NUREG-0948

Special Inspection Report

of the Quadrex Corporation Report on Design Review of Brown and Root Engineering Work for the South Texas Project Units 1 and 2

Docket Nos. 50-498 and 50-499
License Nos. CPPR-128 and CPPR-129

Houston Lighting and Power Company

U.S. Nuclear Regulatory Commission

Division of Resident, Reactor Project and Engineering Programs
Region IV

C. R. Oberg

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ABSTRACT

This report is the NRC staff s review of the South Texas Project's "Quadrex Report." The Quadrex Report contained a limited assessment of the Brown & Root engineering design efforts for STP. This design review was conducted during January-May 1981 by the Quadrex Corporation at the request of Houston Lighting & Power Company. Subsequently, the Quadrex Report will become the subject of a public hearing to be held by the ASLB at a later date.

In November 1981, HL&P announced that Bechtel Power Corporation would replace B&R as the AE. As a result, Bechtel was assigned the task of resolving the Quadrex findings. Their report, EN-619 (Quadrex Work Package) was completed in September 1982.

In February 1982, Region IV requested HL&P to provide information on their transition program pursuant to 10 CFR 50.54(f). Information on the Quadrex Report resolution was specifically requested. A NRC team composed of personnel from OIE, NRR, and Region IV conducted the staff review, principally in the Bechtel offices in Houston, Texas.

This report details the results of the review of approximately 351 separate Quadrex findings. Each finding was reviewed for reportability under 10 CFR 50.55(e), safety significance and generic implications, and adequacy of resolution.

Assessments and conclusions are given in the report along with the individual inspection findings.

U. S. NUCLEAR REGULATORY COMMISSION
REGION IV

Report: 50-498/82-12
50-499/82-12

Dockets: 50-498; 50-499

Licensee: Houston Lighting and Power Company (HL&P)
P.O. Box 1700
Houston, Texas 77001

Facility Name: South Texas Project, Units 1 and 2

Inspection At: South Texas Project, HL&P/Bechtel, Houston, Texas

Inspection Conducted: September 12-October 8, 1982

Quadrex Report Coordinator: C. R. Oberg — 1/7/83
C. R. Oberg, Inspection Specialist, PAB, OIE — Date

Reviewed by: W. A. Crossman — 1/7/83
W. A. Crossman, Chief — Date
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Division of Resident , Reactor Project &
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Inspection Summary

Inspection Conducted During the Period September 12-October 8, 1982 (Report 50-498/82-12; 50-499/82-12)

Areas Inspected: HL&P activities relating to the resolution of the Quadrex Report findings and Bechtel's assessment and review of the Quadrex Report. This inspection period involved 477 inspector/engineer-hours by 13 NRC staff members.

Results: No violations or deviations were identified. All Quadrex findings were satisfactorily resolved or dispositioned. However, followup of selected items was found to be required to assure proper implementation of the proposed corrective action. All findings were considered to be closed.

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Executive Summary

The Quadrex Report on the B&R engineering effort for the South Texas Project was reviewed by a team of NRC staff personnel from Region IV, OIE, and NRR. The results of that review are contained in this report.

The Quadrex Report was a three volume report which made findings in the following areas.

Generic Findings
Civil/Structural Findings
Computer Code Findings
Electrical/I&C Findings
HVAC Findings
Mechanical/Pipe Rupture Findings
Nuclear Analysis/Mechanical Analysis Findings
Piping and Supports/Stress Analysis Findings
Radiological Control Findings
In-Service Inspection and Maintenance Access Findings

The purpose of the staff's review was threefold: (1) to determine if reportability requirements of 10 CFR 50.55(e) had been met; (2) to identify those findings that had safety significance and/or generic implications; and (3) to assess the adequacy of each finding resolution.

A series of documents were used during the staff's review in addition to the Quadrex Report (Section 2.3.1). Of primary importance were the Bechtel Assessment Report (Section 2.3.2), EN-619, Quadrex Work Package (Section 2.3.3) and the transition program documents (Section 2.3.4).

Three hundred fifty-one individual findings were reviewed by the various team members. The results of that inspection and review effort are contained in Section 5.0 of this report. In addition, the findings for each discipline area were compiled in a summary statements at the beginning of that area.

The staff came to specific conclusions as a result of their review relative to the reportability, safety significance and the resolution of each finding. First they found that all items required to be reported under 10 CFR 50.55(e) had been reported although two items were not reported in a timely manner. Management reviews of the Quadrex Report had been conducted by HL&P to identify any reportable items. As a result, six items were reported as potential 50.55(e) matters. Upon subsequent completion of the HL&P detailed assessment, three were found not to be reportable. The reportable items included STP HVAC design (two findings) and (2) Computer Code Verification (one finding).

The staff further concluded that the 17 "generic" findings, identified by Quadrex, were not reportable. In addition, they determined that there was no requirement to report the Quadrex Report as a whole, under 10 CFR 50.55(e). The primary reason for determining non-reportability of the entire report was that the design had not been released for construction, with exception of those items reported.

The second conclusion by the staff was that all items important to plant safety had received adequate and timely attention. The staff identified each item's importance to safety and determined any generic implications. In the context of safety significance of the Quadrex items, it is important to note that the stated purpose of the Quadrex Report was to provide an insight into the adequacy of technical work of the B&R discipline areas reviewed. This was provided by utilizing a sampling program rather than an exhaustive detailed study. The findings were brought to the attention of HL&P so that they could inquire further into specific details of the Brown & Root design activities.

The final conclusion by the staff was that the Quadrex findings had been adequately resolved or dispositioned. In very general terms, resolved means that the finding has been or will be remedied by the normal Bechtel design procedures already in place. Dispositioned items are those that require a specific action to take place before final resolution and correction; however, plans for resolution had been determined. The staff felt that some of the Quadrex items were of sufficient importance to require additional review and followup. These findings are listed in Appendix A. They will be reexamined in future Region IV inspection reports or through the normal FSAR/OL review process. Inclusion of an item in Appendix A does not mean unsatisfactory resolution or disposition.

For purpose of the Quadrex Report review, all findings were considered to be closed.

1.0 Introduction

Houston Lighting and Power Company (HL&P) initiated a review of Brown & Root (B&R) STP engineering design activities in January 1981. This review was performed by the Quadrex Corporation of Campbell, California and resulted in a three volume, 514 page, report issued in May 1981, entitled "Design Review of Brown and Root Engineering Work for the South Texas Project" (the Quadrex Report). This report details the results of the NRC staff review of that report.

1.1 General Background

The primary task assigned to the Quadrex Corporation was to determine the technical adequacy of the STP design. This assignment was to be accomplished not through a detailed review of each and every aspect of the B&R design effort, but rather, by reviewing a limited number of selected areas. The area selection was based on the fact that certain areas had been problems in the past for other A/E's or posed problems unique to nuclear design. It was felt this approach would give a representative indication to HL&P of the B&R design status in a timely manner.

Volume I of the Quadrex Report contained approximately 310 Quadrex findings. The term "Quadrex Finding" or "Quadrex Issue" was used to identify those concerns regarded as examples of technical problems present in the STP design or in the design process used by B&R. The findings covered selected technical areas grouped as follows:

Civil/Structural/Geotechnic
Computer Codes
Electrical/I&C
HVAC (Heating, Ventilation, and Air Conditioning)
Mechanical/Pipe Rupture/ASME III
Nuclear Analysis/Mechanical Analysis
Piping and Supports/Stress Analysis
Radiological Control

Generic and specific technical discipline findings were included in Volume I. Generic findings were those determined by Quadrex to be applicable to most of the technical areas and were based on a detailed evaluation of the discipline findings. In addition to the technical areas given above, In-Service Inspection (ISI) and access problems were examined and the findings were also documented in the Quadrex Report. The Quadrex Report was formally submitted to the NRC on September 28, 1981. Section 3.2.1 contains additional information on the Quadrex Report.

At about the same time, HL&P announced that the construction management and architect/engineering functions at the STP had been reassigned from B&R to Bechtel Power Corporation (BPC). Also, during this time period, Bechtel was requested by HL&P to perform an assessment of the Quadrex findings. A special Task Force, was assembled to conduct this review. Their efforts were documented in a report entitled "An Assessment of the Findings in the Quadrex Report, dated May 1981." This report was forwarded to Region IV on March 15, 1982. Section 2.3.2 contains additional information on this report.

HL&P described a plan for an orderly transition of responsbilities from B&R to Bechtel in a letter to NRR, ST-HL-AE-766, dated December 11, 1981 (Document 22 in Table 4, Section 2.3.5). Although not specifically identified in this letter, there are two phases to the transition program: Phase A and B. When used in the resolution of individual findings, "Phase A" means that period where Bechtel efforts were concentrated on an indepth review and statusing of the construction and design work accomplished by B&R on the STP facilities.

"Phase B" indicates the period in which actual construction and design activities will be commenced. While these phases do not have a discrete time of stopping/starting, they are related to the status of individual systems and their readiness for starting or continuing design or construction work.

In light of these developments, the Region IV Administrator issued a request for further information pursuant to 10 CFR 50.54(f). [1/] With regard to the Quadrex Report, HL&P was requested to "--- describe the corrective actions for substantive issues raised in the Quadrex Report, and (to) provide the rationale for eliminating any issues for which no corrective action is to be taken." Responding to this inquiry, HL&P outlined their program for disposition of the Quadrex findings in a letter on April 22, 1982. (Document 17 in Table 4, Section 2.3.5)

HL&P's general plan for resolving the Quadrex items was to incorporate them into the systematic review of the status of B&R engineering being done by the BPC transition team. The detailed results of that review were documented in engineering work packages (WP's). During the design review, the cognizant system engineers reviewed the applicable Quadrex findings, and, using the Task Force Report as guidance, identified "Action Items," or actions necessary to review the status and complete the STP design. They documented their findings and intended actions in the appropriate engineering work packages.

1/ NRC (RIV) letter to HL&P dated February 12, 1982.

As part of their review, Bechtel assembled a unique Quadrex Compliance WP, EN-619. This interdisciplinary work package consisted of a summary of individual Quadrex findings with an evaluation and disposition. It also included a resolution of all generic and discipline Quadrex findings not addressed in separate discipline work packages. See Section 2.3.3.

2.0 NRC Quadrex Report Review Activities

This section of the report discusses the purpose (Section 2.1) and the general approach taken by the NRC for review of the Quadrex Report (Section 2.2). Section 2.3 discusses the principal documents used in the NRC review of the Quadrex Report.

2.1 Purpose of NRC Region IV Quadrex Review

A review of the Quadrex Report was undertaken by NRC Region IV, OIE, and NRR with three primary questions in mind: (1) Have all reportable 10 CFR 50.55(e) items been identified to Region IV; (2) What, if any, Quadrex items have a potential impact upon plant safety; and (3) Are the resolutions of the Quadrex items adequate? A related question was to determine if any enforcement actions were indicated. A summary of the answers to these questions is discussed in Section 3.0. The detailed results of the NRC review team's efforts for each Quadrex finding are found in Section 5.0.

2.2 General Approach

It was not the intent of the NRC staff's review of the Quadrex Report to either verify the validity of the Quadrex Report or to conduct a technical review of the STP design. Rather the staff's review focused on the resolution of the findings, assuming the findings were valid. B&R had made an assessment of the Quadrex findings (Document 19 in Table 4, Section 2.3.5). However, since B&R was no longer the AE, this document was used for information only, and not considered in the staff's conclusions.

Review of the Quadrex Report by NRC personnel (from Region IV, OIE, and NRR) was accomplished in two phases. Phase I consisted of gathering information and documents relating to the Quadrex Report; discussing the report and other information with the licensee and other personnel where clarification was needed; and subsequent in-office assessment of those pertinent documents. Meetings during Phase I were identified in Region IV's monthly report on STP activities.

Phase II consisted of a detailed review of each of the Quadrex Report findings and its resolution by BPC and HL&P. Dates of reviews and personnel contacted during Phase II are listed in Section 4.0 of this report.

2.3 Documents Reviewed

This section contains a summary of the principal documents utilized in the review of the Quadrex Report. Additional documents, procedures, and work packages utilized are given in Tables 4, 5, and 6.

2.3.1 Quadrex Report

The purpose of the Quadrex Corporation's task ". . . was to ascertain the overall technical adequacy of the STP design" (Quadrex Report, page 1-1). It was stated in the report that a sampling program was utilized and that the study was not an exhaustive review of the design effort at STP. Rather the intent was to provide an indication to HL&P of potentially weak areas that would require further detailed study and inquiry.

Some of the Quadrex assessments of the "Questions" (Volumes II & III) contained recommendations or proposals for HL&P/B&R to do specific activities. Attention was given to those recommendations that did not result in a finding (in Volume I) in order to determine their significance and relationship to the entire report. HL&P had committed to review Volume II and III for these types of items. (See NRC Inspection Report 50-498/499/82-08, page 11). However, HL&P did not identify any additional significant findings.

Some of the findings were found by BPC to be invalid or incorrect and not requiring any further action. Nevertheless, all Quadrex items were reviewed by the NRC team to ensure that appropriate action was taken for their resolution before it was determined that no further action was necessary. Details of each finding is included in Section 5.0 of this report.

Table 1 is a summary of the Quadrex finding rankings and their definitions. These definitions, generated by Quadrex Corporation, provide additional insight into the scope and intent of the Quadrex Report.

TABLE 1

Summary of Quadrex Discipline Rankings
By Line Item*

Ranking/ Discipline**	(1) Most Serious	(2) Serious	(3) Note-worthy	(4) Potential Problem	(5) Other	Total
Civil/Structural	10	0	6	9	8	33
Computer Codes	7	0	0	5	1	13
Electrical/I&C	19	0	2	12	1	34
HVAC	8	1	0	19	2	30
Mechanical Pipe Rupture	18	2	11	20	3	54
Mechanical	7	2	2	8	1	20
Nuclear Analysis	18	1	4	3	0	26
Mechanical Analysis	5	0	1	6	2	14
Piping & Supports	17	4	7	12	1	41
Radiological Control	11	9	1	24	0	45
TOTAL	120	19	34	118	19	310

*Extracted from the Bechtel Task Force Report and presented here for clarification and ease in reference. "Line Item" is a Bechtel Task Force term to identify unique findings. Some Quadrex Findings have more than one line item.

**This BPC list does not contain generic findings or ISI and maintenance access findings.

(1) Most Serious Findings are those that pose a serious threat to plant licensability because either (a) the finding would prevent the obtaining of a license or (b) the finding could produce a significant delay in getting a license, or (c) the finding addresses a matter of serious concern to the NRC at this time.

This category has been further subdivided into those findings that are expected to pose a serious threat to plant licensability, and those findings that may pose such a threat at a future time or are matters that may deserve the attention of the licensing group.

(2) Serious Findings are those that appear to impact the generation of reliable power, but are not considered to be a serious threat to plant licensability.

(3) Noteworthy Findings are those that contribute to project schedule and/or cost increases, but do not pose a concern for either plant licensability or reliability.

(4) Potential Problem Findings are those that may or may not exist, and would require further investigation to determine. Once confirmed, these findings would fall into one of the other categories.

(5) Other Findings represent either relatively minor items or items that are not amenable to corrective action.

It was noted that the definitions of Quadrex rankings of Table 1 were all related in some respect to time and/or cost. Taken on this basis alone, it would appear that the Quadrex Report did not fall within the purview of the NRC. However, since most of the findings emerged from areas potentially important to safety and their related activities, all Quadrex items were reviewed for reportability, safety significance and generic implications, and adequacy of resolution. The Quadrex finding paragraph number was retained throughout the staff's report for continuity of identification.

2.3.2 BPC Assessment Report

The Bechtel Assessment Report or Task Force Report (TFR) (Document 11 in Table 4, Section 2.3.5) was prepared by a group of BPC personnel who were independent of other BPC STP responsibilities. The purpose of the report was to provide an early qualitative assessment of the significance of the Quadrex findings and to place them in perspective with regard to management and design actions necessary to permit timely resolution. Both the Quadrex Corporation and Brown & Root commented on the Task Force Report (Document 15 and 18 in Table 4, Section 2.3.5).

The TFR did not present a final determination of the significance or impact of each finding. However, it was used to confirm reportability of items and as input to each applicable engineering work package generated during Phase A of Bechtel's transition program. Table 2 contains a summary of the Task Force categories. Table 3 contains definitions of each category.

Three hundred ten Quadrex line items were examined in the Task Force report.* Of these only five were determined by BPC to be potentially reportable to the NRC under 10 CFR 50.55(e). Three of these had been previously reported in May 1981 when the Quadrex Report was initially presented to HL&P. Two were reported after HL&P received the TF Report.

*When the generic ISI and access "findings" are added to the 310 line item, the total number of items is 351.

The assessment report did not cover items in Section 4.9 of the Quadrex Report; however, they were covered during the BPC design review and included in EN-619. These issues were related to ISI and Maintenance Access, which were the result of a special investigation of the STP model.

Table 2

Summary of Task Force Categories
by Discipline*

	Category							
	1	2	3	4	5	6	7	Total
Discipline **								
Civil/Structural	0	0	2	3	2	8	18	33
Computer Codes	1	0	2	3	1	2	4	13
Electrical/I&C	1	3	0	2	6	15	7	34
HVAC	2	0	1	4	4	11	8	30
Mechanical Pipe Rupture	0	0	1	2	10	20	21	54
Mechanical	0	0	1	4	3	7	5	20
Nuclear Analysis	0	2	0	8	2	6	8	26
Mechanical Analysis	0	2	0	1	1	7	3	14
Piping & Supports	0	2	3	8	5	11	12	41
Radiological Control	1	1	1	5	5	22	10	45
Total Line Items	5	10	11	40	39	109	96	310

*Extracted from BPC report on the "Assessment of the Findings in the Quadrex Corporation Report" (Document 11) and presented herein for ease in reference.

**Does not contain generic finding or ISI and maintenance access findings.

Table 3

Definitions of Task Force
Categories*

Category 1: Potentially Reportable - 10 CFR 50.55(e)

This category is used to "flag" any Quadrex finding which may affect safety and/or quality and may be potentially reportable under 10 CFR 50.55(e). It must be recognized that this category does not imply an item is reportable, but only that it may be potentially reportable. The Task Force did not make any attempt to delve further into these particular findings to establish their actual reportability. This category does, however, demand that prompt attention be given to the particular finding in question.

Category 2: Action Recommended - Timing Sensitive

This category identifies findings wherein the assessment has concluded that an apparent problem exists and early action is recommended to correct it or investigate its consequences. Timing of the corrective actions is sensitive to minimize the impact on quality, project schedule, or economics.

Category 3: Action Recommended - Timing Not Sensitive

This category identifies findings wherein the assessment has concluded that an apparent problem exists and action is recommended to correct it or investigate its consequences. Timing of the corrective actions is not sensitive to minimize the impact on quality, project schedule, or economics.

Category 4: Added Investigation Recommended - Timing Sensitive

This category identifies findings wherein the assessment has established that additional action is necessary to determine if a problem exists. Timely action is recommended to analyze and assess the situation and to initiate corrective action as necessary.

Category 5: Added Investigation Recommended - Timing Not Sensitive

This category identifies findings wherein the assessment has established that additional action is necessary to determine if a problem exists. The timing of this investigation is not sensitive.

Category 6: Complete Ongoing or Planned Activities

This category identifies findings wherein the assessment has concluded that the ongoing QAR effort as described to the Task Force would have been adequate with no additional effort beyond what was already planned.

Category 7: No Further Action Recommended

This category identifies findings that, in the Task Force's opinion, represent:

- Work already satisfactorily completed
- A statement of fact requiring no action
- Findings for which the bases have already been resolved
- Inaccurate findings, findings incomplete or incorrectly stated, or items for which the current situation is satisfactory

*Extracted from BPC report on the "Assessment of the Findings in the Quadrex Corporation Report" (Document 11 in Table 4, Section 2.3.5) and presented herein for ease in reference.

2.3.3 EN-619 - Quadrex Work Package

EN-619 is an interdisciplinary Work Package (WP) addressing the evaluation, resolution, and disposition of each of the Quadrex findings. This report was forwarded to Region IV on August 26, 1982 (Document 20 in Table 4, Section 2.3.5), and was used as the primary source to determine the adequacy of the resolution of each Quadrex item. It was a summary of all WP actions on the Quadrex findings.

The discipline findings based on the project team's evaluation, were classified as "Resolved" or "Dispositioned." Most of the concerns in the Quadrex Findings were considered resolved. Findings were given a status of resolved when evidence existed that a particular item was not an issue or that methodologies or procedures were in place which either would remedy the underlying concern of the finding or preclude deficiencies of the type identified by Quadrex. The remaining concerns have been given a status of dispositioned. Dispositioned was indicated when a specific action must occur during the production phase of the project to either eliminate an actual deficiency or preclude such deficiencies. Dispositioned included assignment to the Project Work Package Action Item List and assignment of required completion dates for timing sensitive findings. The assignment to the Project Action Item List defined the action that must be taken by the responsible discipline to accomplish final resolution.

2.3.4 Transition Program Documents

An understanding of the procedure followed by BPC in accepting the transfer of responsibilities from B&R was necessary in order to adequately verify the resolution of Quadrex findings. Engineering Transition Procedures QE-001 and QE-002 were the primary means used to review the existing engineering design and the associated records. The information obtained was then used to assess the current status of the work, prepare costs and schedules, and identify outstanding items before accepting responsibility for the project. Ultimately, BPC will assume full responsibility for the engineering design, procurement, quality assurance, and construction management function.

The overall transition effort was divided into segments called Work Packages (WPs). A work package is an assemblage of documents which described the design, scope, and completion status of the STP engineering. The work packages are prepared from material supplied by B&R and turned over to BPC. Most of the packages involve a single system, structure or component. They are then cross-disciplined on major plant subjects in an effort to strengthen the interfaces between the systems. These packages are called compliance work packages. EN-619 is one example.

Work package final reports have a specified format. Briefly, a package contained a cover sheet (providing an appropriate means for signing off the package), a summary of the work to be done, the current status of engineering, an assessment of design verification, documentation and licensing, (including any applicable 10 CFR 50.55(e), 10 CFR Part 21, or Quadrex concerns); recommendations for significant corrective action, unresolved items, a summary of work to go; other organizations involved, a list of related work packages; any additional references, assumptions or special conditions, and items to be entered on the action item list. An assessment of the adequacy of design verification was also made in the final report.

Evaluation and analyses were done under the direction of the responsible engineering group supervisor (EGS). Each discipline developed a procedure, including check lists, for their analysis and evaluation efforts. Specific Bechtel Engineering Department Procedures (EDPs) were identified for use. Review plans were included for the examination of specifications, purchase orders, calculations, drawings, and FSAR and technical reference documents. Each review plan typically included the following:

(a) Scope of review,

(b) Specific references,

(c) Evaluation criteria,

(d) Consistency of items as related to critical design documents, and

(e) Status of system/structure/component reviewed.

Activities requiring work were identified on an STP Action Item List. They were identified in one of three categories:

(a) Critical activities (to at once),

(b) Final Report Items (from Work Package Lists), or

(c) Correspondence Items (from non-BPC organizations).

Upon completion, BPC submitted the final report to HL&P for approval. After acceptance by HL&P, the work packages were transferred into the implementation phase for continued development and resolution of outstanding items and identified deficiencies.

2.3.5 Additional Documents Reviewed

The documents listed in Tables 4, 5, and 6 were used during the inspection NRC review effort. Information contained in these documents were pertinent to the Quadrex Report, its findings and their resolution, and formed part of the bases of the NRC inspection findings. Table 4 lists the principal documents reviewed by the staff. Table 5 lists those BPC engineering procedures reviewed by the staff as part of its review of the Quadrex Report, and finally, Table 6 lists the WP related to EN-619.

Table 4

Quadrex Report Document List

Document 1	Quadrex Report, 3 volumes, dated May 1981
Document 2	B&R letter, Initial B&R response to Quadrex Report, dated May 8, 1982
Document 3	B&R letter, Quadrex Engineering Review, ST-BR-HL-40321, dated July 16, 1981

Document 4 B&R, Quadrex Engineering Review, GM-91311, dated September 11, 1981 (Preliminary Evaluation)

Document 5 B&R letter, transmittal of documents, ST-BR-YB-0069, dated December 14, 1981

Document 6 B&R letter, Quadrex Engineering Review, ST-BR-YB-0060, dated December 7, 1981

Document 7 Bechtel letter, Bechtel Task Force Update, ST-YB-HL-0247 MOC-82-00116, dated February 5, 1982

Document 8 HL&P letter, Quadrex Engineering Review, ST-HL-BR-6497, dated September 7, 1981

Document 9 HL&P letter, Task Force Review of Quadrex Report, dated February 12, 1982

Document 10 STP (Bechtel) Transition Procedure - Engineering, Rev. 0, dated January 15, 1982; Revision 1, dated May 12, 1982

Document 11 Bechtel Power Corporation Task Force Report - An Assessment of the Findings in the Quadrex Corporation Report, dated May 1981 (HL&P letter, ST-HL-AE-804, dated March 15, 1982)

Document 12 HL&P letter, ST-HL-AE-809, dated March 22, 1982 - Response to Request for Information Pursuant to 10 CFR 50.54(f) (Organizational Relationship)

Document 13 HL&P letter, ST-HL-YB-0507, HL&P Comments on Bechtel Task Force Report on South Texas Project Electric Generating Station, dated April 7, 1982 (Document 11)

Document 14 Bechtel Power Corporation (Ashley) letter dated March 10, 1982 regarding forwarding of Quadrex Corporation's comments on Task Force Report (Document 11)

Document 15 Quadrex Corporation letter, LS-82-032, dated March 2, 1982, regarding comments on draft report of Document 11

Document 16 Bechtel Power Corporation letter, ST-YB-HL-0408, MOC 82-290, Quadrex Issues, dated March 26, 1982. (Division of Responsibility Documents)

Document 17	HL&P letter, ST-HL-AE-821, dated April 22, 1982, Program to Disposition Quadrex Findings
Document 18	B&R letter, ST-BR-HL-46577, dated April 4, 1982, Comments on Bechtel Task Force Report and the Quadrex Review (Document 11)
Document 19	B&R Assessment of the Quadrex Design Review of the South Texas Project, April 1982
Document 20	HL&P letter, ST-HL-AE-870, dated August 26, 1982; Final Report "EN-619-Quadrex Work Package"
Document 21	HL&P letter, ST-HL-AE-889, date October 18, 1982, Revision to Final Report "EN-619-Quadrex Work Package"
Document 22	HL&P letter, ST-HL-AE-766, dated December 11, 1981, Submission of Transition Program Description

Table 5

Bechtel (STP) Engineering Department Procedures (EDP)

EDP No.	
2.13	Project Engineering Team Organization and Responsibilities
2.16	Project Design Group Functions
4.1	Design Criteria
4.2	Generic Engineering Documents
4.4	Project Design Standards and References
4.7	Bechtel Manuals
4.22	Preparation and Control of SAR
4.23	SAR Change Control
4.25	Design Interface Control
4.26	Interdisciplinary Design Review
4.27	Design Verification
4.28	Project Q-List
4.33	On-Project Design Review
4.34	Off-Project Design Review (Design Control Check List and Design Review Notice)
4.36	Standard Computer Programs
4.37	Design Calculations
4.43	Standard Project Document Numbering System
4.46	Project Drawings
4.47	Drawing Change Notice
4.49	Project Specifications
4.55	Project Material Requisitions
4.58	Specifying and Reviewing Supplier Engineering and Quality Verification Documentation
4.63	Supplier Deviation Disposition Requests
4.64	Review of Supplier Audit, Survey, and Inspection Reports
6.10	Supplier Quality Assurance Program Selection and Evaluation

