/79
12	Nonconforming Materials	2	1/1/79
13	Corrective Action	2	1/1/79
14	Quality Assurance Records	2	1/1/79
15	Audits	2	1/1/79
16	Special Contract Requirements	2	1/1/79
	including Appendix A, Special Quality Assurance Requirements for Seabrook Station	4	4/26/79

Several items are of note as a result of the review of these manual sections. Section 8.2 related to the Engineering Department requires a scheduled review to be conducted on the current work of each detailer assigned to nuclear projects. The review is conducted to assure conformance to ACI, CRSI, Bethlehem Steel Corporation Standard and the project specifications. This was viewed by the team to reflect Bethlehem's full commitment to a quality system and assuring that the detailing of reinforcing steel is being done as required by the Project documents. In Appendix A the special requirements imposed by UE&C in Section 3.2 of the specification related to Cadweld sleeve criteria fit were reflected.

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The requirements of CC-5340 of the ASME Code regarding visual examination for transverse cracks which were part of the specification were also reflected in the special requirements of Appendix A. With regard to bar testing, Bethlehem included in Appendix A a procedure defining the mechanical testing of reinforcing bar to meet ASTM A615, the ASME Code, Regulatory Guide 1.15, and the specification. Also contained in the Appendix is a commentary on the Reinforcing Steel QA program, mainly emphasizing the traceability of material from the time it is produced in the steel mill to the time it is fabricated, shipped, received and stored on-site.

check this again are they in Appendix A

With the Quality Assurance Procedures Manual for Fabricated Reinforcing Bars the following procedures were reviewed.

Procedure	Title	Rev. No.	Date
II	Document Control	3	2/1/79
III	Review of Placing Drawings	3	2/1/79
IV	Inspection	4	2/1/79
VII	Nonconforming Items	3	2/1/79
VIII	Corrective Action	2	2/1/79
X	Audits	4	2/1/79

All of these procedures were noted as being very comprehensive and detailed and provide an excellent tool for the personnel who must execute these procedures as well as those who use them in the review, inspection and audit functions.

Two additional procedures, which were specifically associated with the work completed for the Seabrook project were reviewed. The first was "Quality Control Procedure for Fabricated Reinforcing Bars for the Bethlehem Plant, Engineering Department, Detailing," Procedure No. I., Rev. 1, 6/1/81 (Reference 4._). The second was the "Quality Control Procedure for Steel Operations For In Plant Shop for Fabricating," Procedure No. 1, Rev. 0, 10/14/77 and the Addendum for Steelton Plant, Rev. 0, 11/28/77 (Reference 4.__). These were noted to be adequate to control the detailing and fabricating work that was done and is still underway.

In addition to reviewing the specifications and manuals documenting quality control and compliance with the pertinent codes and standards, we also reviewed shop drawings, generated at the Bethlehem Steel offices in order to verify their conformance with the design drawings produced by UE&C.

We learned from the Bethlehem staff that the reinforcing steel which ~~have been~~ were detailed at the Bethlehem home office were for the following elements of the containment structures:

(1) Reactor Pit

(2) Containment slab, El. (-)26'

(3) Personnel and equipment hatch

(4) Containment dome - Unit #1 has been completed, Unit #2 is being worked on. Exotic bars (around openings and out of plane bending) are detailed at the Philadelphia office.

(5) Primary shield wall, approximate elevations (-)25' to (-)2'

(6) Containment building slab, El. 0'

Detailing of reinforcing bars for other structures has been done either at the Boston or Philadelphia offices. During our inspection in Bethlehem, Pa., we reviewed some of the drawings pertaining to the reactor pit and the containment dome, Elevation 119' (the spring line) and the apex. The list of drawings which have been reviewed during the inspection is contained in Section 7.4.1 (References 4.__to 4.__). We ~~have been~~ were informed that the major difference between the Unit 1 and Unit 2 drawings is the fact that in Unit 2, by increasing the length of some of the reinforcing bars, the number of caldweld splices has been reduced. We viewed this as an example of both YAEC and UE&C making improvements in the design details.

Due to complexity of the reinforcing in the congested area of the reactor pit, the detailing was done using a model, which was built by UE&C, showing all the reinforcing steel in actual position. The Bethlehem detailers studied the model and then generated the shop drawings.

While reviewing Bethlehem Drawing No. 017RM31, Rev. 4, dated December 5, 1978 (Reference 4.___) and comparing it with the corresponding UE&C design drawing, Drawing F101402, Rev. 13 dated March 24, 1981 (Reference 4.__), we observed that the spacing of the horizontal stirrups which on the design drawing was 16" apart whereas ~~was shown~~ on the detailed shop drawing the spacing was ~~as~~ 8" apart. The total amount of the reinforcing steel remained unchanged in spite of the change in spacing. The design drawing had not been updated to reflect the change in spacing. The reinforcing steel remained designated in the design drawing as 2x4-#6 @ 16". We found that this is a violation of Administrative Procedure #29, "Document Control - Foreign Print System" Section 8.6.2, Rev. 7, dated April 12, 1983 (Reference 4.__). In all of the drawings reviewed this was the only case where a discrepancy between the design and shop drawing was ~~could be~~ found. This was noted as a finding, but had no generic implications and was judged to be an isolated instance of lack of consistency and to maintain up to date documents (Finding 4-21). UE&C did not revise the engrg dwg to reflect shop dwg details.

A review was made of the nonconformances issued against two of the shops within the Bethlehem organization which provided some of the fabricated material to the Seabrook facility. NCR's for the Albany Shop for 1982 were examined. Four separate reports had been issued, three of which related to incorrect bends which resulted in scrapping the material and rebending from new bar stock and the fourth being an incorrectly recorded heat number which was corrected. NCR's for the Steelton Shop for 1983 were examined. Eleven separate reports had been issued. Of these eleven, five involved bending errors, three involved cutting tolerances, and one each involved a detailing error, mislabeling and missing bars from a bundle. Based on the size of bar and the tonnage of reinforcing steel involved the team judged the number of non-conformances to be low. In all cases corrective action was taken before any of the non-conforming items had been incorporated into any safety-related structures.

Based on the review completed and the work observed the team concluded that the licensee's design commitments had been clearly transmitted to Bethlehem via the specification and the engineering drawings and details. Letter and meeting communications also served as an important part of the total process of providing design interfacing and design input. Bethlehem was viewed to have in-place a good quality system with appropriate quality standards and procedures. The team's sample review indicated that Bethlehem had also executed these procedures well. A system for the review of shop and placing drawings existed as was being effectively implemented in accordance with the Quality Assurance Procedures Manual. A fully adequate system to document and control the records and design changes, thus assuring that all the latest updated input data was being used for the development of shop and placement drawing exists. The Drawing Record Card, the Transmittal Control Form Letter and the Order Entry Record Card have been the keys to good document and records control. Based on the team's observations it is evident that the Bethlehem audit system has been effective in identifying some random errors and assuring that corrective action has been taken.

WJ Lotes Co.

As a result of the team's review and observations of the work of Bethlehem Steel Corporation on the Seabrook project it is the conclusion of the team that the necessary elements of design control have been in existence during the detailing and fabricating of the reinforcing steel for the plant structures. Additionally, we have concluded that these controls have been adequately implemented so as to assure safe structures.

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Document Name:
SECTION 4.8 - SEABROOK IDI

Requestor's ID:
EILEEN

Author's Name:
G. Harstead

Document Comments:
As Built Conditions and Surveys

4.8 As Built Conditions and Surveys

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

(1) How the changes generated in as-built conditions such as structures, systems and component are processed by the UE&C and the contractors.

(2) How the final loads resulting from location of pipe supports, electrical cable trays and ventilating systems, including those not specifically considered in the original design, are verified.

(3) How the drawings and identified supporting documents are updated, maintained and certified, so that the completed work reflects the as-built conditions of the plant for future reference.

The team first reviewed the procedures which were in-place to control this area of plant design and construction. Among the documents which control as-built conditions of structures, systems and components we reviewed those which seem to be the most essential in the process. Those are: Administrative Procedure No. 39, "As-Built Documents", issued on November 17, 1980 (Reference 4.____), Administrative Procedure No. 15, "Changes to Engineering Change Authorization", issued on September 8, 1977, Revision ____ with numerous later revisions (Reference 1.____), Technical Procedure No. 11 (TP-11), "Minimum As-Built Record Drawing Listing, issued on April 29, 1983 (Reference 4.____), Field Administration Construction Procedure, (FACP) No. 10, "Procedure for Field Calculations", issued on March 11, 1983 (Reference 4.____) and ~~FACP~~

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move ahead of FACP-10

No. 1, "Project Instruction for Handling UE&C/Contractor Nonconformance and/or Deficiency Reports", Rev. B, dated July 22, 1983, FACP No. 1, (Reference 4.____).

Currently Administrative Procedure No. 15 has 18 revisions since the original issue, the latest being dated August 17, 1983. It describes how questions and changes to design documents, deemed critical to support on-going field activities, are initiated, processed and resolved. It provides the criteria which the proposed changes must meet in order to be approved, the flow charts which describe the sequence by which various site questions are processed and the forms which should accompany questions raised by the contractor. The questions may require an oral response, the response for information response (RFI) or may require an engineering change authorization (ECA), depending on complexity of the problem. The classification regarding oral communication, RFI's and ECA's can be described using the following guidelines:

(1) If the question only requires an explanation or clarification, the oral response is sufficient.

(2) Request for information (RFI) is prepared when an oral response is not sufficient and design documents are not affected which might have ~~be~~ issued by UE&C (site or Home Office) or drawings issued by ~~the~~ a manufacturer or vendor.

(3) When the question/response requires changes (or exceptions) to engineering documents, such as drawings, specifications, or calculations, the contactor submits a proposed ECA.

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The ECA's are subdivided further as follows:

(a) On-The-Spot ECA's ~~which~~ may be used to resolve all the items except those involving generic problems and those requiring YAEC approval. Any Minor ECA (see below) may be issued On-The-Spot.

(b) Minor ECA's which are of repetitive in nature, e.g., involving movement and arrangement of sister splices in congested area to clear interferences of reinforced steel, modification of approved formwork or substitution of higher strength bolts than the design requirements, that have been reviewed and concurred with the Home Office Engineering, YAEC and QA as being appropriate for release.

(c) Major ECA's are those which are not classified as minor and in turn they are subdivided into two categories:

1. Major specific case ECA's

2. Major generic case ECA's.

ECA's and RFI's may be revised or voided by modifying and reissuing the ECA/RFI form or, in certain circumstances, by the use of the Continuation Sheet. On the Continuation Sheet the affected documents, ~~which is~~ ~~are given in~~ are a listing* on the ECA/RFI form, ~~of all the documents that~~ must be revised or from which an exception is taken as a result of an ECA issue must be provided. ok ?

One of the important differences between the RFI's and ECA's is that the RFI's must not include Affected Documents while the ECA's must include them. Thus when an RFI becomes an ECA (when it has been decided that the change requires change of engineering documents) a new ECA/RFI form is issued together with a Continuation Sheet on which all of the Affected Documents must be listed.

Interdisciplinary coordination of all disciplines involved in the ECA is assured by the requirement that all disciplines that are responsible for the documents listed under Affected Documents must review the ECA.