Table 6

Work Package Reference List

Work Package No.	Title
EC-100	SSI STUDIES
EC-101	SEISMIC ANALYSIS-CAT I
EC-103	GEN STRUCT DESIGN CRITERIA
EC-110	REACT. CONT. BLDG-I
EC-111	RCB II-SHELL-GENERAL
EC-112	RCB III-SHELL-DISCONTINUITY
EC-113	RCB IV-STEEL, MISC
EC-120	RCB INTERNAL I-SHIELD WALLS
EC-121	RCB INTERNAL II-NSSS MISC
EC-122	RCB INTERNAL III-STRUCT STL RE
EC-130	MEAB I RELIMINARY
EC-131	MEAB II
EC-132	MEAB III
EC-135	MSIV CUBICLE
EC-138	DIESEL GEN BLDG
EC-140	FUEL HANDLING BLDG
EC-142	ECW IN & DISCH STRUCT
EC-145	TURB GEN BLDG
EC-151	CIVIL SITE AND YARD
EC-160	GEOTECH 1 - MOND & SETTLE
EC-161	GEOTECH 2 - ESS COOL POND
EC-162	GEOTECH 3 - FIELD DATA
EC-163	GEOTECH 4 - DESIGN DOCS
EC 165	CONDENSATE STORAGE TANK
EC-176	HVY CIV - FLOOD DESIGN
EC-177	HVY CIV - THERMAL ANALYSIS
EC-181	EDS PIPE WHIP REST-IN RCB
EC-186	DUCT SUPPORTS
EE-206	NON-CL IE 250VDC POWER SYSTEM
EE-207	125VDC PWR DIST NON-CL 1E
EE-208	NON CLASS IE 48VDC SYSTEM
EE-209	CLASS IE 125VDC SYSTEM
EE-210	120VAC VITAL PWR DIST CL 1E
EE-215	HEAT TRACE & FREEZE PROTECTION
EE-220	SEPARATION CRITERIA
EE-223	CABLE TRAY SUPPORTS
EJ-300	PLANT COMPUTER
EJ-301	CONTROL BOARDS
EJ-303	ESF ACTUATION SYSTEM
EJ-306	RADIATION MONITORING
EJ-310	INOPERABLE STATUS MONITORING ESF/MONITORING
EJ-314	REACTOR PROTECTION SYSTEM

EJ-315	PROCESS SAMPLING SYSTEM
EJ-316	LOOSE PARTS MONITORING SYSTEM
EJ-367	CONTROL VALVES
EJ-370	MISC. ANALOG CONTROL SYSTEMS
EM-400	REACTOR COOLANT SYSTEM
EM-402	RHR SAFETY INJECTION SYSTEM
EM-403	COMPONENT COOLING SYSTEM
EM-406	ESSENTIAL COOLING WATER SYSTEM
EM-407	REACTOR HEAD DEGASSING
EM-408	AUX FEEDWTR SYSTEMS
EM-409	STEAM GENERATOR BLOWDOWN
EM-410	STANDBY DIESEL GENERATOR
EM-450	MAIN & EXTRACTION STEAM
EM-451	CONDENSATE SYSTEMS
EM-452	FEEDWATER SYSTEM
EM-453	HTR VENTS, DRIPS & DRAINS
EM-454	CIRCULATING WATER SYSTEMS
EM-455	CONDENSER AIR REMOVAL SYSTEM
EM-457	TURBINE GEN & AUX SYSTEM
EM-501	FIRE PROTECTION SYSTEM
EM-503	AUX STEAM SYSTEMS
EM-508	AIR SYSTEMS
EM-510	STATION CRANES
EM-511	INSULATION
EM-550	STATION HVAC
EM-551	ELEC AUX BLDG & CONTR RM HVAC
EM-552	MECH AUX BLDG HVAC
EM-553	FUEL HANDLING BLDG HVAC
EM-554	DIES GEN & ECW PUMP BLDGS HVAC
EM-555	REACTOR CONTAINMENT HVAC
EM-556	TURBINE GEN BLDG HVAC
EM-557	MISC. BLDG. HVAC
EM-558	IVC-HVAC
EM-559	REAC CONT FAN COOLERS
EM-572	CHILLED WATER SYSTEMS
EN-600	LICENSING DOCUMENT REVIEW
EN-601	SYSTEMS INTERACTION AND INTERGRATION
EN-602	PRESSURE TRANSIENT ANALYSIS
EN-603	ALARA & SHIELDING CRITERIA
EN-604	ENVIRONMENTAL QUALIFICATION
EN-605	SAFE SHUTDOWN CRITERIA
EN-606	PROTECTION AGAINST NATURAL PHENOMENON
EN-607	IMPLEMENT POST-TMI CONCERNS
EN-608	Q-LIST
EN-609	INCORP NRC BULLETINS
EN-610	UNRESOLVED SAFETY ITEMS
EN-612	BORON RECYCLE SYSTEM
EN-613	CONTAMINATED DRAINAGE SYSTEM
EN-619	REVIEW QUADREX REPORT
EP-709	MODEL SHOP (122)

3.0 Staff Assessment and Conclusions

This section of the report sets forth the basic findings of the staff's review efforts. Section 5.0 contains the detailed results of the review effort.

3.1 Reportability

3.1.1 Discussion

10 CFR Part 50 requires, as a condition of a construction permit, that holders provide the NRC staff with prompt notification and timely information of deficiencies encountered during the construction of a nuclear power plant. A licensee is not obliged to report every problem encountered during the design and construction of the plant; however, by reason of 10 CFR 50.55(e), a construction deficiency must be reported when it:

(1) has been identified; i.e., found;

(2) relates to design, construction or modification activities conducted as authorized by a construction permit holder;

(3) could adversely affect the safe operation of a facility if it was not corrected; i.e., it is significant;

(4) and when the significant deficiency relates to one or more of the following:

(a) a breakdown in the QA program;

(b) a design released for construction;

(c) damage to a structure, system, or component;

(d) construction of a structure, system, or component;

(e) a deviation from performance specifications.

Review of the Quadrex Report for reportability of items was conducted by B&R and HL&P management within 24 hours of its receipt. As a result of that review, the following Quadrex items were reported to the NRC as potential 50.55(e) items:

4.2.2.1(a) Computer Code Verification
4.4.2.1(a) HVAC Design Basis
4.4.2.1(b) HVAC System Classification
4.8.2.1(d) Safety-Related Shielding Calculation

As a result of Bechtel's Task Force review of the Quadrex Report, two additional, but closely related, findings were reported:

4.3.2.1(a) FMEA/Single Failure Criteria
4.8.2.1(a) Instrument Air System Single Failure Criterion

Subsequently, HL&P determined the areas relating to findings 4.3.2.1(a), 4.8.2.1(a), and 4.8.2.1(d) were not reportable.

An NRC Investigation Report documented the results of an investigation of an allegation regarding the withholding the results of the Quadrex Report from the NRC. This investigation report included the timeliness aspects of reporting Quadrex Report 50.55(e) items. It did not include a survey of the Quadrex Report to determine reportability. NRC enforcement action was taken on timeliness of reporting for two of the items, Computer Program Verification (4.2.2.1(a)) and HVAC Design (4.4.2.1(a) and 4.4.2.1(b)). See NRC Investigation Report 50-498/82-02 and 50-499/82-02 and NRC letter to HL&P dated August 11, 1982.

The topic of reportability was considered as a three part question:

(1) Were any individual findings reportable?

(2) Were the generic findings individually or collectively, reportable?

(3) Was the overall Quadrex Report reportable?

Individual Findings

With the exception of those findings listed above, all other individual items identified in the Quadrex Report failed to meet the specific reportability criteria of 10 CFR 50.55(e).

Specifically, with the exception of the reported items, the design efforts which are the subject of the Quadrex Report had not been released for construction and thus do not meet the criteria of 10 CFR 50.55(e).

Generic Findings

Appendix B contains a complete list and analysis of generic concerns and their related findings as identified by Bechtel in EN-619. Some of the discipline findings were considered by Bechtel to apply to more than one generic finding. The following is a list, by Quadrex number and title, of these

findings in relation to reporting requirements and related findings. Note that discipline findings and reportable items apply to more than one generic finding.

3.1(a) B&R Systems Level Integration

Twenty related findings, one reportable. Primarily concerned with the manner in which B&R was conducting their engineering design operations.

3.1(b) B&R Review of Engineering Data

Twenty-seven related findings, none reportable. Concerned with review of vendor documents, checking input data, and review of calculations.

3.1(c) Plant Operating Modes and Environmental Conditions Analysis

Thirty-five related findings, two reportable. Primarily concerned with nuclear analysis group functions and work load.

3.1(d) Safety-Related vs Nonsafety-Related Distinctions

Twenty-two related findings, three reportable. Safety-related categorization of several items were found to be inaccurate or questionable.

3.1(e) FMEA and Single Failure Criterion Analysis

Eight related findings, two reportable. Primarily a lack of adequate written guidelines for conducting FMEA and single failure analysis.

3.1(f) FSAR Commitment Tracking

Thirteen related findings, none reportable. Primary concern is timely meeting of licensing/FSAR commitments.

3.1(g) Plant Design Basis

Forty-four related findings, one reportable. Primarily concerned with an apparent lack of consistent, documented design guidance.

3.1(h) Equipment Reliability

Three related findings, none reportable. Concerned with reliability requirements in procurement documents.

3.1(i) Nuclear-Related Analysis

Eighteen related findings, one reportable (HVAC). Relates to timeliness and amount of analyses conducted and scheduled.

3.1(j) Final Design Verification

Four related findings, none reportable. Primarily concerned with timing of verification of STP design.

3.2(k) Plant Operation Criteria

Four related findings, none reportable. Concerned with B&R's responsibilities for power production needs.

3.2(l) Use of Plant Symmetry

No related findings. Section 4.9 (ISI and Maintenance Access) of Quadrex Report refers to this item.

3.2(m) Valve Opening and Closing Rate

One related, but not reportable finding. Concerns safety-related valve operating rate.

3.2(n) Access Provisions

Nine related findings, none reportable. Concerned with lack of written criteria for providing adequate access for maintenance and ISI.

3.2(o) Test Provisions

Two related findings, neither reportable. Pertains to adequate testing provisions.

3.2(p) Local Temperature During Maintenance

Two related findings, one reportable. HVAC design basis for personnel working conditions.

3.2(q) Pipe Support Requirements

Four related findings, none reportable. Concerned with valve and piping supports.

Bechtel's review of the generic findings was included in Appendix D of EN-619. Their assessment concluded that, with one exception (3.2.(l)), there were no concerns in the generic findings that were not addressed in the specific discipline

findings and therefore, no additional special effort was required to resolve the generic findings.

The results of the staff analysis in Appendix B indicate that the generic findings neither individually or collectively, are reportable under the 10 CFR 50.55(e) requirements.

3.1.2 Conclusion

After review of the Quadrex items for reportability the NRC staff concluded that the requirements of 10 CFR 50.55(e) had been met. Timeliness of reporting of those items reported to the NRC was the subject of the investigation report previously noted where HL&P was found to not have reported two items in a timely manner. It is clear that individual items were reviewed by the licensee for reportability and that these items were processed through HL&P management.

The NRC staff also concluded that the collective array of individual and/or generic findings do not constitute a sufficient basis for reporting the Quadrex Report as a whole to the NRC under 10 CFR 50.55(e)(1)(ii). All reportable items have been identified to Region IV.

3.2. Safety Significance

3.2.1 Discussion

As part of the staff review of the Quadrex Report each finding was first classified for safety signficance, i.e., was the finding important to safety, or related to an activity (design, construction) that was concerned with items important to safety? Items that are "important to safety" include those structures, systems, and components that provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the public.* Once a finding was classified as significant to safety, the resolution was closely monitored to ensure adequate resolution.

The staff next judged each finding in order to determine any specific finding had "generic" implications. "Generic" means that the issue affected broad functions or areas important to safety at STP (or other nuclear plants). "Nongeneric" means that the item was not wide spread and was restricted to a relatively small area of endeavor. This staff judgment was determined on the basis of the initial Quadrex finding, not as the basis of any mitigating information from 3PC, or B&R data, or the finding resolution.

A summary listing of findings (by line item) for safety significance (and generic items) is shown in Table 7. The Quadrex Report although not primarily designed for or intended to be a safety analysis report it did, however, report on items that involved safety-related and safety-significant matters. The specific reason for the safety significant review was to identify those items that would have required direct and timely action by HL&P. The concern expressed to the licensee representatives by the NRC staff reviewers was that items of potential safety significance must be recognized and acted upon.

Findings that were identified as being "safety-significant" were examined in sufficient detail by the NRC reviewers to assure that adequate corrective action and proper disposition had been taken. Generic implications of each finding were considered in this evaluation.

*Note: This encompasses a broad class of plant features, covered (not necessarily explicitly) in the General Design Criteria, and that contribute in an important way to safe operation and protection of the public in all phases and aspects of facility operation (i.e., normal operation and transient control as well as accident mitigation). This also includes safety-grade (or safety-related) equipment and material.

Table 7

Quadrex Report Safety-Significant/Generic
Analysis by Line Item

	SS *	NS *	G *	NG *	TOTAL **
Civil/Structural	22	11	12	21	33
Computer Codes	11	2	6	7	13
Electrical/I&C	31	3	19	15	34
HVAC	28	2	4	26	30
Mechanical/Pipe Rupture/ASME III	56	18	10	64	74
Nuclear-Mechanical Analysis	28	12	0	40	40
Piping/Supports/Stress Analysis	26	15	7	34	41
Radiological Controls	40	5	1	44	45
ISI and Maintenance Access	3	21	3	21	24
Generic Findings	13	4	15	2	17
Total	258	93	77	274	351

*SS = Safety Significant
NS = Nonsafety Significant
G = Generic
NG = Non-Generic

**SS+NS = Total
G+NG = Total

Note: The total line items listed here include generic plus the ISI and maintenance access finding (line items) not counted in Tables 1 and 2. This table was developed by the staff.

3.2.2. Conclusion

The NRC reviewers concluded that all items which had safety significance and generic implications had been adequately considered and handled.

3.3 Resolution of Quadrex Findings

3.3.1 Discussion

The resolutions of individual findings of the Quadrex Report were reviewed and the results were documented in Section 5.0 of this report. Resolution of the findings by Bechtel/HL&P fell into two categories: (1) "Resolved" and (2) "Dispositioned".

(1) "Resolved" means that no further action was required in that the review had been completed or that methodology and procedures were in place to address the concern. In some cases, the "Resolved" issues may not have been completed or even started, (at the time of the NRC review effort) but the methods for handling them were in place.

(2) "Dispositioned" means that the licensee/Bechtel review had been completed and further action was waiting upon issuance of criteria or that the review was not complete, but a plan of action had been identified.

Two hundred twenty-three of the 310 line items were resolved. The remainder (dispositioned items) were assigned to the Project Work Package Action Item List (AIL). This list noted the action that must be taken and the discipline assigned to accomplish final resolution.

Each item of the Quadrex Report was discussed with HL&P/Bechtel representatives at the conclusion of the NRC reviews in the Houston STP Bechtel offices. Some of the dispositioned Quadrex items were of sufficient importance to warrent additional followup action. Where this is the case, it is noted in the staff review of the individual item set forth in Section 5.0. In addition, a list of these items is contained in Appendix A. Any followup action on items specified in Appendix A will be documented as appropriate in either Region IV Inspection Reports or as part of the licensing review by NRR. Inclusion of an item in Appendix A does not indicate unsatisfactory resolution or disposition.

3.3.2 Conclusions

All corrective actions necessary to resolve the dispositioned Quadrex Items have been included in the AIL.

All items have been appropriately considered by HL&P/Bechtel, verified by the staff reviewers, and documented in Section 5.0. Resolution of the findings has been completed and all items

were considered closed for purposes of the Quadrex Report review.

3.4 Enforcement

No evidence was found during the review of the Quadrex Report of violations of NRC requirements.

4.0 List Meetings by Lead Reviewers HL&P/Bechtel Personnel on Quadrex Report Resolution

Personnel Contacted

During the review of the Quadrex Report, discussions were held with licensee and AE personnel on the various findings and their resolution. A meeting was held at the beginning of each week to introduce the NRC reviewers to the appropriate licensee and AE personnel. Toward the end of each week an exit meeting was held. At this meeting each Quadrex item reviewed during the week was discussed and the results of the NRC review were presented to the licensee.

This part of the report lists, by week, these personnel contacted by NRC reviewers.

HL&P Personnel

Name	Position	9/12-17	9/20-24	9/27-10/1	10/4-8
C. Robertson	Lic. Mgr.	x	x	x	x
J. White	Eng. Spec. Coord.	x	x	x	x
P. Newcomb	Ld. Eng. HVAC	x			
L. Clark	Ld. Elec. Sys. Eng.		x		
W. Harrison	Ld. Eng. Phy. Design		x		x
C. Turner	Sr. Engineer		x		

Bechtel Personnel

Name	Position	9/12-17	9/20-24	9/27-10/1	10/4-8
J. Gormley	Eng. Specialist	x	x	x	
S. Bernsen	Proj. Lic. Manager	x	x		
R. Scott	Lic. Assistant	x	x	x	x
B. Lex	Proj. Manager	x			
D. Getman	Mech. Quadrex Coor.	x			
J. Hurley	Proj. Eng. System	x			x
B. Moreton	ME Grop Super.	x			
A. Gajjar	ME Group Super. HVAC	x			
F. Lapex	APE	x	x		x
R. Hemakom	Engineer				x
N. Jooneja	C/S DEGTS	x			x
S. Kancherla	C/S	x			x
S. Nathan	PSSG	x			
C. Tang	PSSG-Sp. Gr. Ldr.	x	x	x	x
R. Singh	PSSG	x			x
V. Starks	Mechanical	x			
L. White	Mechanical	x			

Bechtel Personnel (Continued)

Name	Position	9/12-17	9/20-24	9/27-10/1	10/4-8
M. Moreton	Con. Sys. Gr. Ld.		x		
W. Melton	NSSS Coord.		x		
J. Conley	Lic. Gr. Ld.		x		
H. Yerdos	Dep. EGS		x		
H. Hesihems	ISI EGS		x		
R. Pichett	MEAB/DGB Gp. Ld.		x		
J. Atwell	ALARA/Nuclear		x		
J. Shellabager	Nucl. Anal. Gr. Ld.		x		
R. Velorde	Elect. Eng. Gr. Sup.		x		

Note: The meetings listed above were considered as part of Phase II of the Quadrex Report review. Phase I meetings and personnel contacted were listed in the following monthly inspection reports on STP:

50-498/499/82-01
50-498/499/82-04
50-498/499/82-08
50-498/499/82-09
50-498/499/82-10

5.0 Detailed Listing of Quadrex Findings

This section sets forth the staff's review of each Quadrex finding. The presentation is organized by first quoting the finding as it appeared in the Quadrex Report. The findings are given in sequence and identified by reference to the number assigned to them in the Quadrex Report. Next, the Bechtel/HL&P resolution is given. Finally, the results of the NRC staff's inspection and review efforts are shown, and references used by the staff are presented.

3.0 GENERIC FINDINGS

GENERIC FINDINGS SUMMARY

The 17 generic findings are based on an evaluation of the discipline findings and do not represent any new findings. These findings principally address defects in the practices, policies, and procedures within the B&R design organization which Quadrex stated were applicable to most, if not all, of the disciplines.

Since B&R is no longer involved with the project, the Quadrex observations on the practices, policies, and procedures of B&R design are considered irrelevant and no longer applicable. Bechtel is now the architect/engineer and it is Bechtel's practices, policies, and procedures which are applicable to the STP design effort. The Bechtel design review should identify and resolve design problems which may have occurred as a result of the deficiencies identified in the Quadrex findings.

Bechtel plans to conduct design activities in accordance with the Bechtel Engineering Department Procedures set forth in Table 5. Based on past experience with these procedures and the current status of implementation at the STP, there is reasonable assurance that these procedures will preclude or detect the types of deficiencies described in the Quadrex Report.

The generic findings are considered to be satisfactorily resolved and therefore closed for purposes of the Quadrex Report review.

Finding 3.1(h), Equipment Reliability Requirements, will be reexamined upon completion of Bechtel's action on the related discipline findings. See Appendix A.

Quadrex Finding No.: 3.1(a)

B&R Systems Level Integration

There is no indication that an effective systems integration and overview function exists within the B&R design process.

Plant arrangements and equipment layout that take into account such factors as physical separation, system and equipment performance compatibility, access for maintenance and ISI, and other similar aspects, can be too easily overlooked or missed with the present design review process.

The technical disciplines are organized very tightly. A working interface relationship among the disciplines is not routine particularly regarding follow-through at the discipline input-output interface. Assigned responsibility for systems engineering is only a recent development. The Mechanical Group has come closest in the past to performing this role, but indicated that they are not permitted to review I&C logic diagrams. Other Groups indicated that Mechanical had responsibility for assuring adequate equipment layout in the plant; however, the Mechanical Group was also not aware of this responsibility. HL&P has indicated that their organization structure is closely aligned with that of B&R, and that no systems engineering function exists within the utility either.

A major concern is with the achievement of internal consistency among various design documents and the maintenance of that consistency over time with personnel turnover. For example, an overall plant separation scheme is needed to address the multi-disciplinary concerns of Piping, Mechanical, Electrical, I&C, HVAC, etc. This guidance, in the form of a TRD, does not exist; consequently, each discipline now provides their own interpretation and acceptance criteria using engineering judgment as to what constitutes adequate separation (see Question H-6).

Also, a multi-disciplinary interpretation of the single failure criterion does not exist in controlled documentation.

Licensee Action: Resolved.

The transition program and work package review plans are extensive and provide for the evaluation of the adequacy of systems integration and design interface to detect deficiencies that may have occurred due to this generic finding. Implementation of the Bechtel Project Team Concept using proven Bechtel practices, policies and procedures which stress the need for multi-level system integration activities, will be used on the project to deal with the concerns of this finding. Response to Finding 4.3.2.1(b) discusses issuance of a top level Systems Interaction Design Guide.

Quadrex Finding No.: 3.1(a) (cont)

Interface between safety-related sy ems and their connected systems and/or supporting systems will be identified. The functional relationships between these systems will be determined. The design adequacy of system interfaces will then be confirmed.

Reissu nce of separation criteria is discussed in Finding 4.3.2.1(b).

Access requirements for maintenance, ISI and operability will be evaluated as a part of the physical layout reviews which will be completed on a system-by-system and area-by-area basis.

The Project will implement procedures based upon Bechtel standards which delineate the minimum interdisciplinary interface requirements.

An overall plant separation program to address spatially-coupled interactions will be implemented as detailed in Section 6.0 of EN-601.

A comprehensive implementing document establishing the use of industry standards and regulatory guidance on a single-failure criteria application is not a mandatory requirement. In the short-term, continued use of implementing procedures on a typical or system basis is acceptable. It is; however, advisable for the purposes of assuring consistent application of the many aspects of single failure criteria, to provide STP specific comprehensive guidance for use in an integrated evaluation of these issues. Such a guidance document or program will be developed.

References: EDP-2.16, 4.1, 4.4, 4.22, 4.23, 4.25, 4.26, 4.27, 4.33, 4.46, and 4.49; EE-220; EN-602, 601

NRC Inspection Results: The referenced documents were reviewed. The NRC inspector agrees with Bechtel's resolution that Quadrex concerns have been resolved and are being properly taken care of. EN-601, in particular, addresses systems interaction and integration.

Systems integration should be achieved by following the Bechtel EDP Program as covered in their EDP's. Conversion to this system is covered in their work packages EN-601, EN-602, and EE-200. It was confirmed that the Quadrex concerns are being handled by Bechtel as indicated in the Project Team comments in the Finding Resolution Summary for this finding.

This item is considered closed.

Quadrex Finding No.: 3.1(b)

B&R Review of Engineering Data

(1) Input data to a technical group does not appear to be consistently reviewed by that group for its reasonableness prior to use (see Questions C-1, H-1, H-3, H-27, M-28, N-3, and N-9). Conversely, the technical groups do not consistently check to see that their output data is used correctly.

Proper control and use of input data from HL&P is also a concern.

(2) Calculations containing errors are being reviewed and verified as correct with a higher frequency than should be encountered (see Questions C-16, H-15, N-1 and N-17).

(3) B&R review of vendor submitted reports is not consistent; sometimes they are very well done, and at other times they are poorly done (see Questions M-41, M-49, M-51, M-52 and N-1). No documented criteria exists governing the evaluation process for vendor reports.

Brown and Root continues to pursue a policy that work performed by major subcontractors or suppliers, such as EDS Nuclear and Westinghouse, is design verified by these firms and can, therefore, be assumed to be correct. There is no evidence that analysis methods chosen by these suppliers are reviewed for acceptability and consistency. This policy raises many questions regarding overall technical adequacy at the interface with these suppliers; for example, no evidence was obtained that B&R is checking and approving analysis methods selected by Westinghouse.

Brown and Root does not provide adequate guidance to vendors stipulating acceptable analysis and testing methods, required data, and report format. Vendors are encouraged to select the analysis and/or testing method(s), and subsequent review of submitted reports serves as the focal point where inadequacies are detected and corrected (see Questions H-10 and M-46). This approach is neither cost-effective nor adequate, since examples of inadequate analysis methods approved by B&R have been observed.

Licensee Action: Resolved.

The transition program addresses the concerns of this finding for past activities. Bechtel's procedures and practices deal with these concerns for future activities. The response to finding 4.1.2.1(a) addresses reasonableness of data; 4.1.2.5(y) and 4.6.2.1(b) discusses calculations; and 4.3.2.4(t) discusses vendor review.

Quadrex Finding No.: 3.1(b)(cont)

The transition and work package review plans provide for the evaluation of the current design and resolution of noted deficiencies. The concerns of this finding are addressed by the work package review plans, especially calculations. An entire check sheet is devoted to reviewing calculations for accuracy, input data, etc. In addition, other programs (indicated by specific line items) have been established to provide for additional evaluations of noted deficiencies; e.g., see Appendix E relative to computer codes and calculations. The reasonableness and accuracy of Finding 4.1.2.1(a) calculations are discussed in the team assessments 4.1.2.1(j) and 4.6.4.1(b). See also related Generic Finding 3.1(i).

References: EDP-2.16, 4.1, 4.25, 4.26, 4.27, 4.34, 4.36, 4.37, 4.46, 4.49, 4.55, 4.58, 4.63, 4.64, and 6.10.

NRC Inspection Results: The staff reviewer agreed with Bechtel's comments that the concerns of this finding were addressed by the work package review plans. Transition procedures QE-001 and QE-002 provided for the evaluation of the current design and resolution of any noted deficiencies. Bechtel procedures that address the problem of the review of engineering data are listed above.

The Quadrex concerns were being handled by Bechtel as indicated in the Project Team Comments in the Finding Resolution Summary for this finding.

This item is considered closed.

Quadrex Finding No.: 3.1(c)

Plant Operating Modes and Environmental Conditions Analysis

Thorough and consistent treatment of various plant operating modes and environmental conditions was not evident.

No written design bases are provided to guide the designer in what combinations of events and plant modes must be considered. Consideration of degraded equipment performance was also not evident.

Design criteria provided in issued System Design Descriptions (SDDs) and Technical Reference Documents (TRDs) appear to adequately reflect industry issues for the 1973-1975 time frame; however, they do not adequately address more recent developments (without consideration of TMI-2 concerns) such as loss of off-site power, environmental conditions in specific plant areas, postulated failure modes, and anticipated operating conditions degraded from a normal, full-power, all equipment operable initial assumption. Casualty events, for example, were only added in late 1979 to the FW and HVAC SDDs.

In many instances, the initial condition assumed for system design was stated to be "normal plant operation;" however, this assumption by itself is simply not a sufficient basis for design. Many analyses have been based solely on an assumption of normal plant operating conditions. There is little evidence that other plant operating modes, such as partial power, load shifts, startup, shutdown, pre-op testing, startup testing, normal plant testing, refueling, maintenance, transients, and accidents have been considered. Furthermore, assumed "worst case" conditions may not properly bound the set of anticipated plant conditions (see Questions H-3 and N-17). STP is the first plant to use the Westinghouse three train ECCS configuration; consequently, it is important that any worst case assumptions used to bound the plant analysis be both complete and accurate.

For example, assumptions regarding door and hatch positions seem unrealistic based on plant operating experience (see Questions H-3, H-14, and N-8).