The AP-15 is used together with the AP-39, "As-Built Documents". AP-39 identifies the drawings and other supporting documents to be updated, maintained and certified that the completed work reflects the as-built conditions of the plant. This assures that the documents can be effectively used for engineering reference in the future for various reasons such as future plant operations, start-up testing, maintenance or modifications. The procedure contains a listing of UE&C documents to be revised to reflect as-built conditions as received from the Construction and Start-up departments. Its Attachment No. 2 provides detailed information in that respect and it addresses inspection elements, including piping configuration, location of supports, as-built UE&C construction drawings and as-built tolerances. The procedure provides very detailed and complete information regarding the type of documents which must be revised to reflect the "As-Built" condition. Included in that category are vendor documents which must be revised to reflect the "as shipped" condition of the item. In case of a modification in the field the drawing must state what is "field modified" and provide the reference to the foreign

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print which shows the "as shipped" condition. Any changes should be processed in accordance with AP-15.

may want to turn this over to duBouchet

AP-39 also provides directions to the UE&C design groups such as the Mechanical Analysis Group (MAG) and the Pipe Support Group (PSG) to perform the final configuration verification analysis documentation for pipe stress analysis for ASME Safety Class 1, 2, 3 and B31.1 Critical Piping and NNS-1 Pipe Supports. The data which should be verified are such as the as-built stiffnesses of supports and restraints, attachment points of supports of supports or restraints to the structure, including ARS verification, etc.

delete Gammal will coord. w/Andy

As-built documents are processed through the Field Office Document Control Center (Field DCC) as shown in Figure 4.8-1. Each contractor has the responsibility to provide the As-built documents. Piping and Pipe Support As-builts are handled through UE&C Power Engineering. The Field DCC records the approximate information and processes it further to the Home Office Document Control Center as shown on the chart. We have been informed that the AP-39 is under review and the future revision, No. 5, is expected to be issued by the end of February, 1984. The reasons for the changes ~~was~~ were not pursued by the team.

AP-39, ~~The procedure,~~ in Attachment No. 3, contains the types of conditions or changes which do not require as-built information and incorporation into UE&C drawings. In this category, we found the reinforcing steel changes. ~~Again~~ We inquired why an important item like reinforcing steel is not required to be recorded to reflect as-built conditions and we ~~have been~~ were informed that this item applies to the cases when the amount of steel is the same as stated on the design drawings but for some reason, usually because of local interferences, some of the reinforcing bars have been moved to one side or the other. We expressed our opinion that the listing does not restrict the discrepancy between the design and as-built conditions in any way and such a deviation could consist of providing reinforcing bars of smaller cross-sectional area, omission of reinforcement in some area altogehter or ~~otherwise~~ some other change that might impact the design. We did not received a satisfactory explanation regarding this matter and we consider this a serious shortcoming of the procedure. We do agree that there are many field situations where a change in placing of reinforcing bars may be tolerated and even sometimes necessary. We believe, however, that the procedure should qualify this statement to avoid gross deviations from the design requirements which could result in an inferior or inadequate structure.

The details of processing as-built documentation identified in AP-39 are described in the Technical Procedure No. 11 (TP-11), "Minimum As-Built Record Drawing Listing". This procedure was issued on April 29, 1983 and ~~was never~~ has not been revised. It is referenced as Appendix No. 4 in the AP-39 and its purpose is to interpret the technical requirements of AP-39 and to establish "detailed identification of the specific UE&C Construction Drawings and UE&C approved Foreign Prints which shall be "As-Built" by the appropriate Seabrook Field Organization." Additionally, the purpose of TP-11 is to organize the drawing listing on a Work Package concept to allow effective engineering verification against the design basis condition and subsequent incorporation of the As-built data into the design drawings. The procedure identifies six disciplines and in each of them there are two individuals named as the coordinators: one in the field and one in the home office.

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consider moving to 4.3 instead of leaving here

Several organizational entities are involved in these programs at UE&C. The beam verification program, which involves a complete check of the structural steel, Site Engineering located at the Seabrook site is responsible to respond to certain ECA's, RFI's and Nonconformance Reports (NCR's). If Site Engineering does not have a proposed solution to offer, the responsibility for resolution of the item is then with Site Support Engineering at the Philadelphia UE&C offices. In some instances the Structural Group in the home office may become involved. YAEC also participates in resolution of these items when there is a potential for a major impact upon the project or they were responsible for the original review on the items or activities involved.

FACP-1 & 10 weren't discussed why ref. them?

(1) Structural Steel ~~Program~~

The procedures for this program are described in "Guidelines for Beam Verification", dated September 19, 1983 (Reference 4.____). The beam verification program was established in order to ensure that all the structural steel beams are designed for all the imposed loads. The treatment of live load is in conformance with SD-66 (Reference 1.3), Table 4.2-1. Note 1, to Table 4.2-1 states that uniformly distributed live load shall not be considered with seismic load conditions except those loads which are marked permanent are included in the calculations.

we agree but ere ave a problem else where - need to resolve

The design of the structural steel beams for the Tank Farm Area as provided in Calculation No. WB-61 (Reference 4.34) was based upon using the uniform snow load which is considered a permanent live load. In this case the procedure in which temporary uniform live loads are replaced by actual loadings was not applied.

Finding?

The beam verification program is ~~subdivided into~~ being executed by two methods; namely, computer and manual calculations. The computer calculations are performed using the STRUDL computer program. The beam to column connections generally are shear type connections which are made by angles welded to the beams web and field bolted to the column or girder. Horizontal forces are taken by means of bracing thus eliminating the need for beam moment connections. The beam to column connections are; therefore, modeled as hinges.

The loadings used are:

(1) dead load (steel and general dead load)

(2) permanent live load (for seismic inertial loads one-half of the snow mass is used)

(3) seismic amplification

(4) pipe support loads and for piping of 4 inch diameter and larger

(5) uniform loads for piping of less than 4 inch diameter

(6) cable tray and bus direct loads conduct loads

Are we going to say any thing about manual calcs and whether all significant loads per (1)-(6) have considered

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and then state here that the BVP goes back to original ARS curves in the program

what about putting this into Section 4.2?

The Structural Analysis Group (SAG) has produced Amplified Response Spectra (ARS's) for various elevations of the building. Vertical ARS's were developed which accounted for the vertical response of steel beams. These ARS's are used in order to qualify equipment which may be located on the interior locations. SAG has also directed that the ARS's be used in the design of the steel beams.

The vertical accelerations are obtained from ARS's. One ARS will determine the acceleration at the support while the other will be used to find the acceleration at mid-span. These vertical acceleration values are developed from the appropriate vertical ARS's by selecting the 50 Hz frequency response for the 4% and 7% equipment damping response curves, for the OBE and SSE, respectively.

The horizontal acceleration values used for beam design are taken from the 33 Hz frequency response for the 4% and 7% equipment damping response curves for OBE and SSE. From these values, a uniform seismic acceleration is established for design.

Because the bottom flange of structural steel is used for the attachment of pipe supports, horizontal loads applied normal to the beam axis can cause torsion in the steel beam. UE&C's procedure calls for checking whether the supported slab remains in contact with the top flange of the steel beam. If the beam were to deflect more than the slab, no capability of transferring torsion to the slab could be assumed.

The Tank Farm structural steel has not been addressed by the beam verification program as yet. The team would recommend that this be done subsequent to any reanalysis for the seismic loads as described in Section 4.2 and addressed in Finding 4-17).

(2) Reinforced Concrete

No specific overall program currently exists ot assess the final loads resulting on concrete structures which would encompass pipe supports, equipment, cable trays, and other systems.

Under AP-39 certified As-Built rebar drawings are not required. The footnote in the Attachment 2 of AP-39 states that contractor drawings will be site foreign printed ?, marked for information and turned over to Home Office Engineering and YAEC ~~Owner~~. The method of monitoring and recording of rebars cut or damaged is described in the Administrative Procedure No. 38, "Cutting Reinforcing Steel in Permanent Concrete Structure", issued September 5, 1980, revised on July 31, 1981 (Reference 4. ___). Our inquiries why the drawings affected by the damaged reinforcing bars are not recorded by the DCC in the field or the Home Office did not produce satisfactory results. As described later, it was found that Site Engineering is maintaining documentation. AP-38 establishes responsibilities of organizations for approval of cutting reinforcing steel during drilling into permanent plant concrete structures.

Procedures for cutting reinforcing bars can be divided in two categories:

(a) When Reserve Capacity Forms (the forms which list reinforcing ~~bars~~ steel as required by calculations, those supplied on drawings and the reserve excess of the bars) are available for a given location, and

(b) When such forms are not available.

When a Reservice Capacity Form for a given area is not available, the approval of all reinforcing steel bar cutting must be reviewed ~~with~~ by the ~~Power Engineering (Home Office)~~ Home Office of UE&C. They check the design calculations to determine if there is an adequate margin available to permit the proposed reinforcing bar cutting. If it is permissible, approval of such a cutting is documented by engineering change notice (ECA) or nonconformance report (NCR). When a Reserve Capacity Form for a given location is available, the Resident Construction Engineering Group assumes the responsibility for approving cutting of reinforcing steel based on the information contained in the Reserve Capacity Form. AP-38 states, in Section 3.1, that when the Resident Construction Engineering Group approves reinforcing steel cutting, these approvals are documented on the Site Approved Change (SAC). We learned that the SAC forms have been since discontinued. ~~and therefore an~~ This was noted as an observation ~~has been filed regarding updating the~~ since Revision 1 of AP-38, dated July 31, 1981 has not been updated (Observation 4-?).

RL Do we have sheet on this?

We have been informed by the UE&C staff that since the time when the SAC form ~~has been~~ was discontinued changes resulting from cutting of reinforcing steel have been treated as ~~ECØ~~ ECA's.

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May want to add this on page 4.8-1

We reviewed the "Project Reference Manual" (TP-23) Supplemental Information for Design Change Program, (Reference 4) Rev. 1, dated November 28, 1983 (date of Rev. 0 not listed) which contains a list of Minor Change List (Section X). Since the list does not include reinforcing steel cutting, we concluded and concurred with the UE&C staff that these changes must be treated as major ECA's. This classification reinforces our belief that Attachment No. 3 to AP-39 (listing of types of conditions or changes which do not require as-built information) should eliminate item 1, "Reinforcing Steel Changes" since such changes might result from cutting of steel rebars.

In our inspection we selected few specific cases as the examples by which one could verify how the process of handling the as-built works. In one case, Supplied Material Deficiency Report (SMDR) #357 (Reference 4) was filed by the contractor reporting that a structural steel beam has a tear in toe of flange. The case was processed by the field office and found acceptable. It should be mentioned that according to Rev. 3 of the FACP-1, dated October 4, 1982, processing of the SMDR would have been using the same procedure as for the Nonconformance Report (NCR) and Deficiency Reports (DR). The case discussed here was dated June 4, 1982 and the Revision 2 of the FACP-1 did not require concurrence of the Home Office. The other case, NCR #2584, (Reference 4) was concerning concrete cover over the reinforcing bars, same being too large, ~~some~~ 2 being too small. Similarly to ~~case of the~~ SMDR #357, it was resolved in the field. In both cases an unofficial concurrence of the Home Office was obtained. The third case examined was RFI #593027A (Reference 4) dated June 2, 1982 concerning discrepancy between UE&C Dwg. F-101748 (Reference 4) and Cives Dwg. FP-15407-13 Sheet E-58 at approximately El evation 60'-~~6½"~~7. Another question on the same RFI was concerning discrepancy between UE&C

Dwg. F101750 (Reference 4. —) and Cives Dwg FP-15407-13 (Reference 4. —) at El. 63'-~~6"~~ ½". In this case the disposition was provided by the Field Office.

The last case of as-builts reviewed was ECA ~~458~~/2809, (Reference 4. —) ~~dated April 28, 1982~~, concerning vertical bars in line 2.3 wall which caused a bar conjestion. As required by AP-15, the ECA/RFI Form listed the affected document and Home Office concurrence was marked "accepted".

The program which UE&C has embarked upon in order to analyze and control as-built conditions has a lot of good features. The controls documentation, distribution of responsibilities appear to be effective and practical. It is regretable that this program was enacted so late in the development of the plant. We are aware that in the early stages of construction of the plant the control of the as-built conditions was not so good as could be desired. It is admitted by the UE&C officials as well. In the memorandum dated September 6, 1983, MM-14575A (Reference 4. —), there is a statement "It is recognized that there are a good number of historic ECAs which, based on the judgment of the engineer at the time, were issued for which there may be no calculations." The project has defined a program to address these historic ECAs and develop calculations for them as necessary"... We think that this is a worthy effort which when completed will contribute to improve confidence in the level of quality control of the plant.

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To continue ~~to~~ the review the process for controlling as-built conditions in reinforced concrete the team selected four Engineering Change Authorizations (ECA's) dealing with coring concrete and cutting of reinforcing steel. A series of four ~~ECA's~~ Engineering Change Authorizations were selected in the Diesel Generator Building for review.

(1) ECA 02/0772D (Reference 4.——) was initiated on (date initiated missing) by the UE&C Area Superintendent. The problem was defined to be an interference of service air lines as installed with the fire wall partitions. The solution was issued November 2, 1982 and included cutting, capping and grouting the existing penetration in the floor at the 51'1/2" ~~level~~ 51½ foot elevation, core boring two - 2" inch diameter holes, relocating the air lines, air connectors and valves, deleting pipe supports and grouting the lines into the cored holes. The affected documents were listed and the backup reference which permitted the cutting of reinforcing was provided. In addition, the requirements for recording and reporting the as-built condition were also provided. This ECA had been properly reviewed by the Site Review Group and then by the home office where final concurrence was made on May 18, 1983. The field personnel reported the work completed on November 16, 1982 and provided sketches and details of the cutting and the necessary engineering data. One core bore cut no reinforcing and the other cut one #6 bar.

(2) ECA 06/1670B (Reference 4.——) was initiated September 12, 1983 as an On-The-Spot ECA by the Project Manager for GFPS. Grinnell Fire Protection Service The core drilling was defined as being required in stair walls C&D to allow for installation of new redundant

fire protection system lines. The request was made for two ~~(2)~~-6 inch diameter cores to be cut through a wall section around the stairwell near the ~~Elevation~~ 26 foot elevation. Approval was given on October 18, 1983 after telephone concurrence with UE&C's home office and the completion of the actions by the Site Review Group on October 17, 1983. It was further stipulated that one piece of reinforcing steel could be cut each way in ~~at~~ each face for each core location. In addition, sheets and instructions were provided so that the as-built work would be accomplished in accordance with AP-39 and specific information on actual reinforcing bar cuts information would be forwarded for ~~to~~ engineering review. The completed forms with the as-built information were completed on September 30, 1983 and received by UE&C Site Engineering on October 3, 1983, showed apparently more reinforcing steel cut than allowed. All other aspects of the appropriate procedures had been followed based on the team's review of the information.

(3) ~~(4)~~ ECA 59/4010A (Reference 4.____) was initiated December 9, 1982 by an engineer from Perini Power. This requested authorization to cut rebar, in order to install a Hilti bolt for a surface mounted plate on a floor at Elevation 51 feet. A ~~due to the~~ relocation of the plate ~~of the~~ bolts had been requested in order to miss ~~clear~~ the reinforcing. The field recognized the relocation would violate the centerline of bolt to an adjacent embedded plate distance criteria and requested permission to cut reinforcing steel. Permission was granted at the site on December 17, 1982 and home office concurrence was made on February 1, 1983. This allowed cutting of one piece of reinforcing steel each way, top and bottom and required submittal of data via an attached form after the installation had been completed. The as-built information was submitted by Perini Power on May 20, 1983 indicating that one ~~4~~-#7 bar was actually cut. A sketch was provided to establish the

exact location of the cut, identify the affected UE&C drawing and Bethlehem Steel drawing as well as the reinforcing steel bar type. No deficiencies were noted by the team.

4 ~~(5)~~ ECA 73/4572C was initiated December 3, 1982 by a field engineer from Pullman-Higgins. This document requested permission to cut reinforcing steel in an area near a blockout through a reinforced concrete wall due to the fact that numerous attempts to locate Hilti bolts among the congested reinforcing had resulted in several abandoned holes. A relocation of the plate for which the Hilti bolts were to serve as anchor~~s~~ required a redesign of the support~~, which was to be welded to the surface mounted plate~~. The change was completed, reviewed and finally approved on March 23, 1983. The home office engineering concurrence was completed on June 27, 1983. Again the field information as a result of the relocation and possible reinforcing steel cutting was requested for review via the coring/cut reinforcing sheets. The information was provided to Site Engineering on January 14, 1983 showing the necessary information and indicating that one ~~1~~-#11 and one ~~1~~-#8 reinforcing steel bar had been cut in the drilling process. The team found no discrepancies in the information.

After completion of the review of the information contained in the records related to these ECA's, the team went into the field to verify all information that could be checked given the current completion status in each of the areas. Of particular concern was the information contained in ECA 06/1670B which indicated that apparently more reinforcing than permitted had been cut. ~~and~~ The resolution of this was judged to be important in ~~judging~~ assessing the actions on the part of UE&C in response to the data. All locations associated with these ECA's were reviewed in detail, checking dimensions and where possible the inside cut surface if a core were involved except for ECA 59/4010A for which the drilled anchor bolt was sandwiched between panels of fire stop walls at the floor line.

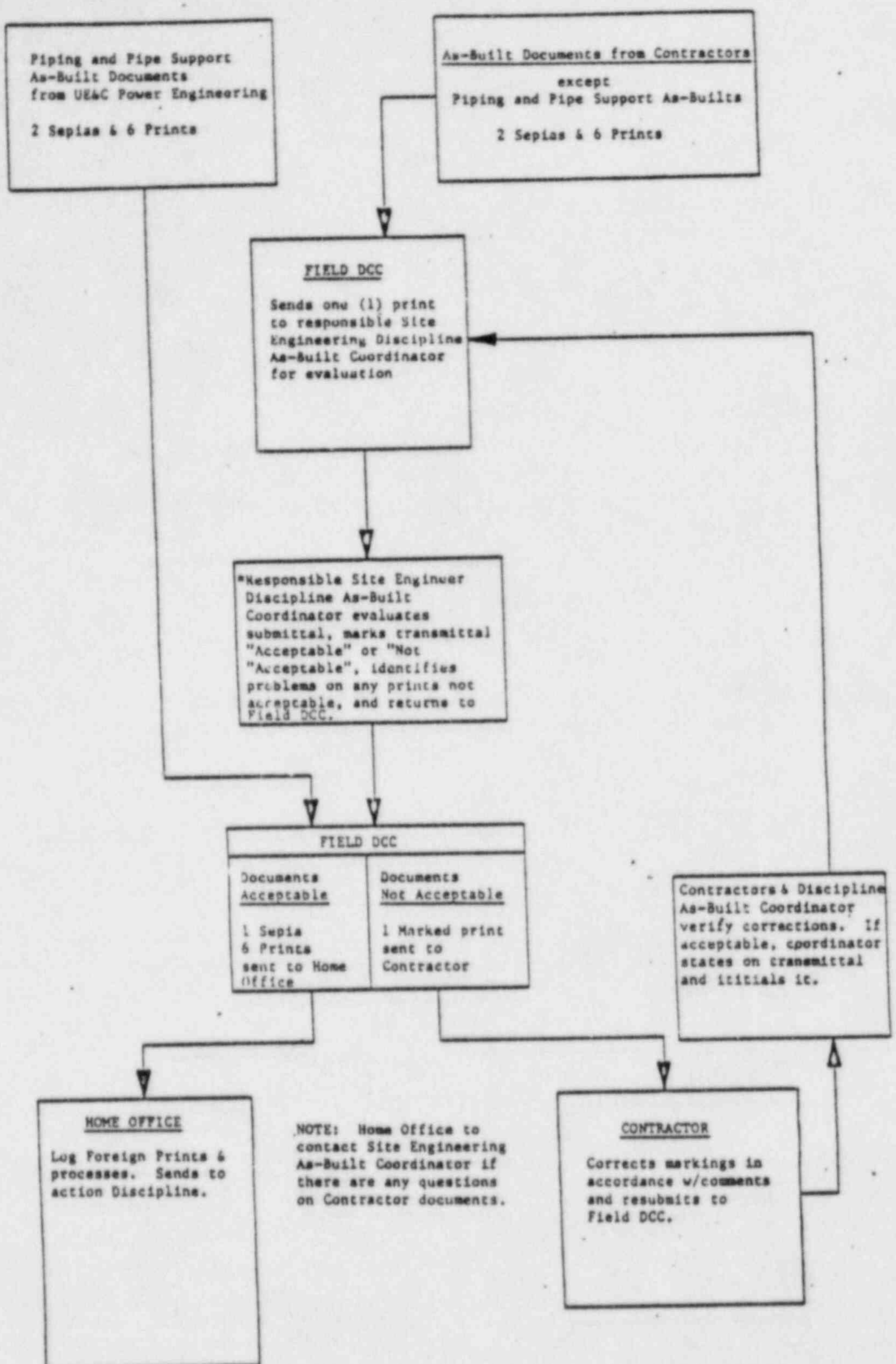
. . .

All as-built information which had been sent back to the UE&C Civil/Mechanical Services Engineering Group was field checked and found to be correct. The team then followed up to determine that the information provided was being systematically recorded and utilized. During this field review questions arose on the status of, and apparent incorrect fabrication of support 9276-12G-38 which was associated with ECA 73/4572C. After a review of field records and discussions it was found the support was on "Hold" and the support was known to be incomplete. The incoming cut reinforcing data from the as-built sheets were being logged and then transferred onto reproducibles created from the Bethlehem Steel shop drawings for reinforcing steel so that a permanent, consolidated record of cut reinforcing is being developed. A review of the information relative to the team's concern about additional cut reinforcing resulted in establishing that the cutting permission had not been exceeded. ~~in that~~ The detailed shop drawings indicated the coring was done in a splice zone and that the pairs of cut reinforcing seen in the as-built data represented actually one bar, but since the cut was in the splice zone, both legs had been cut. Similarly, from the detailed shop drawings and information submitted in ECA 73/4572C it was clear that several of the cuts were the ends of supplementary diagonal reinforcing at the corners of the wall blockout for air ducts. The information gathered in this program can be utilized to compare against known margins of reinforcing steel. Where the margins are not sufficient, the procedures require additional analysis.

Based on the team's review of the control of cut reinforcing, it was determined that this activity is well controlled by procedures and the appropriate interfaces have been established and function checks against known margins to verify that the original design has not been compromised are made and the necessary documentation has been provided. The Technical Assistance Group under the Lead Civil Engineer of Site Engineering was determined to be executing this operation in a very well controlled manner. No findings were identified.

Need 4.8 Summary & Conclusions

FIELD AS-BUILT FLOW CHART



* This step may be omitted on resubmittals if Discipline As-Built Coordinator has already reviewed and accepted submittal.

FIG 4.8-1

1/20/84

Document Name:
SECTION 4.9 - SEABROOK IDI

Requestor's ID:
EILEEN

Author's Name:
R. Shewmaker

Document Comments:
Conclusions

4.9 Conclusions

The scope and the depth of the inspection was sufficient to reach certain conclusions regarding the design and engineering aspects of the civil-structural discipline and the related safety features of the Seabrook plant. Based on the facts, findings, reviewed correspondence, ~~and~~ other information acquired during this inspection and then we concluded that design and construction of the safety related features pertinent to the civil-structural area are incorporate ing design control process ~~to provide~~ which will assure adequate safety to the public. Our inspection encompassed both the technical design and the procedural aspects of the organizations involved in the development of the plant in order to have a broad perspective of all elements of the design and interdisciplinary coordination effort.