Failure to consider the loss of off-site power condition in a timely manner has led to recent MAB, EAB, and FHB studies and the need to designate and upgrade certain HVAC systems to be safety-related (see Question H-5). Prior to initiation of these studies, HVAC outside containment was designed for normal plant operating conditions.

The absence of postulated line cracks and breaks outside containment in the MAB and FHB is inadequate (see Questions M-3, M-5, N-1, and N-3). Similarly, the inability of Nuclear Analysis to develop appropriate environmental conditions for these areas in a timely manner is also inadequate.

Quadrex Finding No.: 3.1(c)(cont)

Licensee Action: Resolved.

Resolution is accomplished by finalization of the transition effort and implementation of the Work Package action items in accordance with proven Bechtel practices, policies, and procedures.

Supplementary information on environmental conditions is developed in Work Packages EN-601, EN-602, EN-603, and EN-604. Work Package EN-609 provided for the review of recent industry issues in the form of I&E Bulletins, Circulars, Notices, Generic Letters, and NUREG reports. Also, a procedure was developed to assure timely reviews of new NRC transmittals. Relative to normal plant operations design basis, the work package review plans specifically address consideration of "all operating modes" and consideration of transients. The concern is also addressed by ANSI N45.2.11 which is cited for guidance by Bechtel Procedures EDP-4.1, 4.25, 4.27, and 4.49.

Preliminary Bechtel assessments indicate that, due to the minimum number of high energy lines and the degree of compartmentalization provided in the MAB and FME, lack of early detailed review of pipe break effects will not result in major problems. Pipe rupture outside containment will be fully evaluated by Bechtel as discussed in Section 6 of EN-601.

References: EDP-2.16, 4.1, 4.2, 4.4, 4.22, 4.23, 4.26, 4.27, 4.46, and 4.49.
EN-601, 602, 603, 604, 609

NRC Inspection Results: Information regarding environmental conditions is contained in Work Packages EN-601, 602, 603, and 604. Work Package EN-609 provides for the review of recent industry issues. Relative to plant operations, the work package review plans specifically addressed consideration of all operating modes and transients. This concern was covered by Bechtel Procedures EDP-4.1, 4.25, 4.27, and 4.49.

The Quadrex concerns were being handled by Bechtel as stated in the Project Team Comments of the Finding Resolution Summary. The NRC inspector agrees with Bechtel's resolution.

This item is considered closed.

Quadrex Finding No.: 3.1(d)

Safety-Related vs Non-Safety-Related Distinctions

It was observed on many occasions that B&R uses a very sharp distinction between S/R and non-S/R categorizations for both equipment and calculations. A non-S/R designation results in the design outputs not being subjected to design verification.

In several instances, design activities that affected plant safety were designated as non-S/R.

In these cases, the B&R position was felt to be either inaccurate or questionable:

(1) A lack of awareness of high energy piping in the MAB (see Questions M-3, N-3, N-15, and R-5).

(2) Certain calculations, such as shielding (see Questions N-23, N-25, and R-7).

(3) HVAC system requirements for off-normal conditions (see Question H-5).

(4) Computer code CPVR status (see Questions C/M-3 and C/M-8).

(5) Identified support systems (see Questions E-3, E-15, H-4, H-13, M-5, M-25, N-10, N-17, and R-6).

(6) Operations performed at remote panels (see Questions E-13 and R-10).

(7) Systems interaction (see Questions H-18, H-23, M-3, M-10, M-50, P-20, and R-12).

It was frequently stated during the design review that only NRC requirements must be met whether or not those requirements are accurate, reasonable, or even meet the intent of the regulations. There has been no planned effort to review new NRC requirements (excluding TMI-2 concerns) to determine their impact on STP, and propose recommendations for HL&P concurrence (see Questions C-3, C-5, C-6, C-35, H-6, P-16, and R-1).

Licensee Action: Resolved.

Adherence to Bechtel Procedures to complete the project will provide a rational basis for the division of safety versus nonsafety-related distinctions.

Quadrex Finding No.: 3.1(d)(cont)

Efforts developed and to be implemented pursuant to EN-600, EN-607, EN-608, and EN-609 address the concerns. Bechtel's position on the need for a "sharp distiction" is best covered in response to 4.6.2.1(o) (Line item 202).

The Project Team, in the development of Work Package EN-613, has noted one case where B&R apparently may not have properly identified a safety-related component. This has been identified and discussed in letters ST-YB-HL-1053, dated 7/16/82, and ST-HL-AE-859, dated 7/29/82*. The major area of concern by Quadrex was related to calculations. The program described in Appendix E of EN-619 provides for assurance of the adequacy of computer calculations. Further, Bechtel treats all calculations with the same degree of concern and care as though all were safety-related. No sharp distinction is made.

References: EDP-2.13, 4.1, 4.2, 4.26, 4.27, 4.28, and 4.43.
EN-600, 607, 608, 609

NRC Inspection Results: Adherence by Bechtel to the referenced procedures should preclude occurrence of this concern within Bechtel. This problem is specifically addressed in work packages EN-600, 607, 608, and 609. The major Quadrex concern involved calculations and Bechtel treats all calculations the same, as though they were safety-related.

The Quadrex concern is being handled as discussed in the Finding Resolution Summary for this finding. The NRC reviewer agrees with Bechtel's resolution.

This item is considered closed.

*NRC Comment: This item was reported to the NRC Region IV as a reportable condition under 10 CFR 50.55(e). The final report on "Classification of the Leak Detection System in the SIS/CSS Pump Cubicle" was submitted on August 19, 1982. (HL&P letter ST-HL-AF-869). This was not a Quadrex Finding.

Quadrex Finding No.: 3.1(e)

FMEA and Single Failure Criterion Analysis

No written guidelines exist for the conduct of failure mode and effects analysis. The only FMEAs provided were those in the FSAR which is not a design document. These FMEAs are too superficial, and are not adequate to assure a satisfactory design.

No guidelines exist on what types of failures should be considered for various types of equipment. There is no documented evidence that the single failure criterion has been satisfied. An HVAC/I&C single failure criterion violation has been noted (see Questions R-6 and E-15).

One concern is the varied interpretation by individual disciplines that can be given to "direct and consequential failures" resulting from a postulated event; such failures establish the initial condition assumed in evaluating the plant for single failure tolerance. There is evidence that B&R does not fully understand these implications (see Questions M-4, H-6, P-20, N-19, and E-2).

A number of disciplines were asked to provide a listing of postulated single failures considered in their design. None of these disciplines was able to provide such a list (see Questions H-6, P-20, N-19, and E-4).

Licensee Action: Resolved.

This is not a programmatic generic concern, but a technical task adequately covered by discipline resolutions. The generic aspects related to these concerns are interdiscipline actions discussed in Generic Finding 3.1(a) and timely actions discussed in discipline disposition of Finding 4.6.4.1(c).

Guidelines for the evaluation of failure modes and effects analysis to treat single failure consequences were developed for STP by NUS in the Event System Analysis Program. B&R indicated that this program had been implemented on STP for selected systems. Bechtel's plan for determining the status of this program and for addressing these concerns in future work is discussed in Findings 4.6.4.1(a) & (c).

See Evaluation 4.6.4.1(c). Also the adequacy of FMEAs is being considered in the review of system work packages in accordance with the Checklists and Review Plans specified by Transition Procedure QE-002 (pages 14 and 15). While not required by Regulations, guidelines did exist. Bechtel intends to prepare new guidelines for completion of the project. Section 7.2.2.2.3.2

Quadrex Finding No.: 3.1(e)(cont)

of the FSAR provides documented evidence of the intention to comply with NRC General Design Criteria GDC-24. The single failure criterion concern is addressed in the System Work Package Review Plans and checklists, as specified by transition procedure QE-002, and design documents are being reviewed for adequacy. The HVAC/I&C single failure criterion concern noted is addressed in the Resolution Summaries for Findings 4.3.2.1(a) and 4.8.2.1(a).

References: EDP-4.4, 4.7; EN-601, 619

NRC Inspection Results: The adequacy of FMEAs and the single failure criterion were being considered in the review of system work packages in accordance with the checklists and review plans specified by Transition Procedure QE-002.

This concern was being handled by Bechtel as stated in the Finding Resolution Summary of this finding. The NRC reviewer agreed with Bechtel's resolution.

This item is considered closed.

Quadrex Finding No.: 3.1(f)

FSAR Commitment Tracking

There was no documented evidence for assuring that individual FSAR commitments for systems, equipment or calculations were being systematically implemented into the design.

There were many inconsistencies noted between the FSAR and other design and procurement documents. There was no assurance that subcontractor methodology changes would be reflected in the FSAR commitments. For example, numerous differences were observed between EDS practices and the FSAR promises.

There did not appear to be any method to assure that timely updating of the FSAR was being accomplished. In a number of areas, the FSAR is now out-of-date.

There is a potential for a lack of awareness of individual FSAR commitments by STP site personnel. This could represent a significant problem for field initiated design changes.

One Group conspicuous by its absence during this design review program was Licensing. No evidence was found of an effective Licensing Group input to the various disciplines to assure consistency in understanding and implementation of NRC requirements. Conversely, there was no evidence of an effective means to secure a timely NRC review and concurrence of desired alternative methods that differ from those described in the FSAR. B&R Licensing does not appear to take the initiative to keep the FSAR current and accurate.

A consistent and documented B&R position regarding Code and Standards interpretations was not evident. These interpretations are left to individuals or to vendor suppliers. The ASME Code interpretation area appears to be particularly weak (see Question M-30).

Licensee Action: Resolved.

This issue is resolved by discipline disposition of 4.3.2.1(g). A computerized tracking system (Licensing Commitment Tracking List) is in place and will be maintained by Bechtel on STP.

Disciplines are resolving this issue. EN-600 will track all FSAR change notices generated by each discipline. Design commitments from the FSAR are being listed on the Licensing Commitment Tracking System (LCTS). The procedure will then require that the implementing document for each commitment be located and listed. Thus, a one-to-one correlation will be possible after a certain time period. Timely updating of the SAR is the responsibility of HL&P. The HL&P site personnel will have a computer terminal onsite through

Quadrex Finding No.: 3.1(f)(cont)

which they will be able to access HL&P's portion of the LCTS. Bechtel Licensing will issue reports as requested from the site for the Bechtel controlled portions of the LCTS. Bechtel's SAR Change Procedure makes the Licensing Group the central focal point of all SAR changes.

The continuing efforts pursuant to EN-609 will provide for systematic reviews of new NRC Bulletins, Circulars, Notices, and Generic letters.

References: EDP-2.13, 2.16, 4.4, 4.23, 4.24, 4.25, 4.26, 4.27, and 4.33.
EN-600, 619

NRC Inspection Results: Work Package EN-600 will provide for the tracking all FSAR change notices. Design commitments from the FSAR are being listed in the computerized tracking system which was in place and was being maintained by Bechtel. This tracking system required that the implementing document for each commitment be located and listed. Bechtel's procedure EDP 4.23 makes the Licensing Group the central focal point for all SAR changes.

Work Package EN-609 will provide for systematic reviews of new NRC Bulletins, Circulars, Notices, and Generic letters for possible incorporation into the FSAR.

This concern was being resolved by Bechtel as indicated in the Finding Resolution Summary. The NRC inspector agrees with Bechtel's resolution.

This item is considered closed.

Quadrex Finding No.: 3.1(g)

Plant Design Basis

There was very little evidence of a well-thought-out and consistent basis for design. Much of the plant design basis is rooted solely in engineering judgment, and the rationale for this judgment has not been documented in a retrievable manner. Personnel turnover can adversely impact this approach.

No document exists that identifies the interface design information required by each discipline from the other technical disciplines (see Question N-1). For at least the Civil/Structural discipline, the lack of verified data may have produced a very conservative design. Consequently, much of the design is based on unverified preliminary data which could cause problems if the data is later shown to be inadequate. A possible cause for the extensive use of preliminary data may be that construction pressures controlled the Engineering schedule.

A number of key front-end criteria documents are missing for STP. A plan to identify and develop these TRDs on the project was not evident. Prior to mid 1980, it does not appear that B&R recognized that fact. For instance, a number of these documents have either been recently issued or are currently undergoing review prior to initial issue, such as:

(1) Safety-Related Classification
(2) In-service Inspection TRD
(3) Environmental Qualification TRD

Significant quality variations were also observed in the design review comments provided for internal documents prior to their initial issue or their subsequent revision. It was noted that the Materials Group does not review subcontractor material selections.

B&R indicated that W has reviewed portions of the initial STP design, but the quality and completeness of their review is uncertain. There is no evidence that revisions to the initial B&R design have been reviewed by W (see Question E-5). For example, B&R was not certain how carefully W had reviewed the proposed SI valve relocation further away from the RC loop. It is not clear that assurance is obtained from W that their interface requirements have been satisfied.

There are indications that W changes to the PIP are not being reviewed on a timely basis. Examples of this include the pressurizer skirt and the RHR motor voltage design changes. The interface between B&R, W, and HL&P needs to be improved.

Quadrex Finding No.: 3.1(g)(cont)

EDS indicated that B&R drawing changes are not reviewed on a routine basis.

In numerous instances, W design bases for the nuclear island portion have been directly carried over to the balance-of-plant design without confirming their appropriateness for this application.

In other instances, design details have been obtained from other PWR plants and used without confirming their applicability to the STP plant.

B&R has not adopted a consistent requirement for design margin to be achieved by each discipline. There was ample evidence that individual engineers make the determination of the margin to be included in the design (see Questions C-12 and H-8).

B&R does not require use of either design manuals that provide guidance on acceptable practices or individual engineer log-books to record key bases, assumptions or decisions. These manuals are especially crucial for the first engineered nuclear plant by an A/E. Consequently, fundamental background information regarding the STP design is difficult to retrieve since many current B&R engineers are not sufficiently familiar with the STP design or its bases.

Licensee Action: Resolved.

This is more of an observation than a programmatic generic concern. Adherence to Bechtel Procedures such as EDP-2.13, 2.16, 4.1, and 4.58 will provide clearly delineated design criteria to be applied on the project.

This finding implies that the AE is responsible for the adequacy of reviews performed by the NSSS supplier; however, this is not practical nor necessary. Bechtel will submit selected design documents to Westinghouse for review in accordance with a mutually agreeable plan and schedule. The details of how this will be accomplished and exactly which documents will be reviewed are being developed. As a minimum, those documents that enable Westinghouse to verify that design interface requirements have been met for system processes, physical arrangement/layout and balance of plant design will be submitted for review. Westinghouse is expected to provide formal documentation to the effect that the design interface requirements have been met. Bechtel will not specify nor monitor the depth or adequacy of that review.

As a part of the design interface review program that is being developed with Westinghouse, Bechtel will evaluate changes to design on a case basis and resubmit items that have previously been reviewed by Westinghouse if necessary. New design items that appear to affect the interface requirements will be evaluated and submitted in a similar manner.

Quadrex Finding No.: 3.1(g)(cont)

Brown & Root's response to this series of concerns stated that documents had been submitted to Westinghouse for review. Westinghouse has not usually responded unless a significant question was raised. Therefore, absence of a comment was interpreted as "No comment." This has been historically true for other projects and other NSSS vendors. However, Bechtel's development of a design interface review program with Westinghouse for the South Texas Project will include documentation to show that critical interfaces have been satisfactorily met.

Bechtel's standards for review of vendor documentation, contained in EDP-4.58 require review of engineering documents at the earliest possible time. The NSSS Interface Document between Bechtel, HL&P and Westinghouse specifies that drawing reviews should be completed within 30 working days, except where a different period is mutually agreed to and individually scheduled. Other changes to the PIP will be reviewed and statused similarly.

While the comment relates specifically to presumed B&R practices which have not been substantiated by objective findings, Bechtel recognizes the need for a viable interface between the AE, the NSSS supplier and the Owner. An NSSS Interface Document (Rev. 1) between Bechtel, Westinghouse and HL&P was signed by the Project Managers of each organization and distributed on June 18, 1982. To date, the interface between the organizations has been effective and viable. It is anticipated that this condition will continue. Direct communication between responsible individuals in each organization is freely exchanged. Bechtel has responsibility for the technical administration of the NSSS contract and HL&P retains commercial responsibility.

While the documentation of rationale of engineering judgment or documentation of interface design information is often helpful, it is not required to be documented in manuals or log books.

References: EDP-2.13, 2.16, 4.1, 4.2, 4.4, 4.7, 4.23, 4.25, 4.26, 4.27, 4.28, 4.33, 4.34, 4.36, 4.37, 4.46, 4.49, 4.58, 4.63, 4.64, and 6.10; EN-619

NRC Inspection Results: Bechtel Procedures EDP-2.13, 2.16, 4.1, and 4.58 were examined. They provide clearly stated design criteria requirements for the project.

Quadrex expressed a concern about design interface information including a timely resolution of this information. Bechtel procedure EDP-4.58 required an early review of engineering documents. An Interface Document between

Quadrex Finding No.: 3.1(g)(cont)

Bechtel, Westinghouse and HL&P was signed by the Project Managers of each organization and distributed on June 18, 1982. This document specified a 30 working day drawing review period.

The Quadrex concerns are being handled by Bechtel as indicated in the Finding Resolution Summary. The NRC inspector agrees with Bechtel's resolution.

This item is considered closed.

Quadrex Finding No.: 3.1(h)

Equipment Reliability Requirements

Specific reliability requirements, such as for the ESF sequencer, have not been established (see Questions E-7 and E-8). If the ESF sequencer reliability should turn out to be incompatible with the remainder of the ESF equipment, then B&R's dependence upon meeting only the single failure criterion would be unsatisfactory from a systems viewpoint.

The absence of specific reliability requirements in both mechanical and electrical equipment specifications, and the inability to produce a standard checklist of postulated failures to be considered casts doubt on the rigor of the safety-related evaluation process.

Throughout the design review, specifications to constrain spurious operation were absent. Such omissions are no longer the industry "norm." (See Question E-5, E-6, E-7, and E-8).

Licensee Action: Resolved

Bechtel does not agree that Quadrex had identified a potentially significant generic concern. During the transition phase, Procedure QE-002 provides for review of the adequacy of the STP design. Reliability along with other pertinent parameters are included in this review and further design will be in accordance with Bechtel procedures and practices.

The specifications are being reviewed for adequacy during the transition phase in accordance with the System Work Package Review Plans stipulated by the Transition Procedure QE-002. The adequacy of the specifications will be established or action taken to establish the adequacy. (See EN-619)

The adequacy of equipment to meet service requirements and maintainability requirements will be evaluated and appropriate action taken by Bechtel in accordance with the Transition Procedure QE-002 and System Work Package Review Plans. (See also EN-600).

References: EDP-4.1, 4.4, 4.25, 4.26, 4.27; EJ-303, QE-002,; EN-600, 601, 604

NRC Inspection Results: The NRC will require the AE/licensee to identify what safety-related equipment requires reliability analysis (i.e., . . . a measurement of the equipment's ability to function without failure over a period of time, associated with the discrete device materials in terms of failure mechanisms, modes, rates, and mean-time-to-failure-(MTTF).

Quadrex Finding No : 3.1(h) (cont.)

The requirement for a reliability analysis from each vendor/supplier, and Bechtel's evaluation to determine if the equipment meets the intended design function, is not being prescribed on all safety-related equipment. Rather, the requirement for specifying reliability requirements in specifications will be prioritized according to safety significance and systems availability, in accordance with Bechtel Procedure QE-002, Rev. 0, which provides for review of the adequacy of STP design. It is Bechtel's intent to meet specific equipment reliability requirements, and constrain spurious operation by upgrading specifications, will be resolved through the use of EDP 4.25, 4.26, and 4.27.

The vendor/supplier for the three ESF load sequences, will be required to submit a reliability analysis (Refer to EJ-303, Section 3).

A specific equipment reliability analysis, which includes figures/values, is not to be confused with the AE/licensee requirements to specify and assure design adequacy in facilitating periodic testing, maintenance, service, and proper operation . . . etc. This was indicated in Bechtel's Resolution Summary. These design adequacies will however, be reviewed, evaluated, and appropriate action taken by Bechtel in accordance with Procedure QE-002, Rev. 0.

Review and evaluation by Bechtel, in consideration of other design adequacy techniques for safety-related equipment, will include: (1) failure mode and effects analysis (FMEA), as referenced in work package EN-601, Section 6. See Quadrex Question 4.3.2.1(a) and 4.3.2.1(d). (2) Environmental and seismic qualification, as referenced in Work Package EN-604, Appendix E, Section 2.0. Refer also to Quadrex Finding 4.3.2.1(i) and 4.6.2.1(a).

This finding is considered closed for purposes of the Quadrex Report review. However, it will be reexamined upon completion of the reliability analysis action. See Appendix A.

Quadrex Finding No.: 3.1(i)

Nuclear-Related Analysis

The chosen analysis methods demonstrate a sharp paradox between the more conventional engineering work and the uniquely nuclear engineering work required for portions of the STP design. In certain disciplines, such as Civil/Structural and Electrical, technically adequate methods have been chosen. However, for the nuclear aspects of the project, Brown and Root has been much less adequate in its choice of analysis methods and assumptions. In addition, an abnormally high error rate was observed in these calculations. In many instances, insufficient work has been accomplished for the present state of STP design, procurement, and construction.

The areas of greatest concern have been with Nuclear Analysis, Piping and Supports, Special Stress, and HVAC. During the design review, many questions were referred to these "pillar" groups for resolution; consequently, they appear to be the highest risk Groups in terms of meeting STP licensing needs.

The amount of nuclear-related analysis that is subcontracted by B&R is higher than a typical A/Es practice. The technical guidance provided by some of these Groups for subcontracted consultants, such as EDS and NUS, does not appear to be adequate. Review of these subcontracted analyses does not appear to be sufficient.

A few examples pertinent to nuclear-related analysis are as follows:

(1) The B&R pipe rupture report provided to the NRC in 1975 is not yet a control document for the STP design. Pipe rupture analysis outside containment is scheduled to start in May 1981.

(2) The AFW pump motors to be located at a low elevation in the IVC may not be qualified for the currently postulated accident environment. No accident environmental analysis has been performed for outside containment. For ESF system components, this situation is not adequate. (See note below).

(3) Durations of required operation for safety-related HVAC equipment have not been specified.

(4) In other instances, inappropriate methods have been selected. Specific details regarding these concerns are provided in Sections 4.4, 4.5, 4.6, and 4.7 of this report.

Quadrex Finding No.: 3.1(i)(cont)

Licensee Action: Resolved.

The programmatic aspects of this concern primarily relate to inconsistent handling, poor scheduling, and appropriateness of computer calculations performed by the Nuclear Group. This was also the subject of a deficiency previously reported to the NRC. Bechtel Procedures, particularly EDP-4.36 and 4.37 address this issue and the associated deficiency relative to the correctness of the calculations and proper documentation of computer codes.

The completeness and adequacy of the analysis method, calculations and assumptions is being evaluated during the Transition Program in accordance with the System Work Package Review Plans stipulated by Transition Procedure QE-002, page 14 and 15. The overall adequacy of analyses will be established or action will be taken and this will be documented in the individual system work package for which the analysis applies. Interface with subcontractors is adequately addressed by procedures EDP-4.25 and 7.3. See also responses to the related findings and in Appendix E of EN-619.

References: EDP-4.1, 4.4, 4.25, 4.26, 4.27, 4.36, 4.37, and 4.49; QE-002

NRC Inspection Results: Bechtel procedures EDP-4.36 and 4.37 cover the issue of nuclear-related analysis. The completeness and adequacy of the analysis method, the calculations, and the assumptions used were being evaluated in accordance with the system work package plans required by transition procedure QE-002.

Quadrex concerns were being handled by Bechtel as indicated in the Finding Resolution Summary. The NRC inspector agreed with Bechtel's resolution.

Note: Example (2) in the Quadrex finding was not specifically identified elsewhere in the Quadrex report. However, the AFW pump motor equipment qualification (EQ) problem was reported to the NRC as a 10 CFR 50.55(e) item on August 25, 1980, prior to the Quadrex Report.

This item is considered closed.

Quadrex Finding No.: 3.1(j)

Final Design Verification

The B&R design verification process permits the use of preliminary data up to the point of STP fuel loading.

In the Structural area, the final verification will likely occur after construction has been completed.

For equipment subject to qualification, final verification will likely occur after delivery has been made to the site.

There are no documented standards regarding the minimum qualifications required for a design verifier. Typically, the Discipline Project Engineer selects the design verifier from within the discipline, but his basis for selection is not documented. While this approach does not violate NRC requirements, the observed error rate suggests that a tighter design review and design verification process is needed. The only evidence of a completed design verification is a signature, since B&R does not require either the use or completion of design verification checklists. Consequently, there is evidence that the key design verification questions are not being adequately considered (e.g., are the assumptions valid, are the input and output reasonable). This process is not typical of industry practices in recent years.

There is evidence that errors have not been detected by the design verifier (see Question C-16). However, in at least one instance, a technical discipline had a very effective design verification accomplished by an individual in another discipline (see Question H-17).

Licensee Action: Resolved.

Bechtel's practices, policies, and procedures, particularly EDP-4.27, will be used for the completion of the engineering design of the STP project.

Bechtel Procedure QE-001 provides for the review of the adequacy of past design verifications. These reviews are being performed during the transition and will be documented in the system work packages. Bechtel Procedure EDP-4.27 defines how the final design will be verified. Paragraph 4.2 specifically discusses the qualification requirements of verifiers.

Quadrex Finding No.: 3.1(j)(cont)

The transition review will be made by all disciplines. All areas of concern are to be documented and compiled in Work Package Final Report Summaries and the associated Work Package Action Item List.

References: EDP-4.27, 4.36, 4.37, 4.46, 4.49; QE-001; EN-619

NRC Inspection Results: It is a general practice to use preliminary engineering data for initial design (sizing) of structures and systems.

Bechtel Procedure QE-001 adequately provides for the review of past design verifications. These reviews are being performed during the transition and will be documented in the system work packages. Bechtel procedure EDP-4.27 defined how the final design will be verified.

Quadrex concerns are being handled by Bechtel as indicated in the Finding Resolution Summary. The NRC inspector agreed with Bechtel's resolution.

This item is considered closed.

Quadrex Finding No.: 3.2(k)

Plant Operation Criteria

From previous nuclear plant experience, supplementary criteria and requirements are needed to assure that systems and components will accommodate all plant operating conditions, and they frequently extend beyond the minimum set needed to satisfy NRC licensing requirements. Because of their importance, such criteria and requirements should appear in design control documents, and their implementation into the design should be evident.

These criteria and requirements generally specify such characteristics as plant equipment layout trade-off objectives, performance bounds for valves, access provisions for maintenance, inspection and test, minimum performance requirements, and identification of equipment needed to accommodate degraded initial plant operating conditions. For some utilities, a number of these requirements result from a systematic "what if" analysis of plant response alternatives to adverse operating conditions.

We found no evidence that B&R has considered or assumed responsibility for HL&P power production needs in their stated design criteria. Many individual operational problems observed on the plant model at Crestpark provide evidence that reliability, maintainability and similar considerations have been largely overlooked, and appear to be compromising the maintainability and accessibility of the plant.

Licensee Action: Resolved

Finalization of the Transition Phase Work Package Effort and the subsequent effort resulting from actions discussed under concern 3.1(g) will establish the design bases of the plant. Interaction with HL&P and agreement on the design bases will enable HL&P to develop operating procedures which are consistent with the design.

The various aspects of this concern (power production needs, reliability, etc.) are addressed in Review Plans for System Work Packages in accordance with Transition Procedure QE-002.

References: EDP-2.16, 4.1, 4.23, 4.25, 4.26, 4.27, 4.46, and 4.49.
EN-619; QE-002

Quadrex Finding No.: 3.2(k)(cont)

NRC Inspection Results: Final agreement on the design bases will provide HL&P information required to develop operating procedures which are consistent with the design.

The various aspects of this concern (power production needs, reliability, etc.) were being addressed in System Work Packages in accordance with Transition Procedure QE-002.