As a result of the inspection we identified twenty-one findings and ____ observations. All of our findings have been discussed with the staff of ~~the~~ UE&C and we have been informed that the appropriate action has been taken to ascertain that there will be no ~~consequences~~ circumstances which might result in unacceptable margins of safety. ~~has been taken.~~ Finding No. ____ which appears to reflect on the across the board applied approach to application of live load in combination with other loads may require further investigation to assure that the structural members have load resisting capability in accordance with the approved regulatory requirements.

There are certain conclusions which appear to be quite obvious as a result of the inspection. In our opinion, interdisciplinary coordination of the design

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effort suffers from the excessive systematization in terms of procedures and manuals. There is an ~~evidence~~ evident effort to document every phase of design, construction, procurement and verification. This is very plausible and has its merits. The system of traceability, however, is handicapped by such a number of various steps and is so fragmented that it requires a monumental task to synchronize it in order to produce practical results. This is augmented by continuous revisions of various documents which in turn necessitates updating of all relevant procedures so that proper cross-referencing would be effective. An example of the above is "Cutting Reinforcing Steel in Permanent Concrete Structures", Administrative Procedure No. 38 (AP-38) (Reference 4.___), Section 3.1, ~~may be AP-38, Section 3.1, Rev. 1, dated July 31, 1981~~, which refers to the Site Approved Change ~~(SAC)~~ which has been discontinued (see Observation 4.____).

UE&C has provided technical guidelines and procedures to be followed ~~at~~ for the Seabrook Project. Extensive programs have been put into force in order to ensure that the latest and most accurate information is used in the design of structural members. Great efforts have been made in order to obtain refinements in the vertical amplification of beams for the design of the beams themselves as well as seismic qualification of equipment located away from the walls and columns. This refinement results in greater vertical accelerations than would be the case if the beams were assumed to be rigid.

However, UE&C did not account for horizontal torsional effects in the development of the amplified response spectra. ~~ARS~~. In the case of the primary auxiliary building ~~PAB~~, the indications were that 10% ~~for~~ represented the torsional effect for locations at the extreme periphery. Normal practice for UE&C was development of the ARS at the mass center. If the torsional effect is only around 10%, the team is of the opinion that it can be neglected.

Since the team recommends that the Tank Farm ~~dynamic~~ seismic analysis be redone, the team would recommend that additional attention be paid to torsional effects inasmuch as the Tank Farm has little structural symmetry.

Another observation is the apparent compartmentalization of the organization. We realize that the complexity and magnitude of the project necessitates multi-directional effort, but there must be a definite gravitation toward an overview of the entire operation in order to achieve a practical efficiency. An example of this conclusion ~~may be~~ is the case of misuse of the amplified response spectra for the annular structural steel framing ~~as described in Section 4.6 of this report~~. As we pointed out previously, establish~~ing~~ment of the position of coordination of seismic design improved this situation.

Organizationally, the SAG appears to be quite remote from the Seabrook Project, and operates in a passive mode. In other words, SAG will be responsible to respond to requests from the project but not to take initiative on changes in the structural design which may develop.

The program of as-builts and the final load verification, which we reviewed, appears to be effective and provides adequate design controls. As it has been pointed out in the ~~Section 4.8 of this~~ report, the as-built program should be extended to incorporate the engineering change authorizations which have been issued prior to the commencement of the program. There should be some mechanism whereby the SAG will have an opportunity of making an assessment concerning as-built conditions rather than leaving these assessments entirely to the project. In the case of the Tank Farm, the design of the bracing took place

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five years ago and the fill concrete under the ~~RWST~~ refueling water storage tank and ~~SAT~~ the spray additive tank was released for construction about four years ago. Up until the time of the ~~IDI~~ inspection these changes which have a direct influence on the dynamic analysis were not acted upon and were unknown to SAG.

SAG also does not appear to be subject to the technical audits required by the "Management Level Design Review by Chief Discipline Engineers," General Engineering and Design Procedure No. 0025 (GEDP-0025) (Reference 1.52). The team recommends that SAG also be subject to technical review. This could be completed by technical personnel who did not do the original work.

From the work observed, it appears that UE&C is conscientious and businesslike in the design of safety related structures and has established procedures, guidelines and organization to meet the requirements of NRC. While many of the programs have not been completed and some analyses and designs must be revised, there is no reasons to believe that the as built structures will be found to be inadequate in light of the exhaustive design efforts currently underway and planned for the immediate future.

In final summary, i is our opinion, that there is sufficient evidence that in civil-structural area the design controls are effective to the extent that they provide a reasonable assurance that the safety related structures will have their expected load resisting capability and will perform their design function without undue risk to public safety.

1/16/84

Document Name:
SECTION 7.4.2 - SEABROOK

Requestor's ID:
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Author's Name:
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Document Comments:
Personnel Interviewed

1/16/84

7.4.2 Personnel Interviewed

put on separate line outside (

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Dennis Reid	Chief Detailer - Engineering	Bethlehem Steel Corporation
Denny Vassa	Detailer - Engineering	Bethlehem Steel Corporation
N. I. Desai	Engineer I - Structural	UE&C - Field Change Completion Group

Move to Sheet 7.4.2-5 as Insert A

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C. E. Morales	Draftsman	UE&C - Technical Assistance Group Civil/Structural Engrg. Civil/Mech. Services Site Engineering
R. P. Kosian	Lead Field Engineer	UE&C - Project Field Engineering Group Civil/Structural Engrg. Civil/Mech. Services Site Engineering
S. N. Caruso	Lead Engineer	UE&C - Cable Tray Bracing Task Group Site Technical Staff Piping & Supports Site Engineering
Julie Drozd	Seismic Analyst	UE&C - Structural Analysis Group
John Alle	Structural Engineer	UE&C - Structural Analysis Group
Susan Hayecki	Field Engineer - Civil/ Structural	UE&C - Project Field Engineering Group Civil/Structural Engrg. Civil/Mech. Services Site Engineering

1/16/8-

Name	Title	Organization
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Frank Dadabo	Construction Superintendent Painting Subcontracts	UE&C - Field Construction
Colin H. Coles	Design Engineer II	UE&C - Seabrook Project Structural (Location ?)
A. A. Haldar	Job Engineer Civil-Structural	UE&C - Civil/Mech. Services Site Engineering
C. Holtzworth	Field Engineer Civil-Structural	UE&C - Civil/Mech. Services Site Engineering

Insert A from Sheet 7.4.2-3

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//

Document Name:

SEABROOK TENTATIVE FINDINGS

Rec'd
1/10/84

Requestor's ID:

KAREN

Author's Name:

Ed Wenzinger

Document Comments:

Sections I-V plus table of contents

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Review

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Seabrook Tentative Findings

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I. Mechanical Systems

II. Mechanical Components

III. Civil

IV. Electrical

V. Instrument & Controls

I. Mechanical Systems

1. FSAR Section 1.8, page 1.8-31, Amendment 47, 9/82 states that the sump design conforms fully to the positions of Regulatory Guide 1.82. Further discussion is provided in FSAR Section 6.2.2.2.j that states "... still limit the maximum approach velocity to the screens to approximately 0.2 ft/sec" (emphasis added). Regulatory Guide 1.82, in Regulatory Position C.7 specified that the design coolant velocity at the inner screen should be approximately 6 cm/sec (0.2 ft/sec). VE&C calculation CI-6 sheet 15 of 16 10/2/79 shows a velocity through the screen of 0.36 ft/sec. This is in conflict with R.G. 1.8.

The Regulatory Guide, in the sixth paragraph of the Discussion, indicates that the 0.2 ft/sec coolant velocity at the screen will allow debris with a specific gravity of 1.05 or more to settle before reaching the screen surface. FSAR Section 6.3.3.3.j states that an approach velocity of 0.2 ft/sec, all debris with a speciifc gravity of 1.05 or more will settle to the floor prior to reaching the sumps. No evidence has been provided to shown that an approach velocity of 0.2 ft/sec will result in debris settling to the floor before reaching the screen surface.

2. Alden Laboratories Report 25-81/M296HF January 1980, "Investigation of Vortexing and Swirl Within a Containment Recirculation Sump Using a Hydraulic Model," recommended as a result of Phase 3 Tests on page 22 of the report recommended in Item D that all top cover plates have at least

3 rows of 1/2" holes on 12" centers. This recommendation was not implemented until after the team discussed the Alden recommendations with UE&C. The memo from Flora to Valawadia (UE&C) dated 12/8/83 requested action to add 1/8" on 3" centers. (1/8" was chosen because of "particle size restraints".)

3. Regulatory Guide 1.1 recommends CBS pump NPSH be based on maximum expected temperature of pumped fluids. UE&C calculation 4.3.5.11.f dated 7/14/81 assumed 212°F. The maximum expected temperature according to the "Centrifugal Pump Specification Sheet No. 1" in the Specification for the CBS Pumps Spec No. 9763-006-238-3 Rev. 5 dated 11/19/79 is 280°F.

4. CBS NPSH calculation 4.3.5.11, dated 7/14/81 does not account for water that may be entraped by the reactor cavity and refueling canals (5,760 cubic feet). This would change the sump water level from -23.33' to -23.78', a decrease in level of 0.45' (~1/2' loss of NPSH).

5. CBS NPSH calculation 4.3.5.11 dated 7/14/81 assumes an inlet loss coeficient for the CBS sump pump suction pipe of 0.37 taken from the Alden study (January 1980). However, the Alden study calculated the average value of 0.37 but also calculated a maximum value of 0.53.

6. Alden Labs determined a pressure drop due to swirling flow in the sump pump suction pipe could occur. This effect was not included in the NPSH calculation 4.3.5.11 dated 7/14/81. UE&C Calculation 4.3.5.41F dated

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12/1/83 determined that the effect could result in a decrease in NPSH of 0.09 foot.

7. CBS NPSH calculation 4.3.5.10F dated 12/1/83 calculated an available NPSH of 21.73 feet at 260°F. Considering entrapped water (NPSH -.45'), inlet loss coeficient (NPSH - .45') and swirling flow (NPSH -.09') the total NPSH could be 0.99 foot less. The available NPSH could be as low as 20.74 feet. Required NPSH is 20.8 according to Foreign Print 53205, Rev 01. NPSH may not be conservative enough.

8. The FSAR 6.3-1 indicates that NPSH available for the RHR pumps is 20 feet. Westinghouse calculation SD/SA-NAH-114 "ECCS Analysis" dated 11/10/78 indicates available NPSH of 22.3 feet. FSAR table 6.3-1 indicates required NPSH is 13.5 feet at 3800 rpm. Runout flow calculated in the Westinghouse calculation is 4691 gpm for which the required NPSH is 19.5 feet. Considering the factors listed in items 3 (temp), 4 (entraped water) and 6 (swirling flow) the RHR pump may not be conservative enough.

9. FSAR Section 3.6(B).1.3 states that results of failure modes and effects analysis presented in Appendix 3A verifies that the consequences of failures of high and moderate energy lines will not affect the ability of the plant to be shutdown safely. FSAR Appendix 3C provides detailed criteria for evaluating jet impingement loads from high energy piping failures. However, these evaluations have not been completed.

10. Two out of 100 zones have had jet impingement analysis performed but the reports have not been approved. These analyses have not utilized the criteria contained in Appendix 3C of the FSAR "Procedure for Evaluating Jet Impingement Loads from High Energy Piping Failures." In the analysis performed jets from small pipes impinging on larger pipes would cause no damage. No basis was provided for this assumption. We note that SRP 3.6.2 allows assumption of no damage when a small whips into a larger pipe.