The Quadrex concerns were handled by Bechtel as indicated in the Finding Resolution Summary. The NRC reviewer agrees with Bechtel's resolution.

This item is considered closed.

Quadrex Finding No.: 3.2(1)

Use of Plant Symmetry

Effective use of natural plant symmetry in the arrangement of mechanical components was not evident. Locations chosen for RHR valves, SI valves, and accumulator tanks suggest that the use of symmetry was not a major design objective in the RCB.

Licensee Action: Resolved

The Project assessment is essentially the same as the Bechtel Task Force Assessment, which is "Considering the status of design and construction, there may be little potential for the enhancement of the use of plant symmetry, but reasonable opportunities in symmetry or duplication of design details should not be overlooked."

The Transition program, procedures, and review plans provide for the evaluation of the design. Required actions to complete the design will be documented in the system work packages. The subject of symmetry may appear in individual work packages if deemed appropriate by the discipline. With the exception of certain requirements dictated by the unique 3 train Safety System at STP, symmetry of design in STP is consistent with plants of this vintage and would not be expected to result in significant operational difficulties.

References: EDP-4.1, 4.46, and 4.49; EN-619

NRC Inspection Results: The NRC inspector agrees that there may be little potential for the use of plant symmetry which is not a design requirement.

Symmetry of design in the South Texas Project was consistent with plants of this vintage. Lack of symmetry should not result in significant operational problems.

The Quadrex concerns were being handled by Bechtel as indicated in the Finding Resolution Summary. The NRC inspector agrees with Bechtel's resolution.

This item is considered closed.

Quadrex Finding No.: 3.2(m)

Valve Opening and Closing Rates

If ambiguously specified, unanticipated valve closure or opening rates can pose operating difficulties for the plant. Instances of incomplete specification of valve closure rates were noted during the review. Acceptable bounds on valve closing and opening rates should be consistent with appropriate transient analyses; however, performance of such transient analyses could not be confirmed during this design review.

Licensee Action: Resolved

While specification of such items as valve closure rate is a discipline concern, see finding 4.5.5.4(p), the generic aspect of this concern is resolved by 3.1(a). Engineering procedures require that the system design requirements be incorporated into the specifications. Review of vendor engineering, inspection, etc., is utilized to determine that specification provisions are satisfied. As stated in the proposed resolution, the opening and closing characteristics will be examined during the normal course of ongoing work to confirm that system design requirements are met.

The adequacy of specifications is being addressed with the Transition Procedure QE-002 and Review Plans for System Work Packages.

See the resolution to Finding 4.5.5.4(p) wherein it is stated that the valve opening and closing characteristics shall be examined in Phase B to confirm that system design requirements are met.

Further, the Transition Program provides for a thorough evaluation and, if analyses are deemed necessary, this will be documented in the applicable work packages.

References: EDP-4.1, 4.25, 4.26, 4.27, 4.46, and 4.49; EN-619

NRC Inspection Results: Discussions were held with licensee and Bechtel personnel involved in assessment and resolution of this item. The staff inspector found the resolution to be adequate. Review of the referenced Bechtel procedures indicated that activities involved in the resolution and future design work were adequately defined.

This item is closed.

Quadrex Finding No.: 3.2(n)

Access Provisions

Access provisions for maintenance, inspection and test appear to be determined solely by engineering judgment rather than from established and documented requirements (see Questions M-26A, R-1, M-36, and P-17). There is ample evidence that analysis methods used to assure adequate access for maintenance and ISI, coupled with considerations for ALARA radiation exposures, have been inadequate. The decision to provide seismic supports for non-safety piping in the MAB, rather than peform a systems interaction analysis, has caused access space to be severely compromised.

Licensee Action: Resolved

The generic aspect of this issue again is addressed by the resolution of 3.1(a) while the specifics are addressed in the discipline resolution to 4.8.2.1(b) and 4.9.1(b).

The adequacy of the aspects of this concern is being evaluated in accordance with the Review Plans and Checklists, and Transition Procedures QE-002 and QE-001. Results of the evaluations and the required corrective actions are being documented in applicable work packages. See also Work Package EA-005.

The approach taken by B&R in the seismic treatment of nonsafety-related equipment in proximity to safety-related equipment represents a common practice in the design of nuclear power plants. By attempting to eliminate the need for detailed systems interaction analysis through conservative design on nonsafety-related components to seismic Category I status, B&R presumably reduced the design effort necessary to address this issue. Such an approach may have inherent penalties relative to constructability, cost and, as pointed out by Quadrex, operability and access. In Section 6.0 of Work Package EN-601, Bechtel outlines a program for addressing this concern which also attempts to reduce the amount of required engineering effort. Further, by applying the experience gained on previous projects, this program is expected to minimize the impacts on material procurement, construction, and eventually operation of the plant. In any event, it is common practice within Bechtel nuclear projects to systematically evaluate the results of such "analysis-minimizing" conservatisms through drawing and model reviews, field verifications and other review techniques. These reviews are intended to optimize the final plant design with regard to numerous design factors, including accessibility.

References: EDP-2.16, 4.1, 4.4, 4.23, 4.26, 4.27, 4.46, 4.47, and 4.49; EN-601, 619; QE-001; QE-002

Quadrex Finding No.: 3.2(n) (cont)

NRC Inspection Results: It is Bechtel's practice that access design provisions are reviewed and evaluated for maintenance, inspection, and testing provisions with consideration to ALARA principles. Modifications are developed, as required, based on guidelines provided by the individual Bechtel discipline design standards.

The adequacy of the aspects of this concern was evaluated in accordance with the Review Plans and checklists contained in Transition Procedures QE-0C and QE-001.

Quadrex concerns were handled by Bechtel as indicated in the Finding Resolution Summary. The NRC inspector agreed with Bechtel's resolution.

This item is considered closed.

Quadrex Finding No.: 3.2(o)

Test Provisions

Pre-op test requirements and resultant test provisions do not appear to have been systematically considered and implemented into the design documentation (see Questions H-3, H-7, E-11, and E-21).

Licensee Action: Resolved

Bechtel will establish a startup group to work with Bechtel Engineering/ Construction and HL&P during the design or production phase of the project. This will bring concerns associated with system start-up to the attention of the engineer at a point in the process where pre-op test requirements can be factored into the design. The programmatic aspects of this issue are addressed by adherence to Bechtel practices.

Test requirements are addressed in the Review Plans and Checklists stipulated by Transition Procedure QE-002. Evaluations performed during the transition program will be documented in system work packages and additional efforts required will appear in the applicable work package.

References: EDP-4.26, 4.27, 4.36, 4.37, 4.46, and 4.49; EN-619; QE-002

NRC Inspection Results: Bechtel will review the System Design Descriptions during the detailed review of the status of the project. Where deemed appropriate they will identify testing requirements and resultant test provisions.

Test requirements were addressed in the plans and checklists stipulated by Transition Procedure QE-002.

The Quadrex concerns are being handled by Bechtel as indicated in the Finding Resolution Summary. The NRC inspector agreed with Bechtel's resolution.

This item is considered closed.

Quadrex Finding No.: 3.2(p)

Local Temperatures During Maintenance

Areas in the MAB and FHB have predicted temperatures in the 76°F to 85°F range, and certain cubicles are predicted to be as high as 103.8°F during routine operation. HVAC considerations for maintenance personnel, especially if suited-up for radiation protection, may not be adequate to meet HL&P's needs (see Question H-3).

Licensee Action: Resolved

This is not a programmatic generic issue in itself and the condition cited will be resolved by discipline Finding 4.4.2.1(i). The generic aspect of the concern is the proper definition of design requirements as discussed under [illegible]k.

The Transition Program, Review Plans and Checklists, and transition procedure address this concern, evaluations, and recommended action are documented in applicable work packages. Per the Mechanical Discipline assessment/action plan outlined in finding 4.4.2.1(a), Bechtel will be revising the HVAC design criteria and evaluating B&R, NUS and OPS calculations to this criteria.

References: EDP-4.1, 4.26, and 4.27

NRC Inspection Results: The transition program, review plans and checklists, and transition procedure address this concern; evaluations and recommended action are documented in applicable work packages.

As a standard practice Bechtel has developed HVAC designs for different plant areas by considering personnel occupancy requirements as appropriate for the access needs of the area. These access needs are established based on consideration of various plant operation modes and equipment servicing requirements. In this manner inappropriate ambient temperatures should be avoided.

The Quadrex concerns were handled by Bechtel as indicated in the Finding Resolution Summary. The NRC inspector agreed with Bechtel's resolution.

This item is considered closed.

Quadrex Finding No.: 3.2(q)

Pipe Support Requirements

Continued use of abnormally low seismic values for valve and pump end loads (even though the chosen values were an industry norm in the 1975 period) is a major factor in the number and size of pipe supports currently provided in the STP design. Other firms have progressed in recent years to the use of much higher acceleration limits for valves and other components so as to reduce the number of supports (see Questions M-51, P-6, and P-8).

Licensee Action: Resolved

The generic aspect of this concern is whether the design is overly conservative and costly procedures have been used. While Bechtel's review has identified some conservatisms, the evaluation of whether or not these are excessive or justified was outside the scope of this review. In any event, overconservatism is an economic issue as opposed to a safety concern.

This is a discipline concern and is addressed in Findings 4.5.5.3(k) and 4.7.2.3(i). As stated in the resolution to 4.7.2.3(i), the values are acceptable.

If additional effort is determined necessary as a result of the evaluations pursuant to the Transition Program, that effort will be documented in the system work packages.

References: EDP-4.1, 4.4; EN-619

NRC Inspection Results: The staff inspector considers the Quadrex finding to be an economic consideration. The values used for the valve and pump end loads are satisfactory.

The finding is considered closed with respect to the Quadrex Report review.

4.1 CIVIL/STRUCTURAL FINDINGS

Civil/Structural Finding Summary

There were 30 Quadrex findings in the Civil/Structural Discipline. Seven were dispositioned and the remainder resolved.

No potential reportable 10 CFR 50.55(e) items were identified in this area.

All finding resolutions and dispositions were found to be adequate and acceptable to the NRC staff reviewers. Ten of the findings are scheduled for rereview at a later date. See Appendix A.

Quadrex Finding No.: 4.1.2.1(a)

B&R Structural Group does not appear to question the reasonableness of input data including margin (see Questions C-1 and C-4). Some of the environmental information that affected the Structural discipline has not become fixed even at this point in design (see Questions C-1, H-12 and N-3).

Licensee Action: Resolved

The input data reviewed to date for the civil/structural design is reasonable and generally consistent with Bechtel's past experience. No specific evidence has been found that B&R formally questioned the reasonableness of the input data. However, many times this type of coordination is done informally with only the final information being documented formally.

QE-001, "Design Verification Assessment" applies to work package reviews of previous work. Item IV-13 addresses questioning reasonableness of output compared to input. For further design work, this issue is addressed by Bechtel EDP-4.26 section 4.1, 4.27 item 3 of Exhibit A under design verification elements, and 4.49 item 1 of Exhibit A. Further, margins are usually not specifically identified and are treated informally, but reasonableness and conservatism are considered in data developed for design purposes.

Bechtel's reviews have indicated that some of the environmental information is not fixed or final at this time. The preliminary nature of this information is noted in the appropriate SDD or TRD and calculations. There are presently plans to analyze the high energy line breaks within the MEAB. High energy line breaks in the IVC are currently undergoing a thorough review.

The normal course of design evolution will resolve the concerns noted. No further action other than the normal continuation of the design process is required. The follow-on effort of EN-602 relative to sub-compartment pressure temperature analysis will provide fixed environmental information on pressures and temperature. The follow-on effort of EN-603 will provide the information on radiation.

References: EN-619, 602, 603, EC-103

NRC Inspection Results: It was agreed by the staff inspector that it is acceptable and often times necessary for preliminary designs to be based on conservative assumptions which will subsequently be subject to verification. It is also agreed that each discipline generating design data utilized by other groups is solely responsible for such data. Bechtel's planned follow-on efforts are acceptable.

This finding is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.1(b)

There was no evidence of Civil/Structural evaluation of the reasonableness of postulated internal missiles or that the criteria for internal missiles presented in TRD 1N209RQ013-A had been implemented in the design (see Question C-9)

Licensee Action: Dispositioned

Bechtel's past experience is that internally generated missiles will not govern the design of structures with the exception of specific missile barriers used for no other function.

The completion of the calculation review is required to fully assess the status of design for internal missiles. This review was scheduled to be complete in September 1982.

As in the case of pipe rupture effects, detailed review of internally generated missile effects is not performed until the design becomes finalized. With the separation provided in the STP design and the limited damage potential of most postulated internally generated missiles, lack of early detailed evaluation of these missiles is expected to have little impact on plant cost and schedule. Bechtel will perform all detailed evaluations of postulated missiles and their effects as ongoing work as is discussed in Section 6 of EN-601 Work Package Report. The evaluation of internally generated missiles will be performed during the normal course of design evolution. Completion of EC-103 calculation review is scheduled on the Work Package Action Item List. Resolution will be provided upon review of the EC-103 calculations.

References: EC-103; EN-601, 619

NRC Inspection Results: Bechtel's planned calculation review of all postulated missiles and their effects serves to address this issue. In addition, to the Quadrex concern for missiles inside containment only, Bechtel planned to apply the requirements of NRC Standard Review Plan No. 3.5.1.1, "Internally Generated Missiles (Outside Containment)," and Regulatory Guide 1.115. This will be reviewed during the normal OL review. See Appendix A.

This item is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.1(c)

It was determined that the turbine building had not been specifically analyzed for the SSE. This analysis must be completed since it is a PSAR commitment and actually should have been accomplished much sooner (see Question C-40).

Licensee Action: Dispositioned

SDD 7G019SD004-F specifies that a non-collapse check of the Turbine Generator Building under an SSE is to be performed. Review of the Turbine Generator Building calculations indicates that no non-collapse check under an SSE has been performed. Bechtel plans to perform this non-collapse check. Due to the very low seismic level (.1g for SSE) it is not anticipated that this non-collapse check will have a significant impact on the design of the structure. Resolution will be provided upon performance of the non-collapse check.

References: EC-145; EN-619

NRC Inspection Results: Bechtel's planned non-collapse and Category 1 impact check for SSE loading will satisfy SAR commitments and serves to resolve the Quadrex Report finding. This will be reviewed during the normal licensing review. See Appendix A.

This item is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.1(d)

There is evidence that significant Civil/Structural differences may exist with respect to approved NRC criteria or methodology and/or FSAR commitments (see Questions C-5, C-20 and C-43).

Licensee Action: Resolved

The questions that formed the basis of this finding were individually reviewed in depth. Based on engineering documents available to Bechtel, no significant differences have been found with respect to approved NRC criteria or methodology or FSAR commitments.

Bechtel has reviewed the Cask Drop calculations and found them to be acceptable.

References: EC-103, 140; EN-619

NRC Inspection Results: The staff inspector reviewed work package EC-103, "General Structural Design Criteria," and EC-140, "Fuel Handling Building." The NRC staff inspector concurred with the Bechtel finding that no significant differences with approved NRC criteria or FSAR commitments were identified. It is the finding of the staff inspector that only the item discussed in Quadrex Finding 4.1.2.4(t) required additional consideration by Bechtel.

This item is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.1(e)

The Civil/Structural discipline does not appear to be fully responsive to recent NRC requirements (see Questions C-3 and C-35).

Licensee Action: Resolved

(The basis of the finding is Question C-3 and C-35 which questioned whether a review of certain Reg. Guides and NUREGs had occurred.) Quadrex was "unable to make an assessment as to whether all of the proper loading combinations and acceptance criteria were handled properly." Quadrex states that RG 1.104 or NUREG-0554 was not reviewed for potential impact on STP. (However, R.G. 1.104 is discussed in detail in the FSAR.) RG 1.104 or NUREG-0554 is applicable to single failure proof cranes. The polar crane is not a single failure proof crane and as such the Quadrex concern is not valid. However, early drafts of RG 1.104 were addressed for STP cranes, as appropriate. RG 1.104 is applicable to the fuel handling building crane which has a single failure proof 15 ton hook, and satisfies RG 1.104 requirements. Accordingly, this issue is considered closed.

The RCS component supports of this project are designed to the ASME Code Section III Subsection NF. The material for these supports has been tested for fracture toughness characteristics (Charpy V Notch tests) in accordance with subsection NF requirements. HL&P has conducted a preliminary study for the implementation of NUREG-0577 recommendations on STP RCS component supports. However, to date, NRC has not finalized its position on NUREG-0577.

Work Package EN-609 has developed a procedure to assure timely reviews of NRC Bulletins, Circulars, etc., by the disciplines and responses to be submitted to the licensing group for development of a coordinated position letter. Further, EN-600 will verify the responsiveness to NRC requirements by tracking FSAR commitments via the Licensing Commitment Tracking System.

References: EM-510; R.G.1.104; EC-121, EN-619

NRC Inspection Results: The staff found that the requirements of RG 1.104 have been satisfied where applicable. The material utilized for ASME-NF supports satisfied all applicable requirements and was satisfactory to the NRC. Procedures to be implemented as a result of EN-609 will assure review of NRC documents.

This item is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.1(f)*

(1) B&R use of input data from EDS for pipe rupture loading may not be adequate (see Questions C-4 and C-15). (2) No pipe rupture loads have been determined for outside containment.

Licensee Action: Resolved

(1) Preliminary loading (130^k applied per SDD) was used by B&R in the design of the containment structures. This is a common industry practice as generally the pipe routing and rupture data is in a very preliminary state at the time that structures must be designed. It must be noted that the majority of these restraints are attached directly to major concrete walls (secondary & primary shields). Generally these loadings are relatively small compared to the pressure and equipment support loads on the walls. From Bechtel's past experience the inclusion of these pipe rupture loads will have little if any affect on the design of the walls. For restraints supported by structural steel, the structural steel reverification effort is incorporating all up to date loads.

The only pipe rupture loads determined outside the containment are for the five-way restraints on the main steam and feedwater lines in the MSIVC. Due to the plant layout, there will be very limited number of restraints for lines outside of containment. Generally, these restraints will be attached to concrete which usually will have sufficient margin to accomodate these rupture loads.

(2) Evaluation of proper input of pipe rupture loads in the containment design is discussed in work packages EC-181 and EC-120. The most significant pipe rupture loads outside containment are found in the IVC. Teledyne completed a dynamic analysis in December 1981 to quantify these loads. Evaluation of proper input of these loads for design of the IVC is discussed in work package EC-135. No further action is required to resolve this finding.

Preliminary loading (130^k) applied per SDD was used by B&R in the design of the containment structures. This is a common industry practice because, generally, the pipe routing and rupture data is in a very preliminary state at the time the structures must be designed. It must be noted that the majority of these restraints are attached directly to major concrete walls (secondary and primary shields). Generally, these loadings are relatively small compared to the pressure and equipment support loads on the walls. From Bechtel's past experience the inclusion of these pipe rupture loads will have little, if any, affect on the design of the walls. For restraints supported by structural steel, the structural steel reverification effort is incorporating all up-to-date loads.

*This finding contains two line items.

Quadrex Finding No.: 4.1.2.1(f) (cont)

References: EC-181, 120, 135

NRC Inspection Results: Bechtel's proposed evaluation of proper pipe rupture loads will resolve the adequacy of the preliminary design input values. Pipe ruptures outside containment have been addressed by Bechtel. The Bechtel WP procedure to be utilized for analyzing the effects of loadings on structural members from pipe supports was reviewed by the NRC inspector and found to be adequate.

This item is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.1(g)

B&R assumptions regarding MAB dead loads may not be representative of actual conditions. In reviewing the design of the floor elements in the MAB and EAB, it was determined that although the final design may be adequate, there were areas where the calculations were hard to follow and there was evidence the amplification effects of vertical seismic were not properly considered (see Question C-7).

Licensee Action: Resolved

Dead and live load assumptions for design of the MAB and EAB are typical of the industry. Therefore, we do not expect to find many cases, if any, where these have been exceeded by actual loads. Amplification factors used to calculate vertical seismic forces are not correct for miscellaneous platforms and concrete slabs. However, our preliminary review of the calculations indicates that the effects of additional vertical seismic loads can be accounted for by reducing overconservative live loads and by the normal overdesign inherent in choosing uniform reinforcing sizes and spacings. A complete review of the design will be performed as a normal course of load verification.

References: EC-130, 131, 132; EN-619

NRC Inspection Results: The Bechtel plans to conduct a complete evaluation of actual stresses resulting from incorrect vertical amplification factors were reviewed by the staff inspector. It was agreed that overconservative dead and live load assumptions may satisfy any negative influence from incorrect vertical amplication factors. NRC-SRP-3.8.4, Appendix D, was identified as presenting new NRC criteria which must be considered by Bechtel for the design of the spent fuel pool to resist seismic loadings (see Quadrex finding 4.1.2.3(j)).

This item is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.1(h)

The plan to verify actual loadings only after the structure has been erected poses potential licensing risk (see Questions C-7 and C-15).

Licensee Action: Resolved

Many loads are still of a preliminary nature as is noted in the SDDs, TRDs and calculations. A reverification program using the final loads was planned by B&R.

The use of preliminary information in the design of the structure and verifying it with the final loads after the structure has been erected is generally accepted design approach in the nuclear power industry. Bechtel will continue the reverification of the design with the final loads as part of the design evolution process. No meaningful problems are expected.

Bechtel STP Procedures, EDP-4.26 and EDP-4.27, cover the engineering activities related to design reviews and verification of the design of safety-related systems and structures.

References: EC-103; EN-619

NRC Inspection Results: The staff inspector concurred with the AE's philosophy that the design of structures using preliminary data that will be subsequently verified is a standard industry practice. Bechtel's planned load verification process will assure that actual loads will be utilized and thus result in a representative design.

This item is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.3(i)

The secondary shield wall is heavily reinforced and appears to be controlled by compartment pressurization. This input was developed by other disciplines and included factors of 1.2 for dynamic effects and 1.4 for NRC margins (see Question C-4). Use of an arbitrary dynamic amplification factor for a compartment pressurization analysis in excess of 1.0 should have been reviewed before acceptance by B&R.

Licensee Action: Resolved

A rough calculation performed by Bechtel indicated that the dynamic load factor (DLF) of 1.2 used by B&R for the compartment pressurization load in the secondary shield wall design is reasonable. Past Bechtel design have used a similar factor.

References: EC-120, EN-619

NRC Inspection Results: The NRC inspector agreed that an arbitrary dynamic amplification factor in excess of 1.0 need not be reviewed prior to utilization. Factors in excess of 1.0 provide conservatism in design which results in a higher factor of safety. The Quadrex finding is considered without basis.

This item is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.3(j)

Review of the calculations for the fuel pool design indicated evidence of a lack of consistency in considering proper input loading for the fuel pool floor design (see Question C-7).

Licensee Action: Resolved

Review of the fuel pool floor calculations indicates that the fuel rack loads, as provided by the vendor were properly included in the loads used for the design. Appropriate coefficient for vertical seismic from the floor response spectra was also included in the design. Therefore, this item does not require any further action.

References: EC-140; EN-619

NRC Inspection Results: In response to the staff inspector's review, Bechtel plans to question the fuel pool vendor (Westinghouse) with regard to the requirements of NRC-SRP 3.8.4, Appendix D for seismic design of fuel racks. The response will be reviewed by the NRC. See Appendix A.

This item is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.3(k)

There did appear to be a few areas of slight overconservatism in the containment design because of conservative interpretation of codes and standards. Specifically, the amount of prestressing could be more than required by considering liner thermal expansion as a primary instead of a secondary mode of behavior (see Questions C-12 and C-14).

Licensee Action. Resolved

The level of prestress as presented in B&R calculations is defined as:

$$X = \frac{F + D}{Pa}$$

Where D is dead load, F is prestress force and Pa is internal LOCA pressure of 56.5 psig. X = 1.3 for vertical tendons and X = 1.2 for hoop tendons were used in the analysis which is consistent with the general industry practice. Although B&R took additional temperature over the normal operating condition for the accident case and applied it as an equivalent pressure to the shell wall, this additional pressure load was not included in evaluating the prestressing requirements. Therefore, the amount of prestressing was not affected by the method of analysis for the accident thermal load case.

References: EC-111, EN-619

NRC Inspection Results: The application of an equivalent pressure resulting from accident thermal conditions in the design of a containment shell is considered to be a more representative design than if it were omitted. Although Brown & Root did not include this contribution in the determination of prestressing requirements, the ductility and strength inherent in the prestressing tendons provide a large reserve capacity to resist accident loads. The Quadrex observation of slight overconservatism is considered an economic consideration that does not impact upon safety.

This item is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.3(1)

Potential overconservatism was observed in the containment structure and cable tray areas (see Questions C-4 and C-18). The cable tray and conduit supports area was evaluated because of its potential impact on engineering and design manhours. It is also an area that is frequently a bottle neck because of interfacing problems between Engineering and Construction. The systems and procedures developed by Brown and Root for cable tray and conduit support design seem to be well-organized and utilized sound methodology for standardization. However, it is our judgment that the "standard" support system developed by Brown and Root is overly conservative, and may cause increased construction cost and complexities as compared with other industry designs. There seemed to be excessive longitudinal connections between supports.

Licensee Action: Resolved

B&R, in order to provide "standard hanger calculations," in most cases used the largest acceleration values from the response spectra for all structures in the design of the cable tray hangers. A 20% increase in accelerations was incorporated to account for the tray-support interaction. This results in overconservatism in the calculations, in particular for the MEAB which has smaller acceleration values. We, therefore, agree with the Quadrex assessment. For future analysis and design of cable tray hangers, current Bechtel procedures shall be employed.

References: EC-185; EN-619

NRC Inspection Results: The overly conservative "standard" support system utilized by Brown & Root does not represent a safety issue. This Quadrex finding is based on economic considerations which do not impact on the capability of any system to meet the intended design function. Bechtel procedures for design of cable tray hangers were acceptable to the staff reviewer.

This item is considered closed with res[illegible] Quadrex Report review.

Quadrex Finding No.: 4.1.2.3(m)

A significant improvement is needed in the interface between Civil/Structural and external vendors relative to equipment qualification (see Questions C-32 and C-33). The Materials Group should have reviewed more carefully the PDM welding procedure for the fuel pool liner channels (see Question C-37), and the specification of materials by subcontractors (see Question C-39).

Licensee Action: Dispositioned

Review of Seismic input for Qualification of Category I equipment will be done. Bechtel procedures address the concern of maintaining a satisfactory interface with vendors. See EDP-2.16, 4.25, 4.26, 4.34, 4.55, 4.58, 4.63, 4.64, 6.10. Work Package EN-604 will establish the seismic and environmental qualifications of all safety-related equipment. The PDM Welding procedure and the specification of materials will be evaluated. In addition, a visual inspection of the fuel pool liner will be performed. Bechtel STP Procedure, EDP-2.16 also provides for the overall review of specifications of materials and the administration of vendor contracts for materials. Resolution will be provided upon completion of evaluation.

References: EN-604, 619

NRC Inspection Results: Bechtel's plan to review the seismic input for the qualification of Category I equipment and the review of the welding procedures and material specification for the fuel pool liner will serve to resolve this finding. Implementation of EDP-2.16 will ensure vendor compliance with material specification requirements. See finding 4.3.2.1(i) also. This item will be reexamined at a later date.

This item is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.4(n)

The Structural discipline appeared to have transmitted appropriate information to other disciplines without confirming its receipt or proper use. There was no evidence that Civil/Structural provided instruction on its proper use to the receiving disciplines (see Question C-1). Conversely, there was no evidence that other Groups providing input data to Civil/Structural checked to see if that data was being used correctly.

Licensee Action: Resolved

Confirmation of receipt of information or data is obtained when the information is incorporated in design documents. Other confirmation is not required nor considered necessary. Proper use of the information and data is addressed by procedure. EDP-2.16 section 2.p addresses coordination with other design groups to ensure complete, economical, and accurate project development. EDP-4.27, item 3 of Exhibit A, under design verification elements, requires assessing if output is reasonable compared to input.

Information of a very significant or general nature were transmitted to other disciplines via SDDs or TRDs (e.g. response spectra and settlement data). Information of less significance or very specific nature were transmitted to other disciplines via controlled Intra Office Memos (IOMs). Many of these IOMs have been referenced in the SDDs and TRDs as a source of the design basis. This method of transmitting information from one group to another is acceptable. Confirmation of the receipt of the information from one group to another is acceptable. Confirmation of the receipt of the information or clarification on its usage can many times best be accomplished on an informal basis. Generally a group is fully aware of the information required for design or if changes have occurred prior to the actual receipt of the official IOM or TRD. Reviews thus far have not revealed any misuse of data obtained from other disciplines.

References: EC-103, EN-619

NRC Inspection Results: The NRC staff inspector concurred that confirmation of the receipt of data from one design group to another is not required to be formally documented. It is further agreed that final design reviews represent the mechanism that assures conformance with required correct design practices.

This item is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.4(o)

Another area of potential concern was the tangential shear design (see Question C-6). This area has been under discussion in the containment code committee for the last six years and was in the process of evolution when Brown and Root selected their methodology. Although criteria adopted by B&R in this area are generally less conservative than the current code permits, the design of the containment is probably not controlled by this load case.

Licensee Action: Dispositioned

B&R has performed the design for tangential shear in accordance with FSAR commentments. Quadrex's concern is that this methodology used by B&R is less conservative than currently allowed per the approved code case. Bechtel agrees with this evaluation. Information presently available to Bechtel strongly indicates that the present design will meet the current code requirements and construction activities may proceed. However, all the necessary information, including the computer output, needs to be thoroughly evaluated before a final resolution can be reached. It is expected that this can be done by December 1982. Resolution will be performed upon completion of evaluation.

References: Ec-110, 111, EN-619

NRC Inspection Results: Bechtel intends to evaluate the tangential shear design of the containment structure. The NRC inspector identified the current NRC-SRP 3.8.1 requirements that take exception to the ASME code requirements of Section III, Division 1, Sections CC-3421.5 and CC-3441.1. The NRC will review Bechtel's evaluation of the tangential shear design of the containment. See Appendix A.

This item is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.4(p)

The coefficient for vertical seismic in the Mechanical Auxiliary Building (MAB) did not include the correct amplification factor (see Question C-7).

Licensee Action: Resolved

Amplification effects of vertical seismic are not correct for miscellaneous platforms and concrete slabs. However, our preliminary review of the calculations indicate that the effects of additional vertical seismic loads can be mitigated by reducing overconservative live loads and by the normal overdesign inherent in choosing uniform reinforcing sizes and spacings. A complete review of the design will be performed as a normal course of load verification.

References: EC-101, 131, 140; EN-619

NRC Inspection Results: Bechtel's plan to conduct a complete review of the design, satisfied the Quadrex finding. Bechtel representatives stated that the design review will assure that the applicable factors of safety are included in the final stresses computed after the overconservative live loads are reduced to account for the additional seismic loads.

This item is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.4(q)

The original duct ring calculation did not include the appropriate pressure load (see Question C-12).

Licensee Action: Dispositioned

The duct ring calculation will be reviewed to determine if the appropriate pressure loads have been used. Resolution will be provided upon completion of evaluation of calculations.

References: EC-121; EN-619

NRC Inspection Results: Bechtel's proposed reanalysis of the duct ring calculation will include the correct loads. The disposition of this Quadrex finding will be reviewed at a later date. See Appendix A.

This item is considered closed with regard to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.4(r)

The procedure for determining lateral capacity of vertical walls may not be sufficiently rigorous (see Question C-15).

Licensee Action: Resolved

A review of the calculations indicates that in most cases lateral seismic loads and the effects of concentrated moments from beams framing into embedded plates were not considered. Based on preliminary review of the calculations we do not anticipate a significant impact on the design of the walls because the effects of lateral seismic loads and concentrated moments are small. A complete review of the design of walls will be performed.

References: EC-103, 140; EN-619

NRC Inspection Results: Bechtel will conduct a reanalysis of wall designs with respect to lateral seismic loads which will determine the validity of the original designs. This item will be reeamined at a later date upon completion of the design review. See Appendix A.

This item is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.4(s)

In many areas, the equipment loading values are still preliminary (see Question C-17).

Licensee Action: Resolved

Many equipment loads are still preliminary and are noted as such in the appropriate SDD or TRD. The usage of preliminary loads in design is an acceptable practice. Bechtel will continue the process of finalizing these loads and verifying the adequacy of the structure for these as part of the normal design evolution process. See also the evaluation to Finding 4.1.2.1h.

References: EC-103; EN-619

NRC Inspection Results: The use of preliminary loads for initial designs is considered valid. Subsequent load verification provides satisfaction of specification and code requirements. This iterative design process is standard industry practice. The staff reviewer agreed with the finding resolution.

This item is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.4(t)

Although Brown and Root did consider torsional effects in the building structural analysis, the torsional effects on the generation of response spectra were not considered (see Question C-27).

Licensee Action: Resolved

The floor response spectra obtained at the center of mass have been generated by accounting for the actual eccentricity between the center of mass and the center of rigidity. These computed spectra are normally used for systems and components design. Since systems and components may not always have the same distance away from the center of mass, a more correct and conservative approach is to regenerate the horizontal floor response spectra to the edge by combining with the torsional response spectra. However, this theoretical approach is not commonly used as a standard design tool since the overall effect is insignificant. Quadrex concern is, therefore, not valid.

References: EC-101; EN-619

NRC Inspection Results: Bechtel recognized that the torsional response spectra combined with the horizontal floor response spectra results in a more correct and conservative design. The staff inspector identified the NRC-SRP 3.7 requirement for including plus or minus 5 percent of the maximum building dimension to account for "accidental eccentricity." Inclusion of this NRC design consideration in the generation of response spectra will be reviewed by the NRC staff. See Appendix A.

This item is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.4(u)

In the generation of vertical response spectra, there is a current practice to more rigorously consider the flexibility of slabs. There was no evidence of any consideration of this phenomenon by Brown and Root (see Questions C-28 and C-31). This may affect equipment qualification.

Licensee Action: Dispositioned

Ther is no evidence in the calculations reviewed to date that B&R considered the floor flexibility effect for generating the vertical floor response spectra. Bechtel will evaluate whether floor slabs can be considered rigid in the vertical direction. This evaluation will be completed by December, 1982. Resolution will be provided upon completion of evaluation.

References: EC-101; EN-619

NRC Inspection Results: Bechtel's generic evaluation of floor slab rigidity in the vertical direction will be subject to future NRC review. The vertical floor response spectra will also be reviewed. See Appendix A.

This item is considered resolved with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.4(v)

In the area of equipment seismic evaluation, there was evidence of a lack of continuity in Brown and Root staffing. However, it was evident that Brown and Root understood the nature of this activity, and their methodology is in line with industry practices. To date, there was not much evidence of completely cycled vendor seismic analysis with Brown and Root interaction; consequently, we feel that this area will need considerable attention and manpower effort in the near future (see Questions C-32 and C-33). B&R has no criteria for determining whether a given change in response spectra requires requalification of equipment.

Licensee Action: Dispositioned

echtel Mechanical will review the equipment seismic reports and any discrepancies will be resolved to ensure equipment loads and supports are compatible with design requirements. Work Package EN-604 and the follow-on work addresses the concern relative to equipment seismic qualification. Bechtel practice is to reevaluate equipment when response spectra is [illegible]. Resolution will be provided upon issuance of the Environmental Qualification program.

References: EC-103; EN-619, 604

NRC Inspection Results: Bechtel's plan to review equipment seismic reports to incorporate applicable seismic response spectra adequately addressed the Quadrex finding. This finding will be reexamined upon completion of Bechtel's planned actions. See Appendix A. Also see finding 4.1.2.3(m).

This finding is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.5(w)

Some input data to the discipline was provided in the form of unverified letters or IOMs (see Questions C-1 and C-39).

Licensee Action: Resolved

Design information has been provided to the C/S group in the form of IOMs. The IOMs have been referenced in the appropriate SDDs; TRDs and calculations. The usage of a memo to transmit data from discipline-to-discipline is perfectly acceptable.

Information contained in SDDs and TRDs will be reissued in accordance with EDP-4.1. Calculations will be issued in accorance with EDP-4.37.

References: EC-103; En-619; EDP-4.1, 4.37

NRC Inspection Results: Bechtel's plan to reissue information contained in System Design Descriptions and Technical Reference Documents in accordance with EDP-4.1 will adequately serve to formally document design input data.

This finding is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.5(x)

A standard penetration anchorage design procedure may have been more efficient (see Question C-2).

Licensee Action: Resolved

This finding is an observation by Quadrex. Their review stated that the design was adequate. Since the penetrations designs are completed and anchorages installed, no further action is required.

References: EC-112; En-619

NRC Inspection Results: Penetration anchorage designs utilized are of two types, flange-gusset and annular plate-stud. Both configurations are acceptable to the NRC.

This item is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.5(y)

During our review it was evident that there was some lack of understanding of some aspects of the design process (see Questions C-7, C-12 and C-32). This was demonstrated by the fact that B&R had some difficulties in following and explaining the progression of some of the calculations and in being aware of what load cases were controlling. Inexperience in implementing nuclear power plant design was also observed.

Licensee Action: Resolved

The review of the calculations, thus far, has not supported this finding. Generally, it has been found that the calculations are at least equal to the industry standard with respect to technical content, thoroughness, and clarity. In fact, some calculations have been performed using two completely different methods to verify that the design is adequate. The fact that B&R had trouble following and explaining the calculation is understandable. The nuclear power plant design process is very long and complicated. It cannot be expected that one should remember exactly what was done in the calculations five (5) or six (6) years ago without a thorough rereview.

References: EC-103; EN-619

NRC Inspection Results: The staff inspector concured that Bechtel's work package review of Brown & Root design calculations in the civil/structural area has not shown an inadequate design. Unfamiliarity with specific design calculations due to personnel turnover was noted by Quadrex as contributing to their conclusion. The staff inspector does not consider this to be a basis for concluding that a lack of understanding of the design process is evident. B&R is not longer the AE and thus this finding is not applicable.

This item is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.5(z)

B&R did question the finite element model conservatism, but decided to use it anyway (see Question C-26). Justification for this decision was not evident.

Licensee Action: Resolved

The LUSH finite element analysis used by B&R to compute the dynamic lateral earth pressure on embedded walls is conservative, but not outside the bounds of good engineering judgment. Quadrex stated in their assessment of B&R's response to Question C-26 that the technique is consistent with industry norms.

References: EC-100; EN-619

NRC Inspection Results: Lack of justification to provide a more conservative design approach actually relates to economic concerns on the part of Quadrex. The less conservative analytical technique referred to by Quadrex is known as the Macoby-Anobe method. Utilization by Brown & Root of the LUSH finite element analysis resulted in more conservative values of lateral soil pressures.

This item is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.5(aa)

There was also a concern on the lack of use of mass participation in the high frequency range (see Question C-29). We were unable to evaluate the impact of this concern, and it is very possible that it is insignificant.

Licensee Action: Resolved

The contribution from high frequencies of up to 33 cps has been considered by B&R in the seismic analysis of major Category I structures. Modal participation factors for frequencies in excess of 33 cps are of no significance. Quadrex also states in their assessment of B&R's response to Question C-29 that the omission is probably negligible.

References: EC-101, EN-619

NRC Inspection Results: The staff inspector agreed that mass participation above 33 Hertz is negligible and of no safety significance.

This item is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.5(bb)

A parametric analysis for tornado loadings may have reduced the total computational effort (see Question C-36).

Licensee Action: Resolved

Each building has tornado missile impact calculations originated for that building. A parametric analysis for different panel sizes, rebar ratios, and thicknesses would have reduced the total computational effort. There is no impact on design because a parametric analysis was not performed. The finding is a suggestion on how the computational effort could have been reduced. It is not a concern.

References: EC-103; EN-619

NRC Inspection Results: Both Quadrex and Bechtel reviews found no problem with the adequacy of the design for tornado loadings. The Quadrex observation relates to a perceived excess in computational effort. The final design result is not in question.

This finding is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.5(cc)

Several computer codes generated data for use in the major Structural computer codes. The interface between these codes was not reviewed (see Question C-11).

Licensee Action: Resolved

This is not an issue. It is an action not performed by Quadrex. The rest of the assessment given with question C-11 is: "B&R response on selection and use of computer codes seems to be consistent or better than industry standards in this area. A representative sample of the verification manuals for some of the structural codes was examined and found to be in very good order. The codes selected were consistent with industry practice and documentation appeared to be adequate."

The correct (and consistent) use of data for future work is controlled by Bechtel EDP Procedure 4.27 "Design Verification" which requires checking reasonableness of output compared to inputs. (See EDP-4.27 Exhibit A).

This is not a finding, but only a comment that the interfacing between computer codes was not reviewed. From the Bechtel STP review of the calculations, the interfacing between the structural computer codes is acceptable.

References: EC-103, EN-619

NRC Inspection Results: The staff inspector agreed that interface between codes is not required since there is independence between data generation in one code and data utilization in another.

The finding is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.1.2.5(dd)

There appeared to be an inconsistency in the value of the containment minimum temperature (see Question C-39).

Licensee Action: Resolved

The structural SDD (2C019SD010-G), HVAC SDD (5Y149YD006-D), calculation SC 003-4, and specification 2C269SS006-H all show the containment minimum temperature as 65°F. This is based on Westinghouse Containment System Design Criteria Manual Vol. 4-1 and NUS preliminary calculation A509XC009 ANS. No evidence has been found in the structural calculations that something other than 65°F has been used as the minimum containment temperature. It is furter pointed out that even if some calculation did use a design temperature of 60°F, the resulting impact on design would be inconsequential.

References: EC-122; EN-619

NRC Inspection Results: The staff inspector agreed that both the structural and HVAC system design descriptions indicate a minimum containment temperature of 65°F. The resulting impact, however, is of no safety concern.

This finding is considered closed with respect to the Quadrex Report review.

4.2 COMPUTER CODES

4.2 Computer Codes Summary

The twelve computer code findings are based on the answers to sixteen questions (Volume II) asked of B&R disciplines. The findings deal, in general, with programmatic requirements for control of computer program verification and qualification. The Quadrex effort was restricted to B&R in-house computer codes. The general plan of action to resolve the Quadrex findings was found in EN-619, Appendix E. See finding 4.4.2.1(a). Bechtel's resolution involved the complete review of all computer codes and calculations involved in each system work package.

A construction deficiency (10 CFR 50.55(e)) was reported to Region IV on May 8, 1981, regarding the verification methods employed by B&R. This 50.55(e) report has not been closed by HL&P. Region IV will followup to assure corrective action is taken.

Bechtel's procedures were reviewed and found to be adequate and conforming to the requirements of ANSI N45.2.11 and RG 1.70. A CPVR program was found to be in place.

All findings were resolved by Bechtel with one exception. Item (4.2.2.1(d)) was dispositioned and involved updating of the FSAR to conform to the Program Status Summary. All items were considered closed by the NRC staff. Four findings were scheduled for rereview at a later time. (See Appendix A)

Quadrex Finding No.: 4.2.2.1(a)

Numerous programs are listed in the Program Status Summary as having heavy usage on STP with no Computer Program Verification Report (CPVR) in place (see Question C/M-3).

Licensee Action: Resolved

CPVR's are being reviewed as part of the program described in Appendix E of EN-619. The finding concerning CPVRs was reported to the NRC. Bechtel Procedure EDP-4.36 will be followed for verfication of programs.

References: EN-619; EDP-4.36; EDP-4.37

NRC Inspection Results: This item had been reported to the NRC on May 8, 1981, as a potential 10 CFR 50.55(e) reportable occurrence. The computer verification program given in Appendix E of EN-619 was found to be in place and provided for the reviewing of design calculations and associated CPVR's. Appendix E describes a program to review and finalize B&R calculations.* This review, when completed, will determine if the requirements of EDP-4.36, Standard Computer Programs, and 4.37, Design Calculations, have been met.

Review of EC-110, EN-603, and action item work package listings confirmed that action had been initiated. Appendix E provided adequate resolution of the Quadrex finding.

This item is considered closed for purposes of the Quadrex Report review. (Note: The 50.55(e) final report had not been completed by HL&P. This item will be reexamined upon issuance of the final report to Region IV). See Appendix A.

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*The following is taken from: EN-619, Appendix E

Bechtel's Program to Finalize
B&R Computer Calculations

Each Bechtel discipline will review the B&R calculations and associated Computer Program Verification Reports (CPVR's), turned over during the Transition Phase as part of the work package reviews, and develop their status. In order to minimize the recalculational effort B&R calculations previously transmitted will be used where their appropriateness and correctness can be verified in accordance with the following:

(a) If the calculation is not required as part of the design bases documentation it will be marked Preliminary and filed.

(b) If the calculation is required as part of the design documentation and is appropriate and meets all other Industry Codes or Standards associated with the design, it must still meet certain standards of acceptability as delineated in Bechtel Engineering Department Procedures (EDP's) 4.36 and 4.37 before it can be marked Final.

(1) B&R calculations developed using codes with documented CPVR's consistent with B&R procedures may be marked Final if the verification adequately meets the requirements of paragraph 5 of EDP 4.36. This level of acceptance is to be used only in the case of relatively simple "one of a kind" solutions and where the reasonableness of the solution is self evident.

(2) B&R calculations not meeting the "one of a kind" criteria or calculations which, while meeting B&R criteria for code verification, do not meet the requirements of EDP 4.36 but were made with the valid codes, must be verified before acceptance as final in accordance with EDP 4.37. As a minimum this verification can be accomplished using limited reruns or bounding calculations of the design problems on the similar verified versions of BPC or contractor codes. If the reruns provide reasonable and consistent results, these be accepted as Final.

(3) B&R calculations which do not meet the criteria of paragraph (1) or (2) above, must be redone in accordance with EDP 4.36 or 4.37 before they can be accepted as Final.

In addition to the above verification effort, from time to time, Discipline Chiefs, at their discretion, may require that calculations be given additional review prior to acceptance, and will so advise the EGS.

Quadrex Finding No.: 4.2.2.1(b)

Procedure STP-DC-017 does not require verification of non-safety-related programs; however, it is the project application of the code rather than the code itself that really determines whether a safety-related verification is needed. The basis used by B&R for determination of safety-related is not sufficient; for example, some safety-related calculations are not directly related to plant safety-related systems (see Question R-7). B&R's practice is not typical of industry practice (see Question C/M-8).

Licensee Action: Resolved

A CPVR program (of Appendix E to EN-619) is in place involving some 43 work packages to provide for proper documentation on the respective programs. Procedure EDP-4.36 requires verification for all codes whether used to perform safety or nonsafety-related calculations. All calculations are treated with the same degree of concern and care, i.e., all calculations are treated as though they are safety-related. EDP Procedures EDP-4.36 and 4.37 are used for reviewing, checking, and verifying all calculations.

References: EN-619; EDP-4.36; EDP-4.37

NRC Inspection Results: Appendix E of EN-619 required that all computer programs receive the same review regardless of end use. EDP-4.36 and 4.37 were reviewed and determined to be adequate.

This item is considered closed for purposes of the Quadrex Report review. This area will be examined at a later date. See Appendix A.

Quadrex Finding No.: 4.2.2.1(c)

Because of the highly modular nature of most computer programs, it is not adequate to assume that an entire code is verified if a portion of that code has been verified (see Question C/M-13). The P&R CPVR does not indicate which options of a particular code have been verified.

Licensee Action: Resolved

A CPVR program is in place. See response to 4.2.2.1(a) and 4.2.2.1(b).

References: Data Processing Manual: Bechtel Standards for Production Computer Programs

NRC Inspection Results: The referenced DP Manual was applicable to the STP program and included provisions for computer program review, program control, revision, and document control. It was also applicable to programs developed outside of Bechtel. This manual, when combined with Appendix E of EN-619, should assure computer program verification. This would include a thorough verification of all sub-routines. The Bechtel resolution was acceptable to the NRC staff reviewer.

This item is considered closed.

Quadrex Finding No.: 4.2.2.1(d)

Identified discrepancies between the FSAR and the Program Status Summary need to be resolved (see Question C/M-1).

Licensee Action: Dispositioned

Resolution will be provided upon updating of the FSAR Appendix 3.A.

References: EN-603

NRC Inspection Results: The planned action is acceptable to the NRC staff. The Work Package Action Item List (for EN-603) contained a requirement for updating the FSAR. See Finding 4.3.2.1(g) for a discussion of FSAR updating.

This item is considered closed for purposes of the Quadrex Report review. However, this is a dispositioned finding and will receive a final close out inspection. See Appendix A.

Quadrex Finding No.: 4.2.2.1(e)

The CPVR procedure did not prohibit use of a wrong verification problem to be subsequently signed off as verified. Computer calculations are not being treated with the same degree of stringent quality control that is required of all manual calculations (see Question C/M-2).

Licensee Action: Resolved

Deficiencies of this nature will be resolved by the CPVR program now in place as described in Appendix E. (See letter ST-HL-AE-720, dated August 27, 1981.) Bechtel EDP Procedures 4.36 and 4.37 will be used for future verifications.

For shielding calculations, requisite checks and reviews were performed on CPVR's with the exception of those identified in finding 4.2.2.1(a). See also the response to 4.2.2.1(a). This finding (4.2.2.1(e) does not apply specifically to the shielding programs. Computer output for the RHR and VCT series of calculations is acceptably documented. Other calculation packages will be reviewed for identification of computer output.

References: EN-619; EN-603

NRC Inspection Results: EDP 4.36 required that changes to computer programs must be reviewed in the same manner in which the original program was reviewed. Sufficient controls exist to prevent use of unverified versions of computer programs. EDP-4.36 and 4.37 and the CPVR program (Appendix E of EN-619) adequately address this item. (See Finding 4.2.2.1(a))

This item is considered closed; however, this area will be reviewed at a later date. See Appendix A.

Quadrex Finding No.: 4.2.2.1(f)

STP-DC-017-C allows any one or a combination of five options to be used for computer code verification; in our opinion, there is insufficient guidance for selecting which option is preferable in a given STP application. Also, the procedure should not limit reverification to only those deemed significant (see Questions C/M-8 and C/M-9).

Licensee Action: Resolved

All B&R calculations and CPVR's are being reviewed for compliance with Bechtel Procedures EDP-4.36 and 4.37 (see Appendix E). EDP-4.36 does not limit reverification of codes to only significant changes.

Each of the five options is an acceptable verification method. The appropriate methods used for program verification are determined on a case-by-case basis. The method used for QAD-P5A and QAD-CYL is acceptable.

References: EN-603, 619; EDP-4.36

NRC Inspection Results: The staff reviewer verified that EDP-4.36 provided for reverification of all computer code changes.

The NRC reviewer agrees with the licensee resolution.

This item is considered closed.

Quadrex Finding No.: 4.2.2.4(g)

A control document identifying all computer codes used on STP may not exist and should be prepared since the FSAR is not a design document (see Question C/M-1).

Licensee Action: Resolved

B&R listed the various computer programs used on STP in various documents including the Program Status Summary and FSAR. This approach is adequate.

A single control document is not required. Disciplines maintain lists of codes applicable to their activity.

References: EN-619

NRC Inspection Results: A single document is not required by the NRC. The FSAR will contain a list of specific codes as required in RG-1.70. Bechtel also maintained a "Catalog of Bechtel Computer Programs" which described all computer codes registered with and controlled by the Data Processing Library.

This finding is adequately resolved and is considered closed.

Quadrex Finding No.: 4.2.2.4(h)

Guidelines for certifying the appropriateness of computer code applications do not now exist (see Question C/M-7).

Licensee Action: Resolved

It is the joint responsibility of the originator, checker, and reviewer of each calculation to assure appropriate application of computer programs. Typically, the user's manual describes the capabilities and limitations of a program. Written guidelines are not necessary.

References: EN-603, EDP-4.36

NRC Inspection Results: The staff reviewer agrees that there is no requirement for the proposed guidelines. The Bechtel program now in place should assure appropriate computer code application.

This item is considered closed.

Quadrex Finding No.: 4.2.2.4(i)

Use of nationally recognized programs without further verification relative to the intended application is not a typical industry practice (see Question C/M-8).

Licensee Action: Resolved

For the CPVR's reviewed, the programs were tested with benchmark calculations by B&R.

The Bechtel CPVR program, now in place, will resolve this concern. In the future, Bechtel Procedures EDP-4.36 and 4.37 will be used for verification of programs.

References: EDP-4.36; EDP-4.37; Appendix E, EN-619

NRC Inspection Results: A CPVR program has been developed and implemented. Appendix E, EN-619, will finalize B&R calculations. Nationally recognized programs were included in the verification of programs in accordance with EDP-4.36 & 4.37. See also 4.2.2.1(c).

This item is considered closed.

Quadrex Finding No.: 4.2.2.4(j)

Improved control procedures for reflecting program modifications in the computer code CPVR appear necessary (see Question C/M-10).

Licensee Action: Resolved

Appendix E of EN-619 contains a description of the "CPVR Program to Finalize B&R Computer Calculations" which will verify the adequacy of B&R calculations. Bechtel Procedure EDP-4.36 addresses program modifications and documentation.

For the two shielding programs used extensively for shielding, QAD-P5A and QAD-CYL, the verified and nonverified options are discussed. Computer output for the RHR and VCT series of calculations is acceptably documented. All other calculation packages will be reviewed for identification of computer output. The method used for verification of QAD-P5A and QAD-CYL is acceptable except the CPVR's lack a listing of the program or other method for verifying actual changes made. If these cannot be provided, the calculations will be verified in accordance with Bechtel EDP-4.37.

References: EDP-4.36

NRC Inspection Results: The staff reviewer verified that Bechtel Procedure EDP-4.36 provides for modification control of computer programs.

This item is considered closed.

Quadrex Finding No.: 4.2.2.4(k)

Improved "upward" communication procedures appear to be necessary whenever program errors are discovered (see Question C/M-15).

Licensee Action: Resolved

Bechtel EDP-4.36 requires upward communication and will be adhered to in ongoing work which includes resolution of CPVR items.

References: EDP-4.36

NRC Inspection Results: EDP-4.36 provided for "upward" communications.

This item is considered closed.

Quadrex Finding No.: 4.2.2.5(1)

A standard format and content guide does not now exist for STP User's Manuals (see Question C/M-4).

Licensee Action: Resolved

EDP-4.36, Section 5.1 describes the content requirements of user manuals and is applicable to all standard computer programs used on the project.

References: EDP-4.36

NRC Inspection Results: A user normal format and content were specified in EDP-4.36. This was also verified by the staff reviewer by review of NE-007 User, Theoretical and Verification Manual (Version B1-4, August 1981)

This item is considered closed.

4.3 ELECTRICAL/I&C FINDINGS

4.3 ELECTRICAL/I&C FINDINGS SUMMARY

There were a total of 29 specific Quadrex findings in this area. Nine were dispositioned and the remainder were resolved.

The one potentially reportable 10 CFR 50.55(e) issue, identified as Quadrex Finding 4.3.2.1.a, was adequately resolved and is not reportable. There were no other 10 CFR 50.55(e) items identified in this area. Region IV will close the 50.55(e) report at a later date.

During the review, the staff reviewer found no instances of impact on safety by the identified Quadrex issues. The staff reviewer found no instances where the Bechtel resolutions failed to adequately address the Quadrex issues.

It was observed that the Quadrex Findings and Quadrex Questions were in many instances repetitious. The same train of thought appeared in many findings and questions.

All finding resolutions detailed in this section were determined to be adequate. Eleven of the findings are scheduled for rereview at a later time (See Appendix A).

Quadrex Finding No.: 4.3.2.1(a) (Note: This finding contains two line items.)

For the Electrical discipline only, no findings were identified for this category (Most Serious Finding). However, the following I&C finding, if left uncorrected, would be a violation of 10 CFR 50 and would seriously impact plant licensability. An overall review should be made to determine if this is a generic design error, as similar problems could exist in other portions of the design:

(1) The common instrument air line, as depicted in FSAR drawing 9.4.2-2 attached to Question R-6, does not meet the single failure criterion required by IEEE 279-1971 and 10 CFR 50 (See Question E-15).