11. FSAR Section 3.6(B).1.1 states that measures for protection against pipe whip are not provided where the whipping pipe cannot cause unacceptable damage to any essential system or component. There is no documentary evidence that whipping pipes have been evaluated over their envelope of whip for potential impact at specified finite distances from targets. Supporting documentation for Appendix 3A of the FSAR indicates that equipment is protected from specific line breaks by "distance" but no distances are specified and no acceptable distances are given.

12. The FSAR Section 3.6(B).2.1.b indicates pipe cracks in moderage energy lines were postulated to occur in locations that result in the maximum effects from spraying or flooding, except where pipe stress levels are below a specified value. There is no evidence that spraying analyses have been done.

13. The CBS Pump Specification requires that each pump be individually tested in the as-built configuration. The motor to be used at Seabrook was not tested with the pump. Further, the FSAR Section 8.3.1.1-1, page 8.3-22

states that motor suppliers are required to verify that actual test data confirm that the torque margin is equal to or greater than that of the calculated data. UE&C has no corresponding data on hand for the CBS pump motors.

14. The CBS pump motor seismic qualification is incomplete. Qualification is required by Specification 9763-006-128-1 Rev. 4, 4/23/75. The seismic analysis is contained in the Westinghouse "Seismic Analysis of Containment Spray Pumps ...." Westinghouse PO-80632-L7 (Seismic) approved 2/25/81. The analysis does not include stress in the stator end turn insulation support system.

15. GEDP-0033 Rev. 2 11/20/78 requires that the responsible engineer complete the comment resolution status on the Document Review Request form. This was not done on one form concerning changes to Rev. 5 of SD-20.

16. A number of technical changes were made in SD-20 without an ECA or DCN in violation of GEDP 0032, Rev. 3, 10/29/76 and AP-46 Rev. 1, 10/18/82.

    a. Sump ph changed from 8.5 to 11 (Rev. 5) to 8.5 to 10.5 (Rev. 6).

    b. RWST and SAT min temp 40° Rev. 5, 50° Rev. 6.

    c. Inner screen (sump) particle inclusion size 1/4" Rev. 5, 0.097 Rev. 6.

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d. Inner screen

"maximum velocity" Rev. 5

"approach velocity" Rev. 6

e. CBS actuation

"high-high" Rev. 5

"high-high-high" Rev. 6 - had DCN

"high-high" Rev. 8 - had no DCN

17. In violation of QA-2-2 Rev. 8, 9/9/83 Section IV.A.2 some UE&C project personnel had not recieved indoctrination training prior to performance of safety related activities including review and approval of safety related documents.

18. Calculation CI-2 "Design Screen and Supporting Structure for Recirculation Sump" Rev. 1, 8/29/83 assumes no jet impingement and missle load required in the design of screen supporting structure. This assumption is not supported in violation of GEDP 005, Section III.5, Rev. 3, 9/9/75.

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II. Mechanical Components

1. The thermal displacement during the faulted condition of the tube side outlet nozzle (Nozzle N2) of the CBS Heat Exchanger (CBS-E-16A) is 0.044." This nozzle is oriented in the plant northern direction which is the plant + 7C - direction. This displacement was input to the pipe calculation 550.02, Part A (2/4/81) as -0.044" instead of +0.044."

   For stress analyses MCD 550.02, Part A (2/4/81) and MCD 550.03, Part A (2/4/81) there were not any Anchor Displacement Data Sheets which would have provided documentation for the CBS-E-16A&B outlet nozzle thermal displacements. This is a violation of Section 8.0 of DEDP-2607, Rev. 1 1/19/81. Recently, UE&C has done a displacement analysis for the CBS Heat Exhcnagers nozzles (Calculation 4.5.5.39F, Rev. 1, 11/15/83) and it confirms the magnitudes used in the analysis MCD 550.02, Part A and MCD 550.03, Part A, specifically the 0.044" referred to above.

2. In UE&C stress calculation MCD 550.02 2/4/81, the interaction effects between an 8" run line (1214-2-301-8" in the CBS) and a 4" branch line (1218-1-301-4" in the CBS) were not accounted for as prescribed by DEDP-2607 Rev. 1, dated 1/19/81.

3. In UE&C stress calculation MCD 550.03 2/4/81, the interaciton effects between an 8" run line (1216-2-301-8" in the CBS) and a 4" branch line (1217-1-301-4" in the CBS) were not accounted for as prescribed by DEDP-2607, Rev. 1 date 1/19/81.

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4. In UE&C stress calculation 551.00 (7/30/82) on line 1217-1-301-4" and line 1218-1-301-4" on 3 lines at least, the valve operators for the valves (4"-CBSV31, 4"CBS-V33 and 4" CBS-U32) and the corresponding operator supports (1217-SG-8, 1217-SG-9, and 1218-RG-3) were excluded (with regard to moments and loads) in violation of DEDP-2607, Rev. 1, date 1/19/81.

5. CBS sump isolation valve encapsulation vessel weight is noted in PX Engineering Stress Report for the vessel CBS-Tk 101A & 101B Rev. 4 dated 2/23/81 as 5,307 pounds empty and 14,113 pounds full. PX Engineering General Arrangement Drawing #578, sheet 1, Rev. 5, dated 1/13/81 for the vessel states the weight as 2,900 pounds empty and 11,700 pounds full.

6. Four project documents, the FSAR, SD-20, UE&C Specification 9763-006-246-1 and Westinghouse system description of the Safety Injection System specify design temperature for RWST as 86°F (FSAR) to 200°F (W). The SD-20 and the UE&C Specification state 100°F. The code stamp on the vessel says 100°F.

7. UE&C Specification 9763-006-248-47, Rev. 3 date 4/26/81 states that the CBS Sump Isolation Valve Encapsulation Vessel may fill with steam or water. UE&C Specification 9763-006-248-L Rev. 6, date 5/23/80 specifies 90% relative humidity for the valve actuator.

8. SD-3, Main and Auxiliary Steam System has had 3 versions, Rev. 0, dated 7/15/74 Rev. 1, 6/28/77, and Rev. 2, 11/18/81. No DCN or ECA exists for a number of changes between Rev. 0 and Rev. 1 and between Rev. 1 and Rev.

2. This violates GEDP-0032, Rev. 3, 10/29/76 on control, evaluation and implementation of design changes and GEDP-003, Rev. 1 dated 2/10/75 and Rev. 2 dated 11/20/78 concerning control, evaluation and implementation of review comments on design documents.

9. Bingham-Willamette performed a thermal transient qualification test on a 12 x 14 x 23 type CD pump, considered similar in design to the Seabrook CBS pumps that are 6 x 10 x 14 type CD pumps. Modification of the tested pump (enlargement of wearing ring clearances) was necessary for sucessful qualification of the tested pump. Based on review of the test results of the tested pump UE&C recommended in SBU-13320 dated 7/25/77 to YAEC that the Seabrook CBS pump be tested for thermal transient capability. This recommendation was rejected by YAEC in SB-5178, dated 8/10/77. No data was available on the clearances for the pump that was tested or for the clearances on the Seabrook pump. This vioates YAEC Seabrook Station Quality Assurance Manual Procedure 3.3 Rev. 6, dated 3/13/77, Section 4.1 and ANSI N45.2.11 Section 6.3.3.

10. The FSAR, Subsection 3.7(b).2.3 states that the major equipment systems, whose stiffness, mass, and frequency have significant dynamic interaction with the supporting structure are included in the detailed model of the structure. The dynamic interaction effects between the tributary piping, pipe support and the supporting structural steel at pipe support 1201-SG-02, As given in calculation set no./support no. 1201-SG-02, Rev. 2, 9/30/83, were not considered. As an example, the mass of the component support and piping is 3,637 pounds, while the lumped mass of the support

structure is approximately 16,300 pounds. The approximate mass of the supporting structure is only five times greater than the mass of the component support and piping. The support steel and associated piping should therefore be dynamically coupled and reanalyzed.

11. Same as #10 except:
Pipe support M/S 1214-SG-63
Calc set no./support no. M/S 1214-SG-63, Rev. 3, 8/15/83
Component support and piping 2672 lb.
Support Structure 937 lb.

12. The top of steel (T.O.S.) elevation for the (W)12X79 beam at azimuth 270° at elevation -8 ft. 4 in. is shown as -8 ft. 4 in. on UE&C Containment Steel Framing Plan Drawing 9763-F-102316, Rev. 6, 3/17/82 and UE&C Piping Isometric Drawing 9763-D-801216, Rev. 7, 7/7/82. However, the T.O.S. elevation for this W12X79 beam is shown as -7 ft. 10 in. on UE&C Piping Isometric Drawing 9763-D-801214, Rev. 6, 7/7/82.

13. M/S 1214-SG-63 is attached to the underside of a W12X79 beam, located at 270° elevation -8'4" on the inside of the containment. The design of the component support and the support steel (W12 x 79) does not account for the effect of the lateral sheer and torsional moment induced by lateral seismic piping loads.

14. ITT Grinnell Technical Specification SB-001, Rev. 2, 7/12/82, concerning reverification of supports, specifies in Section 6.II, temperatures to be

considered in the design of lines in containment to be the maximum line temperature or 370°F whichever is greater, an in all other areas, the maximum line temperature. UE&C Pipe Support Design Guidelines, Rev. 1, date June 17, 1981 specifies, on page 2-14, that a temperature of 650°F be used.

15. A sample of 12 reverification packages prepared by ITT Grinnell were reviewed to determine if computer program coding (STRUDL) for the component support geometry and loads had been signed by the preparer and checker.

The package for support 1201-RG-07, Rev. 7, run 1 of 2 had been signed by the preparer but not the checker.

The package for support 1201-SH-1, Rev. 3, run #1 (of 1) was not signed by preparer or checker.

These 2 examples violate procedure QCES-2.3.3 of the ITT Grinnell Corporation Engineering Services QA Manual, Rev. 1, dated 2/14/83.

16. Pullman Power Products Piping Isometric Drawings that were placed under UE&C control after 1/17/83 were subsequently issued by UE&C without a P.E. stamp.

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Two such examples of these drawings are Pullman Power Products Isometric Drawing No. CBS-1213-01, Rev. 9, dated 11/1/83, which carries the note

"U.E. & C. Drawing as of Rev. 7," and Pullman Power Products Isometric Drawing No. CBS-1213-02, Rev. 2, dated 4/14/83, which carries the note "U.E. & C. Drawing as of Rev. 12."

This is in violation of the U.E. & C. Nuclear QA Manual, Subsection 3.2, which mandates certification of piping erection drawings by a registered professional engineer.

17. The ITT Grinnell engineering standards, Design Policy Procedures, and Rework Procedures that formed the technical basis for the ITT Grinnell reverification program, and which were listed in ITT Grinnell Technical Specification SB-001, were not examined by YAEC.

This is contrary to the requirement of Change Order No. 42 to UE&C Purchase Order 248-8, dated June 1, 1982, which requires that "the technical specification covering reverification (meaning SB-001) shall be reviewed and accepted by Purchaser prior to work." The purchaser is YAEC.

This is also contrary to Subsection 2.1.1.5 of the YAEC QA Manual, Rev. 2, dated 3/31/78, which requires that: "Provisions of technical documents by the vendor shall be examined."

18. The component support reverification packages prepared by ITT Grinnell for UE&C did not consider frictional effects for thermal moments less than 1/16 inch.

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Two such examples are contained in the UE&C calculation sets for support nos. 326-SG-01, Rev. 1, 5/12/83, and 179-SG-04, Rev. 3, 9/22/83, which contain both the ITTG calculations and the UE&C closeout calculations.