(2) The occurrence of this design error in the late 1970's in concert with the B&R response to other single failure criterion questions suggests that B&R is not sufficiently experienced in the performance of a Failure Mode and Effects Analysis (FMEA) that crosses discipline boundaries.(5) In most organizations, the I&C discipline would detect and immediately correct this type of design error by performing a rigorous examination of the separation provided between redundant divisions in the safety-related portions of the plant for all involved disciplines.

Licensee Action: Resolved

(1) The DER 82-001 Section IV states that safety of operation is not adversely affected and the final design of installation details is not approved nor released for construction. The DER concludes that the design configuration is not reportable per 10 CFR 50.55(e). Further, design changes were made by B&R to eliminate any further licensing concerns. A review of all safety-related P&IDs for application of the single failure criterion to instrument air lines was conducted. Based on this review it was concluded that the finding is not generic nor is it a significant safety issue. Refer to Deficiency Evaluation Report 82-001.

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(5) Instrument line blockage was identified as a potential concern for single failure analyses in the 1970 period when an early B&W plant had three instruments connected to two piping taps. Technicians repeatedly replaced the instrument connected to one tap because it read differently than the other two instruments connected in common to the other tap; only later did they discover that a blocked instrument line was causing the two common instruments to read erroneously.

Quadrex Finding No.: 4.3.2.1(a)(cont)

(2) The design error referred to by Quadrex is a misnomer. The design feature referred to was determined to be acceptable. Also, Work Package EN-601 which has addressed the concerns on FMEA's and separation states that guidelines will be developed and implemented.

References: EN-619, 601; EJ-303; DER 82-001.

NRC Inspection Results: (Note: This finding contained two line items)
(1) A review was conducted to determine if a generic design error in the B&R application of single failure criteria to similar designs existed. This apparent design deficiency was reported to the NRC as a potential 10 CFR 50.55(e) matter. Deficiency Evaluation Report (DER) No. 82-001, Section IV concluded that the design configuration was not reportable and that the safety of operation was not adversely affected. Design changes were made by B&R to correct the specific air line blockage design problem. However, generic design considerations required a review of all safety-related P&ID's for application of single failure criterion to instrument air lines. The review concluded there were no generic findings significant to safety. This 50.55(e) matter will be closed out by the NRC, RIV.

(2) Failure Mode and Effects Analysis (FMEA) had been requested for all safety-related systems in accordance with Work Package EN-601, Section 6. A list of safety-related systems/equipment, requiring FMEA, was subsequently provided by the AE/licensee to provide clarification to EN-601, Section 6. The indicated systems are presently included or referenced in the STP FSAR. The NRC will require any changes in FMEA requirements, to be identified by the AE/licensee and included in the FSAR.

During the NRC exit interview with the licensee on September 24, 1982, the licensee indicated a review was in process to determine FMEA requirements on specific safety-related systems. The results were subsequently provided as part of EN-601.

Additional methodology and guidance to system design review is addressed in Finding No. 4.3.2.1(d).

The Bechtel resolution is acceptable to the staff reviewer.

This finding is considered closed for purpose of the Quadrex Report review. However, it will be reexamined upon completion of FMEA action. See Appendix A.

Quadrex Finding No.: 4.3.2.1(b)

No top level document (TRD) exists that specifies the STP plant-wide separation requirement. A TRD presently under review is being generated for the Electrical Group, but no plans exist for such documents in the Mechanical and I&C disciplines. It is our assessment that such a top level document is necessary in order that requirements for STP be communicated consistently to all disciplines and to provide a basis for licensing documentation (see Questions E-1 and E-15).

Licensee Action: Dispositioned

WP EE-220 listed an action item to develop the separation criteria. TRD 3570EQ006C will be incorporated into FA530GP009-B, a top level document, which will then be superceded by Bechtel criteria in accordance with EDP-4.1.

TRD F530GP009-B, issued subsequent to the Quadrex review, provided a top level document for verifying separation adequacy. Implementation of this TRD had begun prior to termination of B&R work. This TRD will be superseded and reissued as the "System Interaction Design Guide" and will include, by reference, EQ006C. There is no requirement for a single top level document. However, TRD FA530GP009-B will be superseded by Bechtel Criteria to provide a top level document. Plant separation criteria is addressed by Bechtel EDP procedures EDP-4.22, 4.23, 4.26, and 4.27. Resolution will be provided upon issuance of the System Interaction Design Guide.

References: EN-601, 619; EE-219, 220; EQ-006, GP-006, EDP-4.1, 4.22, 4.23, 4.26, 4.27.

NRC Inspection Results: Methodology of documentation and Bechtel guidelines for separation criteria and adequacy were addressed in finding No. 4.3.2.1(d).

This item is considered closed.

Quadrex Finding No.: 4.3.2.1(c)

There is ample evidence that B&R has not had an overall plan to identify and develop all of the key top-level TRDs needed for a nuclear power plant (see Question E-1). Furthermore, documentation does not exist for some of the basic design decisions made in the past (e.g., choice of coincidence logic, separation, single failure criterion (see Question E-19).

Licensee Action: Resolved

System design decisions are reflected in the System Design Descriptions (SDDs)

Design criteria incorporating B&R's TRDs and SDDs will be superseded by Bechtel design criteria documents in accordance with EDP-4.1. The transition program and work package review plans developed pursuant to QE-002 will result in identification of needed TRDs. In addition, Bechtel is experienced in the design of nuclear power plants and is aware of the various documents that are required. Bechtel is committed to identify, develop, and superceded TRDs, SDDs, and revise the FSAR, as needed for STP.

References: EE-220; EN-619; EDP 4.1

NRC Inspection Results: It was verified by the staff reviewer that EDP 4.1 provided for the orderly transition of B&R design documents into Bechtel documents. QE-002 also required that needed design documents, such as SDOs and TRDs, are to be identified. The resolution was adequate.

Methodology, documentation, and Bechtel guidelines for separation criteria, single failure criteria, and design adequacy are addressed in finding 4.3.2.1(d).

This item is considered closed.

Quadrex Finding No.: 4.3.2.1(d)

No formal methodology or documentation exists to verify adequate separation or the single failure criterion (see Questions E-1, E-8, and E-19).

Licensee Action: Dispositioned

Listed as an action item for resolution in WPs EE-219 and EE-220. EE-580 computer program will verify separation for electrical equipment.

Formal methodology for verifying separation adequacy was developed (TRD FA5308 GP-009B) subsequent to the Quadrex review. Failure modes and effects analysis will be performed by Bechtel for all safety-related systems. Failure modes and effects associated with in-plant hazards events will be formally documented as part of the detailed reviews discussed in Section 6, Work Package EN-501.

Resolution will be provided upon issuance of STP Systems Interaction Design Guide.

References: QE-002; EDP-4.22, 4.23, 4.26, 4.27; EN-601, Section 6; EJ-301; EJ-314; EE-217; EE-580, 219, 220; TRD-7A 530GP-009-B.

NRC Inspection Results: Separation criteria has been developed which consists of grouping and physical separation techniques for electrical power, instrumentation, and control cables throughout the entire plant, in accordance with Bechtel Work Package EE-220 (Separation Criteria - Electrical).

Methods have been outlined for the simplification of existing B&R criteria involving separation, in accordance with Bechtel Work Package EE-219 (Mechanical/Electrical Auxiliary Building Electrical Equipment). These methods focus on equipment and cable raceway arrangements, and methodology.

Subsequent to the Quadrex Review, B&R methodology for verifying separation adequacy was developed (TRD FA530GP009-B). This TRD will be superseded and reissued as Bechtel criteria entitled "System Interaction Design Guide." Corrective actions were being addressed by Bechtel in each of their electrical physical layout work packages.

Bechtel Work Package EE-580 will utilize a computer program to verify the separation of electrical equipment.

Quadrex Finding No.: 4.3.2.1(d)(cont)

Bechtel will develop and implement STP guidance and procedures for the adequacy of system design effort, including single failure criteria, interface system interaction and integration following the transition phase. Operator actions will be addressed separately. Additional guidance to system designers will address:

Failure modes and effects analysis (FMEA)

Interdiscipline design reviews

Electrical independence

Development of shutdown sequence diagrams

Project design verification

Human Factors Engineering

Equipment environmental and seismic qualification

Future studies

Procedures and methods will provide for a comprehensive review of the STP system design in order to identify and eliminate system interactions. The characteristics of a system interaction are defined as follows:

(1) A system interaction that could lead to the defeat of at least one basic safety function.

(2) Multiple failures from a system interaction are dependently caused through either a process coupling in the system design, or a special coupling in the system layout.

(3) A system interaction is a precondition that causes redundant features to be simultaneously influenced where they were intended to be independent.

During the NRC exit interview with the licensee on September 24, 1982, the licensee indicated a review was in process to determine FMEA requirements on all safety-related systems. A list of safety-related systems/equipment, requiring FMEA was subsequently provided by the [illegible]licensee providing clarification of EM-601, Section 6. The indicated systems were included or referenced in the STP FSAR.

This item is considered closed for purposes of the Quadrex Report review. However, this area will be reviewed during a subsequent inspection upon completion of dispositioned action. See Appendix A.

Quadrex Finding No.: 4.3.2.1(e)

No documentation exists for defining separation barrier requirements (i.e., functional or physical) for internal designers and for vendors supplying equipment (panels, switchgear, etc.) that include barriers (see Questions E-2 and E-6).

Licensee Action: Dispositioned

B&R did require separation in specifications by reference to appropriate standards, but no project specific guidance was issued. While such documentation is not required, it can be useful. Reviews are being performed to assure separation adequacy in EJ-301.

Existing specification requirements will be reviewed and updated as necessary to ensure that documentation is provided by the vendor to enable review of separation barrier methodology. For equipment such as the main control panels where barriers are utilized extensively for separation, the specification will be revised to provide more specific criteria.

The equipment covered by work package EJ-314 is supplied by Westinghouse in the NSSS contract. The solid state protection system separation requirements are specified on Westinghouse drawings 7242D10 sheets 1 through 12 and Westinghouse Control and Electrical System Standards Tex-12-1 Volume 4, Binder 1, Tab 22, Section 2.22.

This finding is listed as an action item (in EE-220) to review barriers during the Detail/Design Engineering Phase of the transition, using Bechtel design practices and procedures. Resolution will be provided upon completion of review of specification.

References: EJ-301, 314; EE-220

NRC Inspection Results: Methodology/documentation and Bechtel guidelines for separation criteria and adequacy are addressed in Finding 4.3.2.1(d).

Control panel specifications will be revised to provide criteria during the detail/design engineering phase of the transition (Refer to Work Package EE-220 - Separation Criteria).

The proposed disposition is acceptable to the staff reviewer.

This item is considered closed for purposes of the Quadrex Report review. This will be reviewed during a subsequent inspection after completion of the intended dispositioned action. See Appendix A.

Quadrex Finding No.: 4.3.2.1(f)

No top level document (TRD) exists for equipment classification requirements (see Question E-3).

Licensee Action: Dispositioned

Bechtel proposed in EN-608 that a project Q-List be issued in accordance with EDP-4.28. Draft TRD A470GQ006-A exists and should be included in the Q-List.

This draft TRD was an attempt by B&R to create a TRD for classification of structures, systems, and components. However, this TRD was not issued for use. The issuance of a Q-list will give the safety classification and location of equipment. Based on the Q-list, the equipment qualification criteria containing the updated environmental conditions will be developed (EN-604). No single top-level document is required.

Requirements for equipment classifications are given in FSAR table 3.2. Resolution will be provided upon issuance of the Q-list.

References: EDP-4.28; EN-604

NRC Inspection Results: B&R did not believe that a top level document for equipment classification (Q-List) was necessary as required. At the request of HL&P, they were in the process of generating a draft TRD which would serve the purpose of a Q-List, as a "convience." EDP-4.28 considers a Q-List to be an essential part of project design and thus, will be developed. The staff reviewer agrees with the disposition. This item was listed on the Work Package Action Item List.

This item is considered closed for purposes of the Quadrex Report review. The issuance of a Q-List will be verified during a subsequent NRC inspection. See Appendix A.

Quadrex Finding No.: 4 3.2.1(g) (Note: This finding contained two line items.)

(1) A systematic method to assure that FSAR commitments are implemented in the design does not appear to exist (see Questions E-1, E-3, E-4, and E-14).

(2) In addition, one W design change may require further review with NRC to assure its acceptability (see Question E-22).

Licensee Action: Resolved

(1) A Licensing Commitment Tracking System is now established to track FSAR commitments until they are implemented. Engineering Department Procedures; e.g., EDP-4.1, 4.23, 4.26 and 4.27, assure FSAR commitments are incorporated into the design.

(2) The Westinghouse design change is being reviewed by NRC. See NRC Questions 211.62, 211.44, and 211.85. No further action required.

References: EDP-4.1, 4.23, 4.26, 4.27; EN-600.

NRC Inspection Results: The Bechtel computerized tracking system was discussed with knowledgeable personnel. EN-600 (PRELIMINARY DRAFT), Licensing Document Review, identified the results of Phase A review of documents. The referenced EDPs adequately establish necessary requirements and controls for FSAR commitment control and are considered adequate for resolution of this finding.

This item is considered closed.

Quadrex Finding No.: 4.3.2.1(h)

No basis or procedures were provided to identify support systems needed to assure safety system performance (see Question E-3).

Licensee Action: Resolved

Bechtel procedure EDP-4.13 provides guidance for the preparation of system descriptions. System descriptions are to address support of other systems. In particular: "The Safety Design Bases subsection for systems which have no safety function as a design basis are to be specifically identified as having no safety function and a statement made assuring that system analysis has shown that failure of that system will not compromise other safety-related systems and prevent safe shutdown." EDP-4.1 addresses the development of detailed design criteria.

References: EDP 4.1, 4.13.

NRC Inspection Results: EDP-4.1, Design Criteria contains interactions for detailed design criteria. EDP-4.13, Project Scope Book, provides adequate information on preparation of system descriptions. TRD MEJ 2.4.2, Design Standards, paragraph 2.4.2a contained the requirement (identified in the licensee action quoted above) for identification of support systems. Criteria for interfaces and system interaction and integration were addressed in finding 4.3.2.1(d).

The NRC reviewer agreed with the resolution.

This item is considered closed.

Quadrex Finding No.: 4.3.2.1(i)

Plant operating and environmental conditions were considered at least in the designs reviewed, but there is no project-wide documented basis for these conditions and their use (see Questions E-4 and E-13).

Licensee Action: Dispositioned

This finding was generated because B&R had not identified high energy pipe rupture locations outside containment. The locations and resulting environmental effects of HELBA (High Energy Line Break Accident) will be determined (EN-604) and factored into the equipment qualification effort.

Other work packages that are developing or providing for follow-on development of bases for environmental conditions are EN-601 on systems interaction, EN-602 on pressures and temperatures, and EN-603 on radiation. Resolution will be provided upon issuance of The System Interaction Design Guide, the STP Directive on ALARA, and the Environmental Qualification Program.

References: EN-601, 602, 603, 604

NRC Inspection Results:

Final resolution of this finding will be provided upon issuance of:

(1) The System Interaction Design Guide - Work Package EN-601. (Refer to Finding No. 4.3.2.1(d))

(2) The STP Directive on ALARA - Work Package EN-603 (Refer to Finding No. 4.8.2.1(b))

(3) The STP Environmental Qualification Program - Work Package EN-604 as follows:

Bechtel equipment specifications are to include descriptions of seismic and environmental qualification requirements (Reference EN-604, Appendix E, paragraph 2.0). Evaluation and appropriate action will be taken by Bechtel.

The licensee was informed that the NRC has directed that the DOR Guidelines (November 1979) and NUREG-0588 (July 1981) form the basis for the requirements that licensees and applicants must meet until the final rule 10 CFR 50.49 (Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants) has been completed. This final rule is based on the DOR Guidelines and NUREG-0588. The licensee should continue to maintain an awareness of its development.

Quadrex Finding No.: 4.3.2.1(i) (cont.)

NRC Inspection Results: (cont.)

For information, the major issues to be considered in specifying requirements for environmental and seismic qualification of Class 1E equipment are as follows:

(a) Equipment to complete one path of achieving and maintaining a cold shutdown condition (NRC staff currently recommends no requirement for cold shutdown).

(b) Equipment located in mild environment (NRC staff currently concludes imposing 10 CFR 50 Appendix B only).

(c) Credit for previous qualification efforts on operating plants (NRC staff currently recognizes previous qualification).

(d) Margins applied leading to excessive stress (NRC staff recognizes conservatisms that can be quantified).

(e) Seismic and dynamic qualifications an integral part of environmental qualification (The Commission currently has elected to pursue this issue at a future date).

(f) Time-dependent variations of relative humidity (The Commission currently agrees this cannot be considered for all equipment).

(g) Prototype equipment naturally aged (the Commision currently recognizes that state-of-art technology will be utilized in any aging program).

(h) Requirements for a central file (The Commission currently agrees this requirement should be deleted, but recordkeeping requirements of 10 CFR 50 Appendix B must be met).

(i) Analysis and partial test data (The Commission currently agrees that analysis should be allowed to extrapolate results for equipment qualification, regardless of equipment purchase date).

(j) Replacement parts (NRC staff currently has deleted the "installed prior to November 30, 1985" date, thus requiring replacement parts after this date to be qualified either in accordance with DOR Guidelines or NUREG-0588).

(k) Deadline for completion of qualification (A schedule must establish a goal of final environmental qualification of electric equipment. The schedule, identifying equipment important to safety, including test

Quadrex Finding No.: 4.3.2.1(i) (cont.)

NRC Inspection Results: (cont.)

laboratories and dates, is to be submitted to NRC. Reference: D. G. Eisenhut letter to all licensees of operating plants, and applicants for operating licenses, and holders of construction permits dated October 1, 1980).

The staff reviewer determined that the disposition is acceptable.

For purposes of the Quadrex Report review, this item is considered closed. However, this area will be reviewed in a followup inspection after issuance of the above documents. See Appendix A. Reexamination will also occur during the normal licensing review in accordance with SRP 3.11 (NUREG 0800).

Quadrex Finding No.: 4.3.2.1(j) (Note: This finding consisted of two line items.)

(1) Specifications reviewed allow the vendor to apply applicable requirements of the NRC regulations and industry standards. In our opinion, B&R should be the responsible engineer doing the specifying of the specific requirement.

(2) Significant decisions for the ESF Sequencer were left for the vendor to make rather than for B&R to specify; such practices are marginal for this type of equipment (see Question E-8).

Licensee Action: Resolved

(1) A detailed vendor document review in accordance with the transition program and Procedure QE-002 will confirm that the vendor has complied with the standards and regulations. Issues requiring interpretation will be amplified with specific guidance provided in the specification. Bechtel procedures EDP 4.58 and 6.10 will be followed relative to vendor documentation.

(2) The vendor was not required to make any significant decisions on the application of the codes and standards specified. The codes and standards specified are such that the equipment will be of a quality consistent with Class 1E equipment, and the ability to perform its intended design function. The ESF load sequencer vendor is required to identify the applicable portions of the specified codes, standards, and NRC regulations, which pertain to the equipment being supplied.

References: EDP-4.58, 6.10; EJ-303; QE-002

NRC Inspection Results: (Note: This finding consisted of two line items.)

(1) Issues requiring interpretation will receive specific guidance in specifications, in accordance with Procedure QE-002. Vendor document review will be accomplished in accordance with EDP-4.58 and 6.10. Procedure QE-002 will ensure that vendors comply with Bechtel standards and NRC regulations.

(2) Refer to Generic Finding No. 3.1(h). The NRC assessment addressed reliability analysis and figures for the ESF load sequencers. Final Work Package EJ-303 does require the ESF load sequencer vendor to identify applicable portions of the specified codes, standards, and NRC regulations.

The staff reviewer agreed with the resolution and this item is considered closed.

Quadrex Finding No.: 4.3.2.1(k)

Recent NRC requirements may not be reflected yet in the STP design (see Question E-10). Many TRDs and SDDs, based on their issue date, refer to superseded industry standards and NRC regulations (see Question E-3).

Licensee Action: Resolved

Work Package EN-609 developed a system to provide for the timely review of NRC Bulletins, Generic Letters, etc. The transition procedure and plans for system work package reviews provide for the review of TRDs and SDDs and revision as required so that applicable standards and regulations are referenced.

The transition program incorporates resolutions for these concerns.

References: EN-609; QE-002

NRC Inspection Results: A requirement for appropriate review of NRC requirements was identified in EN-609. QE-002, provided an orderly review of work for NRC requirements. The staff reviewer agreed with the resolution.

This item is considered closed.

Quadrex Finding No.: 4.3.2.1(1)

The pre-op testing requirements and operating procedures interfaces between B&R and HL&P appear to be long-standing problem areas (see Questions E-11, E-16, and E-21).

Licensee Action: Resolved

Bechtel will assign a startup organization to STP. This organization will work closely with Bechtel Engineering/Construction and HL&P personnel to maximize cooperation between Bechtel and HL&P relative to startup testing requirements and development of operating procedures. This is an observation and is a future task.

References: EJ-306

NRC Inspection Results: The NRC reviewer concurs that this is an observation of a future task.

This item is considered closed.

Quadrex Finding No.: 4.3.2.1(m)

No basis or methodology appears to exist to assure that all required manual operations at remote panels can be performed under various plant operating conditions (see Question E-13).

Licensee Action: Dispositioned

Those panels identified in the B&R response to the Quadrex questions will be reviewed in the ongoing ALARA program. These concerns are addressed in ALARA checklists to ensure that radiation levels allow the required access. Location and access criteria for various operating modes will be reviewed in the on-going ALARA program. For safe shutdown requirements external to the control room, required manual operations will be reviewed and access verified as part of the safe shutdown pathways review. Post-accident access requirements for post-accident sampling will be addressed during system development to post-TMI criteria.

Resolution will be provided upon issuance of the STP Directive on ALARA, completion of the safe shutdown pathway review, and finalization of the safe shutdown criteria.

References: EN-603, 605

NRC Inspection Results: The NRC review verified that the finding should be resolved when the documents, identified in the finding resolution, are completed. See finding 4.8.2.1(b) for ALARA program considerations.

Bechtel will develop and implement STP guidance and procedures for the adequacy of system design effort, including single failure criteria, interfaces, system interaction and integration. Operator actions will be addressed separately. Additional guidance to system design will address the development of shutdown sequence diagrams (See finding 4.3.2.1(d).

This item is considered closed, however, this area will be examined during a subsequent NRC review. See Appendix A.

Quadrex Finding No.: 4.3.2.1(n)

It is planned that various types of isolation devices will be used. Actual devices are still under evaluation and qualification. There is no existing document that provides guidance to the designers on the circuit application of these various types (e.g., optical couplers vs. fuses vs. relays, etc.). It is our opinion that lack of such a document (TRD) could result in design errors and licensing problems (see Question E-14).

Licensee Action: Dispositioned

Resolution of the issue is listed in EE-220 as an action item to complete the implementation of isolation devices in the design and to finalize documents for the procurement of isolation devices. Selection and implementation of isolation devices will be made on the basis of engineering principles, experience, judgment, and case-by-case analysis of design requirements for each type of circuit. This is an ongoing effort and will be completed in accordance with the Project Engineering Schedule.

Specific criteria and guidance in EJ-301 for the selection of isolation devices will be developed prior to specification and procurement of isolation devices being incorporated into the design to isolate Class 1E associated circuits interfacing with the annunciator, computer, ESF status monitoring and other non-class 1E control circuits. Resolution will be provided upon issuance of criteria.

References: EN-601; EE-220; EJ-301

NRC Inspection Results: Reference Work Package EJ-301 (Control Boards): Specific guidance and criteria will be developed prior to specification issue for the Controls and Instrumentation discipline, in the design effort. Also, STP guidance and procedures for the adequacy of system design effort will be developed by Bechtel (Refer to finding No. 4.3.2.1(d).

Reference Work Package EE-220 (Separation Criteria): The Electrical discipline will prepare a specific guidance and criteria document sometime in the future to address isolation devices for MCC's and load centers. STP guidance and procedures for grouping and physical separation techniques has been developed (Refer to finding No. 4.3.2.1(d)).

This staff reviewer concurred in the proposed disposition of the finding.

This item is considered closed for purposes of the Quadrex Report review. However, final disposition will be reviewed at a later time. See Appendix A.

Quadrex Finding No.: 4.3.2.1(o)

One instance was found where the design verifier was also the design checker, which is not consistent with B&R procedures (see Question E-18).

Licensee Action: Resolved

Bechtel will review design verification and design checking as part of the transition program per transition procedure QE-001. Further, designs will be verified in accordance with the Bechtel Engineering Department Procedure (EDP) 4.27 and 4.37, respectively, for the South Texas Project.

References: EDP-4.27, 4.37.

NRC Inspection Results: B&R's procedure STP-DC-015-I paragraph 2.3.2.1 stated that "checking and verification of a calculation may be conducted concurrently by the same individual."

Bechtel's Procedure EDP-4.27, Design Verification and EDP-4.37 Design Calculations, are consistent with the requirements of ANSI N45.2.11, which generally required that design verification is to be performed by any competent individual or groups other than those who performed the initial design. Appropriate records must be maintained.

This item is considered closed.

Quadrex Finding No.: 4.3.2.3(p)

The rapid escalation in late 1980 in the DC battery sizing appears to be untimely (see Question E-23). The absence of adequate interdisciplinary documents may have contributed to the design being late, and may prolong the identification of unrecognized significant problems as the design evolves (See question E-2).

Licensee Action: Dispositioned

EE-208 requires preparation of a load study for Non-class 1E 48V DC battery and charger loads and prepare (sic) the calculations. This is an action item scheduled for completion by July 1984.

EE-206 has as an action item to resurvey the loads and revise the calculations. (Non-class 1E 2500 DC Power distribution systems.)

EE-209 recommends a load study and revised calculations. (Class 1E 125v DC power distribution system.)

All battery systems are being reviewed in accordance with the transition program and procedure QE-002. See also work packages EE-207, 210, and 224. Resolution will be provided upon completion of load study and calculations.

References: EE-206, 207, 208, 209, 210, 224; QE-002

NRC Inspection Results: The staff reviewer concured with the proposed disposition. Load studies are currently being reviewed on all battery systems in accordance with the transition program and procedure QE-002. Up-dating these studies will be required as additional vendor information becomes available and requirements for additional loads are added to the plant design.

This item is considered closed for purposes of the Quadrex Report review. Followup on the resolution will be conducted for safety-related battery systems. See Appendix A.

Quadrex Finding No.: 4.3.2.3(q)

B&R requires the vendor to interpret and implement applicable portions of industry standards (see Question E-5). It would be more appropriate for B&R to provide detailed guidance to vendors.

Licensee Action: Resolved

Issues requiring interpretation (in EJ-303) will be amplified with specific guidance provided in the specifications. A detailed vendor document review in accordance with the transition program and procedure QE-002, will ensure the vendor has complied with the Bechtel standards and regulations. Issues requiring interpretation will be amplified with specific guidance provided in the specification. Bechtel procedures EDP-4.58 and 6.10 will be followed relative to vendor documentation.

References: EDP 4.58, 6.10; EJ-303; EQ-002

NRC Inspection Results: Refer to finding 4.3.2.1(j) for NRC assessment and conclusion.

This item is considered closed.

Quadrex Finding No.: 4.3.2.4(r)

Technical communication among various disciplines may require improvement (see Questions E-2 and E-16).

Licensee Action: Resolved

Bechtel procedures provide for discipline interface. EDP 2.13, paragraph 5.3b listed resolving interface-problems with other groups as an EGS responsibility. Paragraph 5.7c gave the responsibilities of engineers, designers, and draftsmen including coordination activities with other groups. EDP 2.16, 4.25, and 4.26 also address interaction and interface of the disciplines.

References: EDP-2.13, 2.16, 4.25, 4.26

NRC Inspection Results: The NRC reviewer confirmed that technical communications are provided for in four EDPs: EDP-2.13, STP Engineering Team Organization and Responsibilities; EDP-2.16, Project Design Group Function; EDP-4.25, Design Interface Control; and EDP 4.26, Design Interface Control. Resolution of this finding is adequate.

This item is considered closed.

Quadrex Finding No.: 4.3.2.4(s)

Specifications, TRDs and SDDs are inconsistent and could be a source of design error. One example of this is the method of specifying environmental conditions. Some documents reference other documents for this information, while others directly contain the numbers. A second example involves the use of IEEE 344-1971 (see Question E-3). A third example is the referencing of NRC regulations, but B&R stated that this was not the practice for procurement specifications (see Questions E-3 and E-21, B&R response to Question E-16, and STP documents E310EQ002-C Sections 3.1.1 and 3.1.2, and 3Z019ZQ001-C, Section 4.3). In the Process Radiation Monitoring System, B&R was inconsistent since NRC Regulatory Guide commitments were provided in the SDD while IEEE Standards were identified in the procurement specification to the vendor. No resolution of the technical differences between these documents was evident.

Licensee Action: Resolved

Bechtel has the responsibility to review the SDDs, FSAR, and TRDs to resolve inconsistencies. Reviews of the STP documents and design criteria are being conducted for all work packages in accordance with the work package review plans and checklists pursuant to the transition procedure QE-002. B&R's TRDs and SDDs will be superseded by Bechtel criteria documents in accordance with EDP-4.1. Further, it is not inconsistent to use industry codes to purchase equipment which will be included in a system that complies with NRC requirements.

References: QE-002, EDP-4.1; QE-002

NRC Inspection Results: The transition program provided for a review of all design source and procurement documents. Issues requiring interpretation will be amplified with specific guidance provided in the specification. This action should resolve inconsistencies and eliminate sources of possible design errors. See Section 2.3.4 for a discussion of the transition program. See finding 4.3.2.1(j) also.

This item is considered closed.

Quadrex Finding No.: 4.3.2.4(t)

No formal procedures for the vendor documentation review process exist (see Question E-3). For example, the assignment and procedures for reviewing and approving reliability evaluations within these disciplines was not made clear, yet vendors were being requested to submit such evaluation (see STP document 3N099ES071-E, Section 3.4, and Question E-5).

Licensee Action: Resolved

As indicated in EJ-303, Bechtel Procedure EDP 4.58 describes the vendor document review procedure. Supplemental procedures are EDP 2.16, 4.25, 4.34, etc. The vendor will supply a reliability analysis for the load sequencers. Bechtel will evaluate the reliability analysis to determine if the equipment meets the intended design function. As a general rule, BPC does not require reliability evaluations; however, it is not unusual for specified requirements to be included in unique items; e.g. load sequencers and emergency diesel generators. No procedures exist relative to the conduct of reviews of reliability evaluations; however, how the reviews will be done and who will conduct them is the responsibility of the discipline supervisor.

References: EJ-303

NRC Inspection Results: The staff reviewer confirmed that EDP 4.58, Specifying and Reviewing Supplier Engineering and Quality Verification Documentation, provided for the adequate review of vendor documentation. See also finding 4.3.2.1(j).

This item is considered closed.

Quadrex Finding No.: 4.3.2.4(u)

B&R's position regarding use of only fail-safe Class 1E solenoid valves should be re-examined (see Question E-3).

Licensee Action: Resolved

The use of fail-safe designs is acceptable.

References: EJ-367

NRC Inspection Results: Bechtel completed a review of this finding. The NRC reviewer also concluded that fail safe design is an acceptable practice. If Class 1E solenoid valves are used in the STP design, these would be qualified to the harsh environment as addressed in finding 4.3.2.1(i).

This item is considered closed.

Quadrex Finding No.: 4.3.2.4(v)

B&R's criteria regarding equipment and system monitoring is not sufficiently clear and may need to be re-evaluated (see Questions E-5, E-9, and E-21).

Licensee Action: Dispositioned

This concern may be particularly valid (in EJ-300 and 301) for monitoring of control systems such as the ESF Load Sequencer. This area of concern will be reviewed in light of Post-TMI criteria and addressed as part of the Control Room Design Review in Phase B. Criteria for monitoring will encompass alarm criteria for the annunciator, plant computer system, and ESF status monitoring. The criteria in TRD 6Z019ZQ002, System and Equipment Monitoring Generic Design Criteria, will then be revised accordingly. Resolution will be provided upon issuance of superseded criteria.

References: EJ-300, 301, 310; EN-607; TRD 6Z019ZQ002

NRC Inspection Results: Refer to finding No. 4.3.2.1(d). Bechtel will develop and implement STP guidance and procedures for the adequacy of system design effort following the transition phase B in which operator actions will be addressed. Guidance to system design, such as annunciators, alarms, computer I/O, and ESF status monitoring, will be addressed at that time. Also, additional guidance to system design will address:

Development of shutdown sequence

Human factors engineering

Future studies

Bechtel will address TMI upgrading in Work Package EN-607.

This finding is considered closed for purposes of the Quadrex Report review. This item will be reexamined at a later time upon completion of the planned action. See Appendix A.

Quadrex Finding No.: 4.3.2.4(w) (Note: This finding contains two line items.)

(1) Attainment of separation objectives for the ESF Sequencers could not be verified since the design is not yet complete (see Questions E-5, E-6, and E-7).

(2) An improved symbology for designation of redundant trains should be considered (see Question E-7).

Licensee Action: Resolved

(1) Separation is provided by physical location and it is adequate. Three load sequencer cabinets are provided, one per actuation train, and are located in the EAB switchgear rooms for their respective trains, on different floor elevations of the building. Separation barriers are not required within the load sequencer cabinets. (See EJ-303)

WP EE-220 lists an action item to develop separation criteria to provide improved symbology for redundant trains.

(2) Instrumentation "balloons" have been adopted on P&ID legends. B&R logics with identified trains will be utilized. Coded designations on the System 38 Instrument Index have been implemented as part of the instrument tag number. (See EJ-303)

References: EJ-303; EE-220

NRC Inspection Results: (Note: This finding contains two line items).

(1) Separation criteria had been developed in accordance with Work Packages EE-220, EE-219, TRD FA530GP009-B, and EE-580. Refer to 4.3.2.1(d) in which this subject was addressed in detail.

(2) Improved symbology for redundant trains was listed as an action item in Appendix A of Work Package EE-220. This improved symbology is yet to be developed by Bechtel for electrical separation criteria. Legends for P&ID's, B&R logic diagrams, and instrument index, will identify redundant trains as called for in Work Package EJ-303.

The staff reviewer agreed with the resolution.

This item is considered closed.

Quadrex Finding No.: 4.3.2.4(x)

Proper operation of actuated equipment, such as MOVs and pumps, should be verified for all possible transitions in operating modes of the ESF Sequencer (see Question E-8).

Licensee Action: Resolved

The ESF Load Sequencer specification adequately defines the different modes and combinations thereof for load sequencer operation. Proper operation of actuated equipment will be verified for possible transitions in operating modes of the ESF Load Sequencer during startup.

References: QE-002; EJ-303; EN-601; EDP-4.25, 4.26, 4.27

NRC Inspection Results: The micro processor, which is an integral part of the ESF load sequencer, including ESF hardware peripherals, will require a reliability analysis (Refer to generic finding 3.1(h)) and a Failure Modes and Effects Analysis (FMEA). Refer to finding No. 4.3.2.1(a).

Bechtel will develop and implement STP guidance and procedures for the adequancy of system design effort. Refer to finding No. 4.3.2.1(d).

Verification of the ESF load sequencer operating modes during the startup phase, will require startup procedures for onsite use, approved by the AE's engineering department.

This item is considered closed for purposes of the Quadrex Report review. This finding will be reexamined as part of the NRC FMEA review. See finding 4.3.2.1(a).

Quadrex Finding No.: 4.3.2.4(y)

B&R's position regarding sensor response time testing should be verified (see Question E-12).

Licensee Action: Resolved

Transmitters and process switches subject to response time testing are provided with process test connections such that in-situ response time testing can be performed. HL&P will determine the methodology and be responsible for performing the testing. The method of testing and equipment used will demonstrate that the response times are within the values stated in FSAR Table 7.2-3.

Process transmitters not in W scope subject to response time testing will be installed with process test connections such that in-situ response time testing can be performed. (Standard installation details provide test connections for all transmitters.)

References: EN-601; EJ-314; FSAR Table 7.2-3

NRC Inspection Results: Bechtel will develop and implement STP guidance and procedures for the adequacy of system design effort following the transition phase. Design guidance will address facilities for response time testing, incorporated into the STP design, during the interdiscipline design reviews Refer to finding 4.3.2.1(d).

The licensee/AE will be required to develop procedures for periodic testing by plant personnel.

The staff reviewer agreed with the resolution of the finding.

This item is considered closed.

Quadrex Finding No.: 4.3.2.4(z)

An analysis of the actuation logic relative to NRC requirements between the main FW and the AFW system should be performed (see Question E-15).

Licensee Action: Resolved

Bechtel STP concurs with the Task Force Assessment that there are no NRC requirements for a direct actuation signal between MFW and AFW.

References: EN-600; EJ-303; EM-408; EN-607.

NRC Inspection Results: To date, the STP design indicated that a direct actuation signal between the Main Feedwater (MFW) and Auxiliary Feedwater (AFW) systems was not included, and the AFW was controlled through the Westinghouse Solid State Protection System. A decision to include such actuation signals in the plant design, is a Licensee/NSSS option. There is no NRC requirement.

This resolution was acceptable to the staff reviewer.

This item is considered closed.

Quadrex Finding No.: 4.3.2.4(aa)

STP application of "special" raceways should be re-examined (see Question E-18).

Licensee Action: Resolved

Special raceway is a term used in the automatic routing of circuits by computer to identify situations that do not conform to the established field guidelines for standard raceways; e.g., pull box, trough, or wireway. The application of special raceways will be minimized. (EE-217)

References: EE-217, 220, 580; EN-601

NRC Inspection Results: The term "special raceway" as used by B&R in their specifications allowed the use of plastic, aluminum, and materials not necessarily fire retardant, nor necessarily capable of supporting cable weight, (Ref. STP-PE-005A entitled Engineering Procedure for Electrical Cable and Raceway Scheduling). B&R used this type of special raceway only in nonsafety-related field applications, or where imbedded in concrete, as subsequently reviewed and assessed by Bechtel. The present STP design does however, specify PVC conduit for use in the yard area, imbedded in concrete, for the safety-related Central Cooling System. Refer to finding No. 4.3.2.5(cc) for use of both PVC and flamemastic material applications.

The term "special raceway" as used by Bechtel in the STP Project Team evaluation implies the Bechtel definition differs from how this term was used by B&R. Special raceways are those which do not conform to the established field guidelines for standard raceways (computerized automatic routing of circuits) which have special application such as, cable drops and rises, pull boxes, and square ducts. These applications do not necessarily require the supporting weight of cables etc., as do the standard raceways. Use of non-fire retardant materials are addressed in finding 4.3.2.5(cc).

For the methodology used by Bechtel to verify adequate separation criteria, and physical separation techniques for electrical power, control, and instrumentation cables throughout the entire plant see Finding 4.3.2.1(d). Work Package EE-580 will be utilized to verify separation aspects. Bechtel's "System Interaction Design Guide" (Work Package EN-601) will be utilized to address the physical separation aspects of "special raceways."

Special raceways is not to be confused with physically separated wireways, troughs, and conduit used inside control panels. Refer to Work Package EJ-301.

The resolution is acceptable to the staff reviewer.

This item is considered closed.

Quadrex Finding No.: 4.3.2.4(bb)

B&R should verify that no Class 1E heat tracing systems are required for STP taking into account all possible modes of plant operation (see Question E-22).

Licensee Action: Resolved

The design of the Heat Tracing System is incomplete. The present design does not include Class 1E heat tracing primarily due to the fact that the Emergency Core Cooling System uses a boron concentration sufficiently low to preclude precipitation and the need for supplemental protection. Other aspects of the IE heat tracing will be completed as ongoing work. (EE-215)

References: EN-601; EE-215

NRC Inspection Results: Indications at this time from Bechtel show that the Westinghouse NSSS design will employ something less than 4% boron concentration (relatively low). This should preclude precipitation and the need for heat tracing on emergency core cooling systems (ECCS), such as injection tank recirculation flow lines, etc., normally considered in the Westinghouse PWR design.

The AE/Licensee, in their their design review, must consider heat tracing requirements if the NSSS design requirements should change to a higher boron concentration. Refer to design adequacy and review, finding 4.3.2.1(d).

The AE/Licensee will identify Class 1E heat tracing systems in the STP design, if and when they exist.

This item is considered adequately resolved and therefore is closed.

Quadrex Finding No.: 4.3.2.5(cc)

The basis for use of Flamemastic (see Question E-2) and PVC (see Question E-17) should be re-examined.

Licensee Action: Dispositioned

Bechtel's position (EJ-301, 303, 317, and 370) is that the use of Flamemastic is acceptable provided its use, in concert with other materials in fire stops, is verified by tests to ensure that derating margins have not been exceeded. PVC was restricted to yard areas. All specifications are being reviewed for utilization of PVC. In some cases, i.e., vibration monitoring panels, PVC is used extensively and the panels will be rewired. In cases where the use of PVC is limited and enclosed, the equipment will be used as is. The approach that will be taken in Phase B will be: (1) Review specifications/purchase orders for utilization of PVC, and (2) Disposition each case based on location and amount of PVC. Resolution will be provided upon completion of review of specifications.

References: EJ-301, 303, 317, 370

NRC Inspection Results: Bechtel's use of PVC in main and remote control panels (Work Package EJ-301), on a limited basis, will be governed by 10 CFR 50, Appendix R. Bechtel STP design is based on a review of Appendix R with deviations and exceptions to it, submitted to NRC (NRR) for endorsement. Area drawings will be mostly complete by July 1983 in which the Fire Hazard Analysis Report will be submitted.

Part 50, Proposed Rule 50.48 "Fire Protection" should be considered for use of PVC and Flamemastic material applications in future upgrading requirements.

The Licensee/AE will not use "glastic" for barriers inside control boards.

This finding is considered closed for purposes of the Quadrex Report review. However, it will be reexamined subsequent to completion of intended action.

4.4 HVAC FINDINGS

4.4 HVAC FINDINGS SUMMARY

There were 28 findings related to the HVAC system. Eight line items were dispositioned, the remainder resolved.

The HVAC systems became the subject of a 10 CFR 50.55(e) construction deficiency report on May 8, 1981. The entire HVAC system is to be reviewed by Bechtel, statused and redesigned where required. The HVAC area will then be inspected and reviewed when the final 50.55(e) report has been submitted to Region IV.

The staff considers that all findings were adequately dispositioned or resolved and are thus closed for purposes of the Quadrex Report review. However, eight of the findings will be reviewed at a later date. See Appendix A.

Quadrex Finding No.: 4.4.2.1(a)

The design bases are not well defined for safety-related HVAC systems. The plant operating modes and off-normal operating conditions of HVAC systems and systems supported by HVAC, including analysis of plant transient and accident conditions, were not adequately addressed (see Question H-3).

Licensee Action: Dispositioned

Bechtel agreed with the Quadrex finding and will supercede the existing System Design Description (SDD) with a Design Criteria Document (DCD) which will reflect realistic design criteria. The revised SDD will be used to assess the Brown & Root calculations. Additionally, the NUS and Westinghouse OPS contracts will be reviewed to determine the work scopes and criteria. Subsequently, the NUS, OPS and Brown & Root calculations will be evaluated to determine if the revised design criteria is met, "User" heat loads accounted for, etc. Bechtel will then define those deficient HVAC systems and required corrective action. The plan will result in a hold on the applicable systems and construction will probably be impacted accordingly. Resolution will be provided upon issuance of superseded SDD. In addition, HL&P reported the HVAC design as a 10 CFR 50.55(e) construction deficiency.

References: EQ-002, EM-550, 551, 555

NRC Inspection Results: The staff reviewer verified that action for a HVAC design verification review had been initiated. All HVAC systems were included in the review plan. This review was being accomplished during the transition program. (See Section 4.4.2.1(b)) As a specific example, EM-551 documented that a review had been made by NUS considering the heat loads under various plant operating conditions. The three electrical penetration areas in EAB were identified as having no provision for cooling under any operating condition. The proposed resolution is to provide a safety-class chilled water cooling system. Bechtel will followup and take the necessary action to resolve this specific item and others identified during the system reviews. The staff reviewer concurs in the disposition of this finding.

For purposes of the Quadrex Report review, this item is considered closed. Note that the 10 CFR 50.55(e) report is not complete and will remain open until closed by a Region IV inspection. See Appendix A.

Quadrex Finding No.: 4.4.2.1(b)

The safety classification of HVAC systems is not traceable to "user" systems (see Question H-5).

Licensee Action: Dispositioned

Bechtel agreed that the HVAC systems should be classified safety-related or nonsafety-related based on "user" systems. The revised design criteria will reflect realistic design criteria and ensure that safety-related HVAC systems are defined and that calculations adequately size the HVAC systems. This finding was reported to the NRC. (See IRC Issue No. 95.) Bechtel STP procedure EDP-4.28 provides for the development of a Q-list which identifies safety-related structures and systems. Work Package EN-608 and the follow-on work addresses the development of the Q-list and classification of systems. Resolution will be provided upon issuance of superseded SDD.

References: EDP-4.28; EM-550, 551, 552, 554

NRC Inspection Results: Bechtel had initiated a HVAC system design verification review and work plan based on the B&R turnover and Work Package review. The work plan areas to be covered include: I-Design Criteria, II-Review of Calculations; III-P&ID Issue (limited); IV-Duct/Equipment release (with holds); V-resolution of Quadrex and other open items; and VI-Issue Final P&ID's (no holds) and VII, Duct/Equipment Release (no holds). These plans were verified through review of documents and discussions with responsible A/E and licensee personnel. The staff reviewer concured with the disposition plans for this item.

This item is considered closed for purposes of the Quadrex Report review. This area will be reviewed as part of the 10 CFR 50.55(e) report. See Appendix A.

Quadrex Finding No. 4.4.2.1(c)

Calculations for hydrogen mixing and the potential for pocket accumulations in the containment after a LOCA need to be addressed (see Questions H-3 and H-27). There was inconsistency in specifying the hydrogen concentration limit for the battery room.

Licensee Action: Dispositioned

The calculations will be reviewed and Bechtel will provide recommendations accordingly. BPC's approach to evaluating H_2 is to review physical drawings during the normal HVAC design program for H_2 concentrations inside closed compartments of the containment building.

Calculations that used a 3 percent limit have been superceded by calculations which use the correct limit of 2 percent.

References: Work Package EM-550, 551

NRC Inspection Results: The planned disposition was confirmed by the staff reviewer through review of Work Packages, EDPs, plans for the HVAC review program, and discussion with licensee and AE personnel. See finding 4.6.2.1(o).

This item is considered closed for purposes of the Quadrex Report review however, this area will be examined during a later NRC review. See Appendix A.

Quadrex Finding No.: 4.4.2.1(d)

(1) Separation requirements to protect against common mode failures such as fire and jet impingement are not identified (see Question H-6). (2) B&R has not reviewed the impact of non-safety HVAC ductwork on safety-related equipment (see Question H-18).

Licensee Action: (1) Dispositioned (2) Resolved

(1) Bechtel will revise the existing design criteria for the HVAC systems. The Quadrex finding correctly stated that separation of HVAC from the effects of pipe break and fire had not been reviewed. Interaction matrices completed by EDS for pipe ruptures inside containment did not include the HVAC targets. This was of greatest concern within the containment and IVC which house multiple trains of safety equipment and have severe pipe break hazards. Separation of HVAC from in-plant hazards will be evaluated by BPC. (2) Supports for HVAC in safety equipment areas have been specified to Seismic Category I criteria.

References: EN 601; EM-550, 551, 555

NRC Inspection Results: (Note: This finding contained two line items.) (1) EN-601 has detailed plans for system interaction and integration. This item was included in the Work Package Action Item List. See finding 4.3.2.1(i).

(2) For this line item, see Finding 4.4.2.4(q).

Disposition and resolution of these items was considered adequate.

This finding is closed for purposes of the Quadrex Report review, but will be reexamined at a later date. See Appendix A.

Quadrex Finding No.: 4.4.2.1(e)

The floor drainage system needs to be re-examined with respect to the availability of ECW leak detection capabilities (see Question H-23).

Licensee Action: Dispositioned

Bechtel agrees with the finding. Leakage is considered a potentially significant problem. The Floor Drainage System will be re-examined relative to availability of ECW leak detection. Resolution will be provided upon completion of reexamination.

References: EM-406

NRC Inspection Results: The NRC staff reviewer concured in the disposition of this finding. The item had been included in the Action Item List.

This finding is considered closed for the purposes of the Quadrex Report review, but will be rereviewed during a subsequent NRC inspection. See Appendix A.

Quadrex Finding No.: 4.4.2.1(f)

Inconsistencies between the FSAR and other HVAC design documents need to be resolved (see Question H-11).

Licensee Action: Dispositioned

Bechtel will revise the FSAR following confirmation of HVAC criteria and resolution of NUS and OPS efforts.

Work Package EN-600 and follow-on efforts provide for the revision and updating of the FSAR. The work package review plans developed in accordance with transition procedure QE-002 provide for reviews to detect inconsistencies. EDP 4.23 provides for SAR change control to maintain consistency between criteria documents and the FSAR.

References: EM-559, QE-002, EDP-4.23

NRC Inspection Results: Plans for updating of the FSAR to delete inconsistencies were confirmed by the staff reviewer. EDP-4.23, SAR Change Control, regulated changes to the FSAR ensuring consistency and control. This is an administrative function that will be resolved adequately. Followup is not necessary.

For purposes of the Quadrex Report Review, this item is considered closed.

Quadrex Finding No.: 4.4.2.1(g)

The adequacy of HVAC design verification needs to be re-examined since there are no written criteria for the selection of the design verifier and there is no documented method or rationale to be used by the design verifier (see Question H-17).

Licensee Action: Resolved

The adequacy of the HVAC design verification is being re-examined in accordance with transition procedures QE-001 and QE-002. Bechtel Procedure EDP-4.27 provides criteria for selection of design verifier and rationale to be used by the design verifier.

References: EM 550, QE-001, QE-002, EDP-4.27

NRC Inspection Results: The staff reviewer verified that HVAC design verification and review had been initiated. (See finding 4.4.2.1(a)) EDP-4.27, Design Verification, contained provisions for selection of design verifiers. Design verification for each work package was provided for in accordance with QE-001, and documented in an appropriate Design Verification Assessment Report.

This item is closed. Resolution is considered adequate.

Quadrex Finding No.: 4.4.2.2(h)

Consideration of actual plant operating conditions (i.e., open doors and hatches) has not been made in the HVAC calculations (see Questions H-3 and H-10).

Licensee Action: Resolved

Bechtel will review the final NUS and OPS HVAC analyses and design criteria and provide recommendations if appropriate.

Bechtel procedures EDP-4.26 and 4.27 provide for design reviews and design verification and both procedures require reviews such that all conditions are considered. Further, the work package review plans developed pursuant to the transition program and procedure QE-002 provide for the review of STP documents to assure that all operating modes are considered.

References: EM-550, EDP-4.26, 4.27, QE-002

NRC Inspection Results: The staff reviewer considered the resolution of this finding to be adequate. EDP-4.26, Interdisciplinary Design Review, and EDP-4.27, Design Verification, provided for an adequate review and consideration of actual plant operating conditions. The analysis and design review indicated that the HVAC system will be sized such that open doors and hatches will not affect system performance.

This item is considered closed.

Quadrex Finding No.: 4.4.2.4(i)

Based on a cursory review of a few engineering calculations, the quantity and quality of the HVAC design inputs appear to be marginal due to their varying format and uncontrolled modes of transmittal (see Question H-1).

Licensee Action: Resolved

Bechtel will review the final HVAC calculations. The calculations will be revised or superseded as required to meet the design criteria. Bechtel's procedure during design evolution is to keep track of all heat loads. As additional heat loads are proposed, they are added to the initial design bases and the subsequent margin of the HVAC system is evaluated.

References: CM-550, 551, EDP-4.37

NRC Inspection Results: The staff reviewer confirmed that EDP 4.37, Design Calculations, provided methods for preparing, checking, reviewing, approving, controlling, and revising design calculations. Retraining engineering personnel was also provided. All calculations for the HVAC systems will be reviewed during the ongoing design verification review. The resolution to this finding was adequate.

This item is considered closed.

Quadrex Finding No.: 4.4.2.4(j)

The basis for selecting the various ambient conditions in the plant areas was not traceable to "user" requirements (see Question H-4).

Licensee Action: Resolved

The System Design Description (SDD) will be revised to reflect realistic design criteria and "user" heat loads will be accounted for. The final design will incorporate user loads.

References: EM-551, 555

NRC Inspection Results: The evaluation of user heat loads and the revision to the SDD has been started. The resolution was considered adequate by the staff reviewer. (See 4.4.2.1(b))

This item is closed for purpose of the Quadrex Report review. The revised SDD will be reviewed upon completion and issue for use. See Appendix A.

Quadrex Finding No.: 4.4.2.4(k)

One inconsistency in the use of ASME Code dates was found (see Question H-5).

Licensee Action: Resolved

Bechtel's responsibility is to ensure that ASME Codes (and appropriate revisions and dates) are identified and referenced. A determination will be made as to whether the SDD or procurement specification is inconsistent and appropriate action will be taken.

The inconsistency is of no significance.

References: EM-555

NRC Inspection Results: This is not a generic or a safety concern and therefore, the inconsistency is of no significance.

This item is considered closed.

Quadrex Finding No.: 4.4.2.4(i)

A fire hazard analysis has not been converted into a formal control document for use by HVAC (see Question H-6).

Licensee Action: Resolved

The Fire Hazard Analysis prepared for submittal to the NRC is not a design document although it is subject to document control procedures to ensure that it accurately reflects information contained in actual design data. The Fire Hazard Analysis will be updated to reflect the final design as it evolves. No further action is required to resolve this item.

References: EN-601

NRC Inspection Results: The staff reviewer agreed that there was no requirement to convert the Fire Hazard Analysis into a design document. The Fire Hazard Analysis was scheduled for revision and will be reviewed during the normal FSAR licensing review. See Appendix A.

This item is considered closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.4.2.4(m)

(1) HVAC design criteria are not documented in a single, comprehensive criteria document to cover the various design requirements. The criteria are listed in the various System Design Descriptions. (2) In general, maintenance and inspection requirements appear adequate. However, the System Design Descriptions do not contain testing requirements (see Question H-7). Design provisions for testing have not been addressed.

Licensee Action: Resolved

(1) Bechtel is preparing a single design criteria document for the various HVAC system design requirements. Bechtel will review the SDD requirements. Bechtel will review the SDD and propose modifications as necessary. However, Bechtel considers it more appropriate to have equipment maintenance and inspection requirements invoked in the specifications.

(2) Test requirements are addressed in the Review Plans and Checklists as stipulated by Transition Procedure QE-002. Evaluations performed during the transition program will be documented in system work packages. Also, electrical work packages for Class 1E circuits contain check list items requiring verification of on line testing capability.

References: EDP-4.1, EM-550, 555, QE-002

NRC Inspection Results: (Note: This finding nas two line items.)

(1) EDP-4.1, Design Criteria, required issue and control of Design Criteria Documents (DCD). New DCD for STP will be issued as required.

(2) Requirements for testing were confirmed to be part of the electrical and HVAC checklists. (See Section 2.3.4) The staff reviewer concured in the resolution of this finding.

This item is considered closed.

Quadrex Finding No.: 4.4.2.4(n)

The HVAC design does not appear to be overly conservative. The lack of a consistent method for keeping track of margins raises a concern with respect to the adequacy of HVAC margins (see Question H-8).