This is contrary to Subsection 5.I of Technical Specification SB-001, Rev. 2, 7/12/82, which requires that friction be evaluated for all cases where thermal movement does not equal zero.

19. ITT Grinnell support calculation for component support no. 1203-RG-8, Rev. 8, 9/3/82, was reviewed for technical content by the team. The calculations for the principal moments of inertia and section moduli for the 6X4X1/2 inch angle detailed on page 10 of this calculation are incorrect. For example, the calculated value of the principal moment of inertia is 17.33 in^4, while the correct value is 20.07 in^4. This data is subsequently input to the STRUDL run dated 9/7/82, which forms a part of this calculation package.

20. ITT Grinnel support calculation for component support no. 1203-RG-3, Rev. 5, dated 9/3/82, was reviewed for technical content. The calculation for the support stiffness in the negative direction given on page 6 is inadeqaute and possibly incorrect, due to the use of displacement data generated by a STRUDL run which specifies an insufficient number of significant figures.

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The specific stiffness in the negative Z direction is the ratio of the 1000 lbs applied as a load in the negative Z direction in the STRUDL model to the resultant displacement of 0.001 inches output by the STRUDL model. This ratio yields a stiffness in the negative **Z** direction of $1X10^6$ lb/in. which is the magnitude of the minimum stiffness allowed for this support. However, due to roundoff, the magnitude of the displacement could be as high as 0.00149 inches, which would yield a corresponding stiffness of $0.67X10^6$ lbs/in. causing the support to fail the minimum stiffness criterion of $1X10^6$ lbs/in. This appears to be a systematic error because the STRUDL output only prints out thousanths and in these cases only one significant figure.

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III. Civil

4-5

1. P.O. #210-9, February 12, 1982 from UE&C to E. G. Burdette, "Test of Anchorages to Determine Effects of Prying" did not include QA requirements in violation of UE&C, QA-12 "Control of Measurement & Test Equipment," Rev. 5, 12/13/77, paragraph III A&B; QA-3, "Design Control," Rev. 14, 8/16/76, IV, E.7.C and GEDP-0022. As a result, no requirement for control of calibration and adjustment of measurement and test equipment used to confirm the prying factor assumed by UE&C.

4-6

2. The Tank Form structural steel is Seismic Category I. The Design Load Combinations listed on Structural Steel Design Calculations, Tank Farm WB-61, Sheet 10 of 79, 9/28/78 omits load combinations containing SSE. This violates SD-66, Structural Design Criteria, Rev. 1, 11/30/82, Table 5.4-2 and Rev. 0, 10/19/76.

4-8

3. Structural steel beam Mark B9 located on the EL 81'-0" Roof along Column Line 0.5 was designed for dead loads, live loads, and seismic OBE loads in calcuation WB-61 sheet 17 of 79, checked on 9/28/79. Later, a redesign was made to add the sag rod loads to the dead loads, live loads, and seismic OBE loads (sheets 9I and 9J of 79 checked 11/3/79). The original calculation (WB-61 Sheet 17 of 79, 9/28/78) was not voided, as required by GEDP-0005, "Procedure for Preparation, Documentation & Control of Structurals Calculations", original issue 8/21/74, Paragraph II.D. Subsequently another calculation was made (WB-61, Appendix A, Sheet 10 of 16, Rev. 3, checked 6/17/81) which added a pipe support load, but neglected

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the sag rod loads. Again the previous calculation was not voided. The SSE pipe support load was incorrectly combined with beam OBE loading and designed for SSE allowable stresses. The neglected loads and the combining of the OBE and SSE violates SD-66, Structural Design Criteria, Rev. 1, 11/30/82.

4-10

4. Reinforced concrete walls in the Tank Farm along column lines 4.5 and 5.0 are subject to moments and axial forces. ACI-SP-17(73) Design Handbook, Volume I, 2nd Printing, March 1974 presents the design procedure for accounting for these moments and axial forces. Calculation WB-68, Sheets 8 and 9 of 13 checked 2/10/79, did not follow the procedure of ACI-SP-17(73) correctly in determining the required area of steel reinforcing.

4-16

5. Pittsburg-Des Moines calculation, June 1981, PDM Contract 14084, concerning design of the refueling water storage tank contains two ommissions. In calculating the fundamental frequency of the tank, shear flexibility was neglected. Vibration frequencies higher than the fundamental frequency were neglected in violation of 2.3.3.1.7 of UE&C Spec. 9763-SD-246-1.

4-17

6. The tank form modeling of structural steel is not representative of the actual structure. Size and shape of bracing used in the model differs from actual structure and drawings. Model does not account for overall bending. Incorrect shear area used in model. Reference is calculation SB SAG 5WB Rev. 0, 7/10/76.

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4-18
7. Overall bending stiffness of the reinforced concrete in the tank farm was underestimated. Added stiffness due to orthogonal walls in calculating moment of inertia of individual walls was neglected. The calculation of the equivalent moment of inertia in the mathematical model uses a forumlation that results underestimation of the overall bending stiffness for this case.

The mathematical model was prepared ignoring the effect of the 15'-0" ft. thick concrete fill under the RWST and the SAT.

4-11
8. SD-66 Structural Design Criteria, Rev. 0, 10/19/76, specifies in Table 5.4-1 that separate load combinations utilizing both OBE and SSE loads be considered for structural steel inside containment. The design of the screen and supporting structure for the containment sump as documented in calculation CI-2, Rev. 0, 1/29/80 sheet 5 of 16 and Appendix A, page A2, Rev. 1, 2/2/82, do not account for the OBE load combination.

4-21
9. UE&C Drawing F101402, Rev. 13, 3/24/81 "Mat Sections" shows double stirrups at 16". Shop drawing (Bethlehem Steel) #C17RM31, Rev. 4 (12/5/78) Wall Stirrups, Layer #7, shows that these bars have been changed to single stirrups at 8" separation. The UE&C drawing has not been updated to reflect this change in violation of AP 29, Document Control - Foreign Print System, Rev. 7, dated 4/12/83.

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4-23
10. SD-66 Structural Design Criteria, Section 4.2.1, Rev. 0, 10/19/76 and Table 5.4-2 require consideration of live loads concurrent with dead

loads and seismic loads except where known equipment loads are considered in place of live loads. In the primary auxiliary building equipment vault (Calc Set P.B. 76, Rev. 0, 11/18/83) as shown on UE&C drawings F101562, Rev. 4, 9/23/83 and F101558, Rev. 6, 7/9/82, the live loads were not considered in combination with seismic loads for beam B3 for example. Beam B3 does not carry equipment load.

4-1

11. Project Manual of Procedure (UE&C), Section I, Exhibit A, 8/22/80, Rev. 13 contains the Correspondence & Document Distribution Index. This is inconsistent with a similar matrix contained in AP-1, Correspondence - Reproduction and Distribution, Rev. 16, 8/18/83. The matrix contains over 800 entries, approximately 15 inconsistencies were found (Shewmaker has details).

4-12

12. The Structural Subject File Index in the Structural Group has been periodically updated as required by AP-7, "Subject File System". However, AP-7, Rev. 12, 8/18/83 has not been updated to change the subject file index for structural items in AP-7 for over six years.

4-3

13. Twenty-six project design related documents that should have been controlled under the requirements of AP-2, Correspondence Control System, Rev. 2, 10/1/75, or subsequent revisions, were found in the Structural Subject File, which is not controlled. These documents had no correspondence serial numbers. Four of these documents were selected to determine whether or not the Document Control Center could locate them. None of the four

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could be located in spite of the subject to correspondence serial number cross reference system.

4-14

14. A number of errors were found in Administrative Procedures. (Shewmaker has details.)

4-15

15. Two controlled copies of the AP's (#38 and 46) were found with errors. (Missing pages and missing procedures)

4-13

16. Structural steel connections in the containment annular steel which were fabricated as non-standard connections due to errors in the location of steel embedment plates in the concrete structures have not been designed for the eccentricities introduced. The horizontal centroidal axis of the beam and the connection do not coincide. The beams are required to transmit axial loads as a result of thermal loading. Neglection of the eccentricity is in violation of AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, 1969, Section 1.15.3. This Specification is referenced in SD-66, Structural Design Criteria, Rev. 0, 10/19/76, Section 2.1.2 as the governing design document for structural steel. Also see 18, which follows.

4-2

17. Procedures which governed the design control of the project are not available (today) for the entire time span of the project and therefore an audit to ascertain whether the procedures were followed is not possible for certain time spans, for specific procedures. The procedures involved are both corporate procedures (GEDP's) and project procedures

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(AP's). This is considered to be a violation of ANSI N45.2.11, Quality Assurance Requirements for the Design of Nuclear Power Plants, 1974.

4-4

18. Also see preceeding item 16. Inconsistency exists between the actual connection and design calculations for a connection between a beam and an imbedded plate using a bent plate. The calculations assume that the horizontal centroidal axis of the connector (the bent plate) and the beam coincide. However, the shop drawing and installation in the field show the as-built with an eccentricity. AISC Specification for the Design, Fabrication and Erection of Structural Steel Buildings, 1969, requires in Section 1.15.3 that such eccentricities be analyzed. They were not.

4-19

19. Geometry and structural steel detailing considerations for structural steel in the containment annular structural steel have resulted in the creation of connection eccentricities which were not analyzed as required by AISC, Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, 1969, Section 1.15.3. The eccentricities arise at the junction of columns and beams which intersect non-orthogonally. With the beams subjected to thermal loads which introduce an axial load into the beams, the approximately one inch of eccentricity will impose a tensional load on the column. The design calculations do not reflect the eccentricities as required by AISC.

4-20

20. No calculations have been located which supported the engineering drawings released for construction and fabrication of structural steel for an area in the Primary Auxiliary Building as required by AP-22,

Calculations. The drawings were released in 1978 and calculation was performed 11/18/83.

4-7

21. Input for the Shell I Computer program (Sh. 30 through 35 of 289, Calculation Set CS-15 dated 8/4/75, Rev. 0) referenced calculation set SBSAG-4CS4 "Seismic Analysis of Containment Structure" as the source of information. Actually, the information used for Shell I input was taken from SBSAG-4CS3 dated 6/12/75 which was superseded by the memo from SAG dated 3/17/76, reissued 3/29/76. In this memo SAG indicated that "since the increases and decreases in response vary greatly depending on location of response, earthquake direction, equipment damping, and frequency range of interest, the detailed effects will have to be evaluated by each of discipline on a case by case basis." There is no evidence that such an evaluation has been made.

The note which appears on Sh. 30 of 289 of calculation set CS-15 dated 8/4/75 referencing SBSAG-4CS4 is erroneous. It should reference calculation set SBSAG-4CS3.

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IV. Electrical

1. UE&C drawings 9763-F-30028 and 29 (Rev. and date) illustrates anchoring methods for switchgear (welding details for welding cabinet to floor). The switchgear manufacturer (Brown-Boveri) in their letter to UE&C, #BBEL-PMTG dated 9/16/83, stated that UE&C's anchoring method of electric equipment is adequate for seismic loading of switchgear. UE&C specification 9763-50-145-2, Rev. 2. Seismic requirement for 5 KV Switchgear requires that equipment be mounted as closely as possible to the inservice orientiation during testing. However, the Brown Boveri seismic certification report #33-50750-SSA, Rev. 1, Oct. 1983 does not provide details of the inservice orientation during testing. In addition, the test report of a seismic test of a typical switchgear cabinet, performed by Wylie Lab in 1976, that is referenced in the Brown Boveri certification, does not provide mounting details. Thus, there is no apparent basis basis for Brown Boveri's assertion that the equipment anchoring is adequate and no basis for meeting the UE&C specification appears to be available with regard to mounting details.

2. DCN 030303B, dated 7/6/78 changes a delayed non-synch transfer scheme to a residual voltage permissive transfer scheme involving changes in relays and wiring. The DCN does not list the associated 5K switchgear specification (9763-006-145-2) and 4160 volts distribution system description (SD-74) as a document to be changed as a result of this DCN. This is a violation of GEDP-032, Rev. 3, dated 10/29/76 and AP-15, Rev. 7, dated 3/6/78 regarding control of design changes.

Revision 4 dated 6/9/80 of SD-74 incorporated this change, but the specification (present revision 6, dated 1/31/83) was not changed despite subsequent revisions.

3. The FSAR lists (4) trips which can trip the D-G breaker. The 5KV switchgear SD (SD-74, Rev. 5, 5/18/83) lists 5 trips. The Diesel Generator SD (SD-76, Rev. 1, 7/13/76) lists only 3 trips.

   Overspeed
   Gen. Differential Current
   Lube Oil Pressure
   Bus Fault
   SI Signal and Offsite Bkrs Closed

4. Drawing 9763-F-300219, Service Environment Chart, Rev. 13, 6/24/83 refers to two documents, which as listed on the drawing do not exist. These documents, that exist under other names and numbers, contain data on integrated radiation dose values and temperature/pressure profiles outside containment. No technical errors were found on the chart.

5. UE&C Service Environment Chart, Rev. 9, 6/26/79 specifies a maximum external temperature of 148° F. for the PX Engineering CBS isolation valve encapsulation vessel. UE&C Specification 9763-006-47, Containment Recirculation Sump Isolation Valve Encapsulation, Rev. 3, 4/28/81, specifies 140° F. maximum external temperature.

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6. UE&C Drawing 9763-M-505300, Class 1E Equipment List, Rev. 10, 4/27/83 was not signed, reviewed or approved in accordance with QA Procedure QA-3, Design Control, Rev. 11, 2/14/83. Previous versions were apparently not controlled either. (Also see I&C #2)

7. UE&C Calculation 9763-3-ED-00-03-F Power Cable Application and Sizing Criteria, Rev. 4, 8/12/83 uses 40°c for the maximum ambient temperature in the Main Feedwater - Main Steam Piping Enclosure Building (Main Steam-Feedwater East, UE&C Drawing 9763-F-300219, Service Environment Chart, Rev. 13, 6/24/83 specifies 130° F. (54.4° C.) as the maximum ambient.

8. UE&C Specification 9763-006-248-47, 4/28/81, Rev. 3, specifies in Sections 2.7.4.1 and 2.6 that the electrical penetrations of the CBS sump isolation valve encapsulation vessels will be subjected to steam or water. The penetrations, purchased from Conax, are not qualified for steam or water as far as we can tell. Have requested P.O./spec. to Conax but not received yet.

9. UE&C Weld drawing 300209, Rev. 5, 8/31/83 specifies weld configuration for motor control centers, 3/16" fillet x 2" long. The seismic qualifications report SC-275, Rev. 3, dated 3/10/82, Attachment C, drawing R344-4 Rev. 2, dated 10/24/79 specifies a 1/4" fillet weld x 3" long. The welds are installed in accordance with the 300209 drawing.

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10. Seismic qualification documentation (Report SC-275, Rev. 3 dated ?) for motor control centers purchased to UE&C Specification 9763-006-143-1,

Rev. 8, 11/30/82 does not comply with the requirements of IEEE Std. 344-1975, Section 8.5 "Entropolation of Data". The equipment tested was not the same as the equipment supplied.

		Test	Actual
a.	Pull Box Height	9"	12"
b.	Ground Bus Size	½ x 1"	¼ x 2"
c.	Breakers	None	JL Type Frame Installed

11. Welds specified in seismic qualification report SC-275, Rev. 3, 3/10/83 (½" x 3" long) does not meet American Welding Society (AWS) Std. D.1.1.-81 that specifies for ¼" thick or less weld fillet be the same size as the plate. The plate is 3/16". Hence, the weld specification is incorrect but UE&C weld drawing specifies 3/16" that is correct (see item 9 above). Per 9 above, qualification was based on ½". The welds are 3/16".

12. Weld drawing R-344-4, Rev. 2, dated 10/24/79 was checked and approved by the same individual in violation of the FSAR commitment in Section 17.1.1.3 that commits to separate checkers and approvers. This also violates Gould QA manaul Section 3.3.10 that requires different people as checkers and approvers.

13. Brown-Boveri Qualification reports RCC-323.74-64, Rev. 3, dated 3/10/82 for MCC's and R33-50750-QS, Rev. 8, 9/29/83 for Swgr indicate that control wiring is GE type SIS Supreme Vulkene or ITT Surprenant (similar to GE SIS). These reports contain data supporting the qualification. The Bill

of Material (5HK-350, S.O. No. 703-50750 sh 1 thru 9) for swgr and UE&C FP-31151-03, Rev. 3, 1/29/80 and FP-31151-04, Rev. 6, 5/25/80 for MCC's indicate that control wiring in both swgr and MCC's is GE type SIS Vulkene. GE letter to Gould of 1/22/78 (included in the qualification report) states that the SIS wire is not qualified to IEEE Std. 383 and 323.

The actual installation is SIS Vulkene wire in Swgr and SIS Vulkene Supreme in the MCC's even though the Bill of Material says it is Vulkene Supreme in both places.

15. The Class IE battery sizing calculation 9763-3-ED-DO-14F, Rev. 5, 12/29/82 uses a capacity rating factor for a type NC x 1200 battery whereas an NCX 2250 battery is actually used. A short term capacity margin of 21% was present in the calculation whereas using the actual battery only a 16% margin is present. Long term capacities of both batteries is about the same and long term capacity is controlling in battery selection at present.

16. CBS pump motor outline drawing, Rev. 3, 10/9/78 states bearing operating temperatures should not exceed 95°C. The CBS pump instruction manual FP52764, 5/9/83 states the bearing temperature should not exceed 90°C. and that the unit should be shutdown if oil temperature reaches 71°C. Meeting notes between W and UE&C attached to UE&C letter to W SBU-78480, 9/20/83 states that maximum allowable oil temperature is 85° to 90°C. Bearing temperature is alarmed at 80°C. on the station computer.

V. I&C

1. Two errors, one a subtraction error that produces a result with more significant figures than the original values and, second, a transcription error substituting 78.3% for 78.8% resulted in a setpoint calculation error for the low-low-1 level alarm setpoint on the RWST. The correct answer was 110.32 and the answer (110.25) given on Sheet 19 (8/12/83) of UE&C calculation 4.3.5.30F was in error. The calculation was checked on 8/25/83.

2. Two UE&C equipment lists, the standard Equipment List, and the Standard Instrument Schedule have no provisions for the signature of the preparer or a reviewer or checker and are apparently not design documents and not controlled in accordance with design control procedures QA-3, for example. The documents are not stamped "for information only." This is a violation of GAP-0007, Rev. 0 6/25/75 and AP-27 Rev. 4 5/18/82 for the Standard Equipment List.

3. Tobar, a Westinghouse subcontractor for supply of pressure transmitters approved exceptions to a subcontractor specification 5519A54, Rev. 2, 8/3/83 for tantalum capacitor without an independent technical review or approval. The exceptions involved how many capacitors would be tested (50 or 100) and for how long (2000 or 1000 hours). The other involved a possible waiver of elevated temeprature leakage tests. This violates TOBAR Procedure PI-1 Section 3 on Design Control.

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4. ITT Barton test plan 9999.3155.2, Rev. 1, 1/29/82 has not been accepted by UE&C because test temperature and radiation dose (integrated) have not been agreed to. The test covers pressure switches. These switches have been delivered and accepted by UE&C Field QA. No qualification report has been provided to UE&C and no Environmental Qualification per IEEE 323 Test Report has been written. This violates QA-10, Inspection Control, Rev. 3, 10/23/75, Section IV, Procedure E.

5. Tobar Inc., that supplies level transmitters for Seabrook (incl CBS) has changed their organizational structure to make engineering and QA insufficiently independent. This is related to Finding #3 above. The change in organizational structure violates Tobar's Product Integrity Manual PI-1 Section 2.2 which requires periodic updating of PI-1 Nuc Qual Programs and PI-2 with formal notification of changes to holders of controlled copies of the Manual. Group A transmitters have not yet been shipped for Seabrook Unit 1.

6. UE&C Drawing C509037, Rev. 0 10/5/81 "Block Diagram," contains safety related equipment but is not marked in accordance with IEEE Std 494-1974. This is in violation of GEDP 0013 Rev. 3, 3/30/81 and AP 28, Rev. 6, 1/4/83. Numerous Westinghouse drawings, Tobar and Barton (W subs) drawings also do not contain the nuclear safety related identification.

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7. Barton model 351 bellows pressure transmitter is used to transmit a pressure signal representative of containment pressure to a tranducer placed outside containment WCAP-8687, July 1981 indicates that the

sensing line must be filled with Dow Corning 702 silicon oil to be qualified for the expected environmental conditions. The Westinghouse specification sheet applicable to these devices allows either oil or water. (Spec sheet 325 NAH 1141, Rev. 1, 10/17/79, Rev. 7, 6/9/82 and Rev. 9, 1/24/83). Westinghouse drawing 8765052, Rev. 3, 9/1/82 specifies Dow Corning 702 silicon oil. The instruments are not installed. UE&C has not approved Rev. 3 of the W drawing. Rev. 2, 2/20/78 of the drawing speciifes water fill and was approved by UE&C 1/4/83. Hence, the currently approved drawing and the required instrument line fill material are inconsistent.

8. Westinghouse PO 546-ALC-285480-BN 7/26/78 specifies 10 CFR 21 as applicable to ITT Barton pressure transmitters for containment pressure. ITT Barton Engineering Instruction EI-016, sheet 3 of 5 "Baseline Parts List Preparation Instructions" original issue date 3/25/81 specifies required entries on the bill of material lists. On ITT Barton bill of material lists a space is provided for indicating that 10 CFR 21 applies. Six bill of material lists for the transmitter were reviewed. None contained reference to 10 CFR 21.

9. On 11/12/81 Westinghouse submitted environmental and seismic test reports (WCAP-8687, Supplement 2, Rev. 1, E16A & E16B dated 7/81) on their solid state protection system. This report was not entered into the foreign print system in violation of AP-29, Rev. 7, 4/12/83 Section IV, Procedure, Step 3. (It was logged in after being discovered during the inspection.)

10. UE&C CBS Schematic Diagram M-310900 Rev. 9 6/29/83 does not agree with Westinghouse Solid State Protection System Interconnection Diagram, Sheets 20, 26, and 32, Revision 4, 6/21/83, foreign print 70073-7. 23 solid state output relay contacts were checked, 3 differences were found.

11. Gould Qualification Report CC-323 74-93 Rev. 1, 11/9/82, states that "following seismic, tests were conducted to confirm the Class 1E functions of various devices including thermal element trip settings." A review of this report does not provide direct evidence that Class 1E and non-class 1E type E22 and BQ circuit breakers used in control circuit applications have been verified for fault current interruption capability following the seismic and aging tests. YAEC has stated that associated circuit fault currents, postulated from failure on non-Class 1E loads, are interrupted by circuit breaker operation; however, this statement cannot be confirmed from material present at UE&C. UE&C has reviewed Gov'd proprietary qualification documents and has stated their acceptability, but has not explicitly confirmed the fault current interruption aspect in the breakers subjected to seismic tests.

12. FSAR Appendix 8A, Section 5.1.2 and IEEE Std 384-1974 require exposed Class 1E raceways to be marked distinctly and in a permanent manner to identify Class 1E separation groups at 15 foot intervals and at points of entry to and exists from enclosed areas. This is not done for conduits. Conduits are marked at each end. In a telecon between YAEC and UE&C on 6/20 and 23/80 UE&C argued that the 15' markings were

not needed. YAEC concurred and requested UE&C provide written justification. Such justification was not provided. Note that the FSAR Section 8.3.1.4 states that raceways are identified at each end and at both sides of walls, floors and in-line boxes in conflict with Appendix 8A, Section 5.1.2.

13. W System Description NAH/NCH-284, Rev. 1, date August 1976 requires in Section 3.2.4.3.d that valves HCV-606 and HCV-607 be left in the full open position during normal operation to maximize flow from this system to the reactor coolant system during the injection phase of safety injection system operation. However, the valves are controlled by manual hand switches with two positions, open and modulate. In the modulate position, the valves are controlled by current to air converters. No automatic protection system signal is provided to cause the valves to move to full open position when needed. This is considered a violation of IEEE Std 279-1971 Section 4.12. Failure to move both valves to the full open position will degrade the performance of both RHR trains simultaneously.

Similarly bypass valves RHHCV 618 and 619 provide bypass around the RHR heat exchangers. Hand switches without automatic protection system override are provided for these switches also. Failure to move these valves to the close position results in reduction of RHR cooling.

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Failure to move valves 606 and 607 to the open position and failure to move valves 618 and 619 to the close position could seriously degrade RHR performance.

The current to air converters for all four valves are not safety-related. Failure of the 606 and 607 converters can cause loss of flow through the RHR heat exchanger. If at the same time the 618 and 619 converters do not fail, RHR flow is lost in the effected trains.

14. UE&C Specification 9765-006-171-1, Instrument Racks, Rev. 3, 3/14/80, requires Mercury of Norwood to procure and install safety-related terminal blocks in junction boxes for in-containment and ex-containment locations. The UE&C specification calls for States Co, ZWM terminal blocks. The Mercury of Norward Bill of Material DW-N19691-702, Rev. 3 12/3/82 requires the States Co. terminal blocks. The Bill of Material is labeled Seismic Nuclear Safety Related. The Mercury of Norwood purchase requisition specified the States Co. ZWM terminal blocks and identified the purchase as "Nuclear-NO," Mercury Purchase Requisition 68306-N1969 5/10/82 and 66180-N19691, 12/12/80. Mercury QA reviewed and approved the Purchase Requisitions.

A letter from States to Mercury dated 3/23/77 stated the ZWM terminal blocks are not qualified IEEE Std. 323.

On 5/9/80 Mercury informed UE&C that the terminal blocks were not qualified (by telecon). (Mercury telecon note) UE&C directed Mercury to use the terminal blocks.

On 3/30/81 Mercury notified UE&C by letter that the States terminal blocks were not qualified. On 4/13/81 UE&C letter SBV 43972 to Mercury to buy the terminal blocks and submit qualification documentation. For blocks inside containment PSNH ltr SB-14522 11/18/82 recommended replacement of the States blocks with Weidmuller Blocks. We have not reviewed qualification of these replacements.

15. UE&C Specification 9763-006-171-1 Instrument Racks, Rev. 3, 3/14/80 requires procurement of wires for use in-containment and outside containment and specifies an accident temperature, pressure and radiation environment. Mercury of Norwood purchase order #66166 12/9/80 to Rockbestos and 66165 12/9/80 to Dekoron did not specify the temperature, pressure, or radiation listed in the UE&C specification. Mercury cited IEEE Std. 383 that references IEEE Std 323. The maximum temperature/time profile in the UE&C specification exceeds that specified in IEEE Std 383/323-1974. The radiation specified in the UE&C spec exceeds that specified in IEEE Std. 383.

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16. UE&C specification 9763-006-171-1, Instrument Racks, Rev. 3, 3/14/80, requires wires in accordance with IEEE 383 and 323. Upon receipt of the wire Mercury QA receiving inspection report 66165 dated 1/12/81 accepted the wire documentation as acceptable. The documentation received only

addressed the wire flame retardance and not environmental qualification as required by IEEE-Stds 383 and 323.

17. UE&C Specification (same as #16) requires submittal of qualification documentation from Mercury of Norwood to UE&C (Sections 2.7.3 and 4.6). The qualification documentation was not provided to UE&C. Further the UE&C vendor surveillance check plan for the Mercury contract, Rev. 2 9/15/82 does not list environmental qualification reports to be reviewed by UE&C in violation of UE&C QA-7-2, Rev. 15, 10/31/81.

18. The containment enclosure emergency exhaust filter system is an ESF system that starts automatically after an accident to maintain -1/4" WC pressure in the Containment Enclosure. Control hand switches (one per train) are provided with two positions (open and auto). The switches are normally in the auto position so that when the system starts it will be able to maintain the prescribed negative pressure. In the auto position these switches allow current to air pressure controllers to adjust the fan vortex inlet damper that controls to the prescribed negative pressure. These current to air pressure controllers are not safety related and are unqualified. If they are exposed to a severe environment or seismic event they can fail and cause the fan vortex inlet dampers to close. If both I/P converters fail in that manner both trains are rendered inoperable. This is a violation of IEEE Std 279-1971, IEEE Std 379-1972 and Reg. Guides 1.52 and 1.53.

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19. UE&C Specification 9763-006-170-1, Main Control boards, Rev. 5, 11/2/81 requires York Electric Panel to submit to UE&C for approval documentation to support wire flame retardance and environmental qualification per IEEE Std 383-74 and IEEE Std 323-74. York received certificates of conformance and some test data, all of which was not submitted to UE&C in violation of the above UE&C Spec.

20. UE&C Quality Control Vendor Surveillance Check Plan for specification 9763-006-170-1, Main Control Boards, Rev. 5, 11/2/81, identifies that IEEE 323 qualification documentation and IEEE Std 383 flame test reports for wiring be sent to UE&C for review and approval as specified in Section 3.14 of the specification. This documentation was not submitted to UE&C in violation of the QC check plan and UE&C QA procedure QA-7-2, Rev. 15, 10/31/81.

21. A seismic event could cause simultaneous failure of both trains of the primary component cooling water system.

Contributing causes are:

1. Use of non-safety current to air converters for valve controls in the PCCW. C/I converters are TY 2171 4 and 5, and TY 2271 4 and 5.

2. Lack of separation of safety and non-safety wiring in wire bundles contained in panels CP108A and B.

3. Lack of separation of safety and non-safety wiring on terminals of 2 transfer switches (SS-2171 and SS-2271).

The safety signal used to position primary component cooling water system valves to their safe position is defeated by the above.

21.A Primary Component Cooling water heat exchangers operability is controlled by non-safety current to air pressure controllers in both trains. Control wiring for these current to air pressure controllers is physically tied together (in each train) with safety related wiring for safety related solenoids (one each train) which are used to control the position of the heat exchanger outlet and bypass valves. These safety and non-safety wires are connected to the same remote transfer switch in each train. Failure of the non-safety related equipment can cause incorrect control signals, grounds, hot shorts between conductors, open circuits, or hot shorts between transfer switch terminals. Such failures could cause energization of the safety related solenoids on the heat exchanger valves simultaneously in both trains. Energization of these solenoids will revert control of the heat exchanger valves to the failed non-safety current to air converters that cause the valves to close. Closing these valves causes failure of the PCCWS (both trains).

22. UE&C Specification 9763-006-174-2 Rev. 10, 7/1/83, Electronic Controllers and Racks, requires isolation devices be provided to insure that any malfunctions of non-safety related instrument loops will not effect safety related instrument loops. No isolation devices were provided in panel

CP-152B where non-safety instrument loops are in the same panel as safety related instrument loops.

23. UE&C Spec 170-1, Rev. 5, 11/2/81 requires York Electric Panel to procure and install Master Specialties Co. Series 90k backlighted push button switches on the main control board for use with safety related status monitor lights. These switches are required to be seismically qualified. York did not obtain seismic qualification documentation for these switches as required by the specification, sections 2.5.2.5, 3.11.3.5 and 3.14.

24. UE&C Spec 170-1, Main Control Boards Rev. 5, 11/2/81 requires York Electric Panel to procure and install safety related seismically qualified terminal blocks for use with safety related circuits. York procured ETC terminal blocks as NON safety related and without seismic qualification. These terminal blocks are used as shipping split points on the main control board sections. This involves Class 1E circuits for valve position status lights, Class 1E value controller power supplies, Class 1E system status lights, status lights for the reactor trip circuit breakers, SI cross connect valve control circuit, and pneumatic-operated containment isolation valve control solenoids.

~~(As detailed equip #5)~~

25. RHR valves IRH-HCV-606 and 607 have non-safety limit switches wired to the Class 1E main control board system status monitor light panels

MM-UL-2 and 4 (Trains A and B). These lights display status of ECCS injection valves and pumps and containment isolation valves. The RHR valve position switches do not have seismic qualification documentation. The same thing is true for associated push to test buttons and terminal blocks (no qual doc). Ground faults in these circuits could disable the Class 1E system status monitor panels for both A and B trains, if a seismic event were to occur.

26. PSNH prepared a main plant computer specification #146-01 , Rev. 9, 6/3/82 (Foreign Print 71132). Standard design control provisions have not been used. No signature indicating preparer, review and approval are given on the document.

DRAFT

ECW

Shewmaker

10

Conf. Call - Seabrook IDI - 1/16/84 Start 9:18 - 10:35

NRC - Lipinski & Shewmaker

YAEC - Don Johnson]

UE&C - Kalawadia, Dilip Ghosh, Vinnie Patel, Girish Hetwal

Anil Shah

SAG - Majumder

Target to complete @ 10:30AM due to Shewmaker's mtg

F 4-3 Technical memos related to input to analysis

SB-SAG number are considered controlled

in the controlled under GEDP

Johnson call into Kal's mtg room

Technical input all controlled ⟶

Others were not considered necessary for control

review AP-2; GEDP-0005; ~~re~~look at individual documents

Kalawadia will send in next week. Clarification of

27 items

F 4-4 They rechecked and did a calculation set and the joint is OK. We will so state in the report.

Hetwal

A4

F 4-5 They have talked to Burdette; agree they had no QA requirement; had control over specimen's QA

Ghosh

Kalawadia will review

F4-7 CS-15 : they are reviewing; they may be able to let us know the outcome and we can include

F4-8 Calc. is updated; pages have been voided etc.
→ we can make a statement

F4-10 Calc. set has been updated and corrected ϕ ~~factor~~;
had adequate margin
we'll make statement – rebar req'd < provided

F4-11 Calc. set Rev. 2 was being worked on at the time of the inspection; OBE will be shown to be a governing case.
Calc. Set ~~has been~~ will be revised ; ~~OBE still controls~~
Rev. 2 & 3 will be available

F 4-13 Will make calculations on the eccentric condition

Tank Farm Design Basis – Tornado
→ they are reviewing documents
may revise SD-66 or FSAR

Modeling TF – Conf. with Gunnar
4-17 & 4-18

F 4-19 Stiffness of joint may be a factor; They are doing additional calculations

F 4-20 Currently have a calc. set. that show the design is OK.

F 4-21 Note has been revised ~~on~~ drawing

F 4-23 Going to review SD-66, may revise; may also require changes to FSAR

1:30 PM — 1:4~~4~~ all but Kal
Don Johnson, Patel, Shah, Majumdar
Hausteed & Shewmaker

4-17 & 4-18 $\boxed{\text{Dwgs}}$ 111821, 111814

Will Revise model