Licensee Action: Resolved

Bechtel agrees with the Quadrex finding regarding the HVAC design. Revised design criteria will be developed. Tracking of margins is not a normal practice. However, as the evaluation of existing HVAC design is being performed design margins will be determined.

References: EN-555

NRC Inspection Results: It was confirmed that the HVAC design review will determine design margins. This was established through discussions with responsible BPC and HL&P personnel. See Findings 4.4.2.1(a) and 4.4.2.4(i).

This item is considered closed.

Quadrex Finding No.: 4.4.2.4(o)

B&R does not yet have a procedure to assure that volume damper pressure drops are accounted for in HVAC fan selection calculations (see Question H-10).

Licensee Action: Resolved

Bechtel will evaluate the calculations. Proper consideration will be made for volume control damper pressure drops. Additionally, during final testing, fan performance will be verified which will account for the actual pressure drop of the volume control dampers. A separate procedure is not required.

References: EM-555

NRC Inspection Results: This item was included in the current HVAC Design review effort. The staff reviewer agrees that a requirement for a separate procedure was not indicated. The resolution to this finding is considered adequate.

This item considered closed.

Quadrex Finding No.: 4.4.2.4(p)

Adequacy of the pressurizer support skirt cooling will need to be determined during the B&R review of this area (see Question H-12).

Licensee Action: Resolved

NUS is evaluating the pressurizer support skirt heat removal capability. Bechtel will review the design following completion of this effort by NUS and determine the adequacy of design.

References: EM-555

NRC Inspection Results: This item is being covered during the HVAC design verification effort. See finding 4.4.2.1(a)

This item is considered closed.

Quadrex Finding No.: 4.4.2.4(q)

Adequacy of HVAC supports design will need to be assured as the design nears completion (see Question H-13).

Licensee Action: Resolved

B&R had completed most of the design except for special duct supports at bends and transitions. The calculations reviewed by Bechtel during 'Phase A' appeared to be complete and adequate. No major corrective work will be needed.

References: EC-186

NRC Inspection Results: Review of EC-186 was conducted by the staff reviewer. The work package covered the status of structural design criteria and structural design calculations for Seismic Category I HVAC duct and duct supports. 147 seperate documents and calculations have been reviewed, 40 additional documents have been identified and will be reviewed during the final design effort by BPC. There are approximately 3500 typical HVAC duct supports. About 3440 of them are supported by calculations. The remainder need to be designed. In addition, 330 special supports need to be designed. Adequacy of all supports design will be assured during the HVAC design verification efforts.
This item is considered closed.

Quadrex Finding No.: 4.4.2.4(r)

Refinement of the reactor cavity cooling system pressure drop calculation appears to be necessary (see Question H-15).

Licensee Action: Resolved

Bechtel will generate a new calculation to determine the pressure and verify the adequacy of the equipment provided.

References: EM-555

NRC Inspection Results: This item will be accomplished as part of the HVAC design verification effort. See 4.4.2.1(a).

This item is considered closed.

Quadrex Finding No.: 4.4.2.4(s)

Provisions for damper status indication have not been made (see Question H-16).

Licensee Action: Resolved

Bechtel experience indicates that dampers do not normally include position indication. Accordingly, BPC considers this Quadrex Issue is not necessary and no further action is needed.

References: EM-550

NRC Inspection Results: Quadrex question H-16 refers to fire damper indication. EM-550 documented that fire dampers were of the fusable link type actuated by heat. Local indication is available. Any other damper status required by the SRP will be documented in the FSAR.

The staff reviewer confirmed this through review of EM-550 and discussions with Bechtel personnel.

This item is considered closed.

Quadrex Finding No.: 4.4.2.4(t)

Review of HVAC damper vendor's seismic design has not yet been accomplished (see Question H-16). This may or may not be timely.

Licensee Action: Resolved

Bechtel has reviewed the vendor's (AWV) seismic design calculations and transmitted comments to AWV for resolution.

References: EM-570, EDP-4.58

NRC Inspection Results: The staff reviewer confirmed that review of this item was performed by Bechtel on August 4-5, 1982. EDP-4.58, Specifying and Reviewing Supplier Engineering and Quality Verification Documentation, documented the requirements for conduct of vendor document review. EM-570 documented the vendor review requirement.

This item is considered closed.

Quadrex Finding No.: 4.4.2.4(u)

A review of HVAC component locations relative to high energy lines should be performed (see Question H-18).

Licensee Action: Dispositioned

Bechtel will evaluate the HVAC component locations relative to HELB, see Work Package EN-601 (Hazards Analysis).

References: EM-550; EN-601

NRC Inspection Results: This item is scheduled to be completed as identified in EN-601. See finding 4.4.2.1(d)

This item is considered closed for purposes of the Quadrex Report review. Completion will be followed up while reviewing 4.4.2.1(d). See Appendix A.

Quadrex Finding No.: 4.4.2.4(v)

A decision has not yet been made for pressure relief of the RCFC system (see Question H-21).

Licensee Action: Resolved

Bechtel will generate new calculations during the course of design evolution to determine the requirement of pressure relief dampers for the RCFC system.

References: EM-555

NRC Inspection Results: This item will be completed during the HVAC design verification effort. See finding 4.4.2.1(b) The resolution is adequate.

This item is closed.

Quadrex Finding No.: 4.4.2.4(w)

A minimum closure time for the tornado dampers has not yet been addressed (see Question H-22).

Licensee Action: Resolved

The vendor has supplied dampers that will close in 0.25 sec. Closure time appears adequate. However, BPC will review the design criteria to assure that 0.25 seconds closure time is adequate.

References: EM-551

NRC Inspection Results: This item will be examined during the HVAC design verification review. See finding 4.4.2.1(b). The resolution is adequate.

This item is considered closed.

Quadrex Finding No.: 4.4.2.4(x)

A review of ECW system is required to assure that a single rupture in an ECW line will not result in a loss of the source of the ECW (see Question H-23).

Licensee Action: Resolved

Any one of the 3 ECWS trains can be shut down and isolated to avoid Essential Cooling Pond drainage through a rupture. The remaining two trains would be sufficient to maintain proper system operation in any mode. In addition, during phase B, leak detection will be considered with respect to Regulatory Guide 1.97. If leak detection is added, the leak detection scheme will not require instrumentation on the underground piping.

References: EM-406

NRC Inspection Results: It was confirmed that all or any of the three ECW trains can be shutdown and isolated. See finding 4.4.2.1(e). Resolution is considered adequate by the staff reviewer.

This item is closed.

Quadrex Finding No.: 4.4.2.4(y)

A review of the impact of non-safety-related component failures in the Equipment and Floor Drain System has not yet been performed (see Question H-24).

Licensee Action: Dispositioned

Bechtel has established a system interaction work package, EN-601, which will be evaluating, in part, flooding. Results of the evaluation and recommendations regarding changes to alleviate potential flooding problems will be provided.

Equipment and floor drains are a source of potential spatial interaction hazards to safety-related equipment and must be included in the program to evaluate and eliminate such hazards. Consideration of these sources is of particular importance in protection against flooding hazards. Bechtel includes these systems in the systems interaction analysis outlined in Section 6.0 of EN-601 work package.

Under EN-613, a review will be conducted in Phase B to assess the impact of the failure of nonsafety-related drain system components on ESF equipment. Guidance for this review is provided in EDP 4.1, 4.26, 4.33, 4.37.

References: EN-601, 613; EDP-4.1, 4.26, 4.33, 4.37

NRC Inspection Results: Bechtel agreed with the Quadrex finding. Resolution of this issue will be provided upon issuance of EN-601, System Interaction and Integration Criteria. EDPs provide adequate guidance for the review.

This item is considered closed for purposes of the Quadrex Report review. However, this area will be examined during the NRC licensing review. See Appendix A.

Quadrex Finding No.: 4.4.2.4(z)

Specification of required duty cycles or duration of operation for safety-related HVAC components has not yet been accomplished (see Question H-30).

Licensee Action: Resolved

Bechtel agrees with the Quadrex finding. Bechtel will review applicable specifications to determine if duration of operation under accident conditions is a necessary requirement. Subsequently, vendors will be contacted to determine if the components meet the requirements.

References: EM-551, 555

NRC Inspection Results: Specifications will be reviewed as part of the normal transition program and the HVAC verification program. See finding 4.4.2.1(a) and Section 2.3.4.

This item is considered closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.4.2.5(aa)

A documented basis for selection of HVAC system alarms does not exist (see Question H-31).

Licensee Action: Resolved

Bechtel notes that past experience usually dictates what HVAC system alarms are required. BPC review indicates that the existing alarms should be adequate. However, as previously noted Bechtel will be reviewing the HVAC in detail and the HVAC SDD will be superseded. If this review indicates that additional alarms are necessary, Bechtel Mechanical and Control will coordinate the activity.

References: EM-550

NRC Inspection Results: This item will be accomplished during the HVAC design verification review. See finding 4.4.2.1(a).

This item is considered closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.4.2.5(bb)

In one instance, an NUS calculation was not available at B&R (see Question H-2).

Licensee Action: Resolved

(Work Package EN-619) the calculation was subsequently located and is now available. No further action is required.

References: None

NRC Inspection Results: This was not found to be a generic or safety concern and therefore, this item is considered closed.

4.5 MECHANICAL/PIPE RUPTURE FINDINGS

4.5 MECHANICAL/PIPE RUPTURE/ASME III SUMMARY

The findings in Section 4.5, Mechanical/Pipe Rupture/ASME III, further subdivided into three other areas:

a. Pipe Rupture Discipline (Inside Containment)

b. Pipe Rupture Discipline (Outside Containment)

c. Mechanical Discipline

Pipe Rupture Discipline (Inside Containment) 4.5.2.1(a) through 4.5.2.5(p)

The major Quadrex concern in this area was "potential overconservatism in the design" which does not appear to be related to safety. There were 16 findings in this area for the EDS subcontractor scope. There were no findings expected to seriously impact the plant.

All findings have been closed for purposes of the Quadrex Report review. One finding is subject to review at a later time. (See Appendix A)

Pipe Rupture Discipline (Outside Containment) 4.5.3.1(a) through 4.5.3.4(hh)

There were 34 findings identified in this area of B&R responsibility. Quadrex noted that there were no examples of completed pipe rupture analysis outside containment and that overall the pipe rupture design outside containment did not appear adequate. There was one example of a most serious finding which was concerned with pipe rupture analysis. Final resolution of this dispositioned item depends upon the issuance of a "STP System Interaction Design Guide."

All findings were considered to have been resolved/dispositioned adequately and, for purposes of the Quadrex Report review, are closed. There are fourteen items that are of such importance that NRC followup is considered necessary. (See Appendix A)

Mechanical Discipline (4.5.5.1(a) through 4.5.5.(t)

Quadrex had two major concerns in the mechanical discipline area. One involved B&R's understanding and implementation of Code and industry requirements. The second concern was a lack of an integrated systems review.

The 20 findings in this area were adequately addressed by Bechtel. Followup on 11 of the 20 findings was determined to be required (See Appendix A).

Quadrex Finding No.: 4.5.2.1(a)

The 10° half cone angle used to define the jet surface is not appropriate for sub-cooled fluids according to the latest ANSI N176 document. Therefore, selection of targets may not be conservative (see Question M-4).

Licensee Action: Resolved

It is an accepted engineering approach to divide a complex problem into many discrete steps and then deal with the steps individually. It is necessary, however, to select assumptions and criteria such that, when the completed steps are integrated, the result is an appropriate (reasonably conservative yet practical) solution for the original problem. The objective of providing appropriate overall protection precludes use of the most conservative alternative for each step in the process.

In the case of fluid jet expansion for sub-cooled fluids, the 10^{o} half angle has been considered by both NRC and industry as an acceptable model. Due to its simplicity and the fact that it results in conservative calculated loads for components located near the center protection." This is consistent with Bechtel Topical Report BN-TOP 2, "Design for Pipe Break Effects" Revision 2A.

Jet impingement effects will be fully evaluated by Bechtel as discussed in Section 6 of Work Package EN-601.

References: BN-TOP-2 (Rev. 2A); EN 601

NRC Inspection Results: Bechtel's BN-TOP-2 had been reviewed by the NRC and comments were included in Revision 2A. Use of the 10^{o} half cone angle for sub-cooled fluids was acceptable to the NRC.

This item is considered closed.

Quadrex Finding No.: 4.5.2.1(b)

EDS did not perform a design review or design verification of preliminary loads transmitted to B&R; these loads have, however, been used as a basis for plant design (see Questions C-4 and M-8).

Licensee Action: Resolved

Bechtel stated that it is a common practice to use preliminary loads with conservative margins, then verify the adequacy of the design for final loads when they are available. However, preliminary loads should be formally checked in accordance with normal calculational procedure described in EDP-4.37 prior to use in committed design. B&R was in the process of verifying adequacy of the design at the time its work was terminated. Adequacy of final design loads will be fully evaluated by Bechtel.

References: EN-601; EDP-4.37

NRC Inspection Results: Design verification of preliminary data is not a specific requirement of ANSI N45.2.11. EDP-4.37 contains provisions for reviewing calculations. The resolution of this item is adequate.

This item is considered closed.

Quadrex Finding No.: 4.5.2.1(c)

Secondary effects from the pipe rupture event, such as damage to pipe supports and out-of-plane loading on U-bolt restraints, were not adequately investigagated. Damage to pipe supports due to pipe impact and jet impingement was not investigated (see Question M-26), and assumed restraint response was not confirmed (see Question M-19).

Licensee Action: Resolved

EDS procedures required design for a 10% lateral load applied in the plane of the restraint but specify no out-of-plane loading on the restraint.

Due to the fact that essential piping is protected against direct impingement effects, there is little likelihood of unacceptable damage due to impingement on unprotected supports.

References: EN-601

NRC Inspection Results: Per discussions with Bechtel and HL&P engineering personnel, the piping reanalysis will maintain out-of-plane loading on U-bolt restraints at a negligible level. In addition, for cases in which the out-of-plane loading is not negligible, a frame-type support will be used. See finding 4.5.2.4(1).

This item is considered closed.

Quadrex Finding No.: 4.5.2.1(d)

Verification of superpipe stress limits for breaks inside containment has not been accomplished. An analysis which couples pipe runs inside and outside of containment may be required (see Question M-9).

Licensee Action: Resolved

The B&R approach of analyzing superpipe stress only for breaks outside containment is consistent with industry practice for designs which employ the break exclusion concept only for portions of piping outside the containment. Bechtel considers this approach acceptable. Also, see response to finding 4.5.3.4(u). Since containment penetrations are designed to function as full anchors, it is not expected that loads due to a rupture inside containment will exceed those for which the outside piping is qualified due to a rupture outside containment. Bechtel considers the B&R approach acceptable. Analysis is not required.

References: EN-601

NRC Inspection Results: From conversation with licensee and Bechtel personnel involved in the assessment and resolution of this item, the staff inspector found the evaluation and resolution adequate. See finding 4.5.3.4(u).

This item is considered closed.

Quadrex Finding No.: 4.5.2.2(e)

EDS did not apply controlled criteria for ALARA, ISI, and maintenance access in the design (see Question M-26A and P-17).

Licensee Action: Resolved

In its response to Quadrex question P-17, EDS indicated that it did utilize B&R criteria for consideration of access for required ISI. B&R's Design Assurance Group and the joint ALARA review group were assigned responsibility to review EDS implementation of criteria. This approach, although potentially surfacing access or ALARA problems later in the design process, is not unreasonable as a mean of incorporating the work of external design agencies. In providing criteria to externally controlled designers (when used), Bechtel commonly allows flexibility in meeting such requirements. Upon receipt from the external agency, evaluation of implementation of the stated criteria is made. No further action on this question is considered warranted.

Access requirements (but not ISI) have been considered in the B&R/HL&P re-reviews and will continue to be considered in the Bechtel ALARA program. These concerns are addressed in ALARA checklists.

A draft TRD 4U010PQ007-B for ISI did exist and has since been superseded by Bechtel's Specification 4U010PS007, Revision 0.

References: EN-601, 603, 619; Bechtel ALARA Directive; HL&P ALARA Design Review Manual; TRD4U010PS007, Revision 0.

NRC Inspection Results: This resolution was considered adequate. Access and ALARA requirements have been considered in the B&R/HL&P re-reviews and will also be addressed in the Bechtel ALARA reviews (using the guidance contained in the Bechtel ALARA Directive). Bechtel's specification 4U010PS007, Revision 0 (which superceded B&R's TRD 4U010PQ007-B) addressed ISI criteria. See findings 4.8.2.1(b) and 4.5.3.2(1).

This item is considered closed.

Quadrex Finding No.: 4.5.2.3(f)

Timely interchange of jet impingement loads between EDS and B&R is a problem (see Question M-4).

Licensee Action: Resolved

EDS interaction matrices identify B&R designed structural targets which must be qualified for jet impingement loads. Based on Bechtel's assessment that it is overly conservative to protect containment leak tight integrity for all pipe rupture events, it may be possible to eliminate qualification of many components (e.g., containment penetrations). Experience indicates that, with the number of whip restraints provided inside the STP containment, qualification of structural targets can be accomplished in the final stages of the project without undue cost or schedule impact.

Jet impingement effects will be evaluated by Bechtel as discussed in Section 6 of Work Package EN-601.

Timely interchange of information between EDS and B&R is considered to have been an organizational problem not applicable to BPC and no longer meaningful.

References: EN-601

NRC Inspection Results: From conversation with licensee and Bechtel personnel involved in assessment and resolution of this item, the staff inspector confirmed this finding to be of a "timeliness" nature and not a safety issue. Bechtel's resolution is adequate.

This item is considered closed.

Quadrex Finding No.: 4.5.2.3(g)

Simplified analysis techniques and conservative assumptions, although technically adequate, may have resulted in overly conservative protective requirements. Due to the general use of secondary and tertiary restraints, the actual number of restraints may be greater than required. Also, in many cases, restraint design loads probably exceed minimum values by a significant margin, resulting in oversized restraint substructures (see Questions M-6, M-7, M-11, and M-15).

Licensee Action: Resolved

Simplified, conservative methods and assumptions were used for the design of whip restraints for piping less than 14 inches nominal pipe size. The additional cost of protection for pipes of this size is not excessive and, in most cases, easily offset by the advantage of completing the restraint design early with minimum complication in the design process.

Although methods for design of restraints for piping greater than 14 inches are less conservative, the restraint structures are substantially larger than typical. In notable cases, such as the main steam line restraint the oversized restraint structures may add unnecessarily to the cost of the plant.

Whip restraint designs will be evaluated by Bechtel as discussed in Work Packages EC-135 and EC-181 and in Section 6 of Work Package EN-601. No further action is required to resolve this finding.

References: EN-601; EN-135, 181

NRC Inspection Results: This finding is basically one of cost and schedule. This item is part of an ongoing activity in which Bechtel will evaluate pipe whip restraints. The area of adequacy of restraints will be evaluated in the normal FSAR review.

For purposes of the Quadrex Report review, this item is considered closed.

Quadrex Finding No.: 4.5.2.3(h)

Specification of a unique curve to define U-bolt restraint properties without upper and lower bounds is unrealistic. This approach is likely to increase procurement costs (see Question M-16).

Licensee Action: Resolved

U-bars have not been fabricated nor procured. Based on the documents reviewed, it appears that EDS/B&R planned to utilize GE "off-the-shelf" U-bars. The GE catalog has a specific curve (to define U-bar restraint properties) which was used in the EDS design.

References: EC-103

NRC Inspection Results: The NRC inspector questioned Bechtel personnel involved in the evaluation and resolution of this item. It was determined that this item involves an economic issue and is not a safety concern.

This item is considered closed.

Quadrex Finding No.: 4.5.2.3(i)

Restraint design complexity appears to be causing a significant number of interferences (see Question M-26A). Less conservative analyses may permit a reduction in the size and complexity of the presently designed restraints (see Question M-12).

Licensee Action: Resolved

EN-601 provides for a comprehensive evaluation of interaction and interferences and a plan for factoring requirements to minimize interferences into the remaining engineering and construction activities of the project.

References: EN-619, 601; EP 702, 703, 709; EC-181

NRC Inspection Results: The inspector reviewed the assessment and evaluation of this item conducted by Bechtel personnel. The inspector concluded that this item falls in the category of cost impact and is not a safety concern. Bechtel's resolution is adequate.

The item is considered closed.

Quadrex Finding No.: 4.5.2.4(j)

Specific guidelines governing the amount of analysis iteration were not evident (see Question M-7).

Licensee Action: Resolved

The EDS response to Question M-7 indicates that four different methods were used for establishing the design loads. Experience indicates that several analysis iterations are normally required; however, experience, judgment, and good planning are the best practical assurance that designs are properly optimized while minimizing the number of iterations.

Bechtel concluded that specific guidelines on analysis iterations are not required.

References: EN-619

NRC Inspection Results: After questioning Bechtel personnel involved directly in the assessment and resolution of this item, it was determined that Bechtel engineering experience is adequate and that specific guidelines on analysis iteration are of less magnitude than the requirement for the analysis itself. Specific guidelines may result in the performance of unnecessary analysis without a corresponding increase in the safety of the STP design.

This item is considered closed.

Quadrex Finding No.: 4.5.2.4(k)

Evaluation of the effects of pipe whip impact, jet impingement, and restraint loads on structural components should have been completed much sooner (see Question M-10). This evaluation is primarily a B&R responsibility following completion of the EDS analysis.

Licensee Action: Resolved

Experience indicates that with the number of whip restraints provided, qualification of structural targets can be accomplished in the final stages of the project without undue cost or schedule impact.

References: EN-601

NRC Inspection Results: This item related to timing and scheduling of the subject evaluation. While this may have been a weakness in project management, no safety significance can be attributed to this item.

This item is considered closed.

Quadrex Finding No.: 4.5.2.4(1)

No evidence was presented to confirm that the second restraint prevents out-of-plane loads (see Question M-19).

Licensee Action: Resolved

The use of secondary and tertiary restraints to prevent out-of-plane loads is conservative. The industry practice is not to consider out-of-plane loading on the restraints.

References: EC-181

NRC Inspection Results: From questioning Bechtel personnel involved with the evaluation and resolution of this item, the activities that address this concern will consist of an analysis of the function of the secondary and tertiary restraints. Some of the secondary and tertiary restraints may be removed if the primary restraint has a safe margin. This item was addressed adequately by Bechtel.

For purposes of the Quadrex Report review, this finding is closed.

Quadrex Finding No.: 4.5.2.4(m)

The stability guidelines used for evaluation of computer output results for dynamic analyses may be nonconservative (see Question M-23).*

Licensee Action: Resolved

PWHIP and SIMPWIP (EDS programs) were used to perform pipe whip analysis. The stability criteria are based on maximum deformation, maximum displacement, maximum force and maximum moments. They are consistent with industry practice.

References: EN-619

NRC Inspection Results: The staff reviewer found that the referenced programs appear to be adequate and consistent with industry practice. One or both of these programs may be evaluated during the FSAR review. See Appendix A.

This item is considered closed for purposes of the Quadrex Report review.

*This finding was categorized as a "potential problem." The Quadrex assessment noted that the "stability criteria is reasonable . . . "

Quadrex Finding No.: 4.5.2.5(n)

A test plan to verify theoretical thermal movements should be developed on a timely basis (see Question M-26B).

Licensee Action: Resolved

The thermal expansion verification program is part of the start-up operation. Verification of expected thermal expansion is based on as-built arrangements and measurements made during hot functional testing. PSSG will participate in this verification program. The plans for this program will be developed at the appropriate time.

References: EN-619

NRC Inspection Results: This item is of a timeliness concern on the part of Quardrex. After discussing this matter with Bechtel Engineering personnel, resolution of this item was considered adequate.

This item is considered closed.

Quadrex Finding No.: 4.5.2.5(o)

Adjustment provisions for pipe whip restraints may not be adequate if installation tolerances are not closely observed (see Question M-26C).

Licensee Action: Resolved

Quadrex indicated in their assessment of Question M-26C that adjustment provisions are typical. Installation tolerances will be closely observed during construction. The gap and final restraint position will be determined during hot functional testing as a part of the preoperational testing program. The Civil/Structural discipline will design or review the existing designs of rupture restraints. They will include tolerance criteria in rupture restraint fabrication and installation specification.

References: EN-619

NRC Inspection Results: This item is of concern only if construction tolerances are not observed. Since these were defined, and construction guidelines are provided, there is no anticipated concern. The Bechtel resolution was considered adequate.

This item is closed.

Quadrex Finding No.: 4.5.2.5(p)

Stability criteria used for evaluation of dynamic analyses does not ensure that a maximum response has been determined.

Licensee Action: Resolved

EDS analysis uses a time period of sufficient duration to assure that pipe motion has stopped, energy input has ceased and maximum restraint deformations have been reached. Therefore, dynamic analysis does not need to be continued to capture oscillatory response. Rather, separate static analysis is performed to assure stability of the system under a steady state blowdown force. Additionally, the blowdown forces used for time history analysis by EDS are consistent with this approach, accurate, and appropriate.

The methodology as described appears to be a reasonable approach. Bechtel will follow the same procedure.

References: EN-619

NRC Inspection Results: The staff reviewer discussed this finding with the licensee and Bechtel personnel from PSSG. The analysis techniques appear to be acceptable. In addition, the analysis will be required to meet the applicable SRP when complete.

This item is considered closed.

Quadrex Finding No.: 4.5.3.1(a)[1/]

(1) No analyses have been completed at this time, and no moderate energy systems were listed for evaluation.

(2) The proposed interaction matrix example does not address the essential aspects of potential targets or emphasize the types of interaction (see Questions M-3 and M-5). A TRD is needed to identify the essential components possibly through the use of safe shutdown logic analysis (see Questions M-4, M-10, and M-25).

(3) No methodology for restraint design was available (see Question M-12).

Licensee Action: (1) Dispositioned

Protection against water spray and flooding due to postulated moderate energy pipe cracks is provided mainly through separation until the final stages of design. Experience shows that additional protective features identified at that point are no a significant cost or schedule impact. B&R planned to assess damage to all safety-related equipment for each postulated crack. Moderate energy pipe rupture effects will be fully evaluated by Bechtel as discussed in Section 6 of EN-601. Resolution will be provided upon issuance of the STP Systems Interaction Design Guide.

Licensee Action: (2) Dispositioned

A Systems Interaction Design Guide is planned for use on STP to provide guidance on essential target definition. The assessment of protection of potential targets would have been aided through the use of shutdown logic diagrams; however, the task has been completed successfully by other projects without them. It should be noted that such shutdown logic diagrams are now available in preliminary form having been developed to support the Fire Hazards Analysis. Resolution is provided upon issuance of the STP Systems Interaction Design Guide and the safe shutdown logics are updated.

Licensee Action: (3) Resolved

Methodology for design of restraints inside containment is described in EDS procedures and calculations (refer to Work Package EC-181). Restraints outside the containment have not been designed. A design document was being prepared by Westinghouse for B&R to be used for pipe restraint design outside the containment. For consistency, Bechtel will utilize methods similar to those used by EDS for the remaining restraint designs.

[1/] This finding was addressed in three parts.

Quadrex Finding No.: 4.5.3.1(a) (cont)

References: EN-601, EC-181

NRC Inspection Results: After holding discussions with licensee and Bechtel personnel, the assessment and resolution of these items were considered adequate by the NRC staff reviewer. A follow-up inspection on the STP System Interaction Design Guide will be done upon its issuance as part of the licensing review. (See Appendix A)

For purposes of the Quadrex Report review, the finding is closed.

Quadrex Finding No.: 4.5.3.1(b)

Isometric drawings do not show the location of restraints (see Question M-4).

Licensee Action: Restraint locations are shown on drawings other than piping isometrics. Bechtel considers this approach acceptable. No further action is required to resolve this finding.

References: EN-619

NRC Inspection Results: The staff inspector verified that restraint locations are detailed on other design drawings. Resolution is adequate.

This item is closed.

Quadrex Finding No.: 4.5.3.1(c)

The current B&R status indicates a general lack of understanding, planning, preparation, and availability of procedures. One criteria guideline document exists, but it has not been issued and is not a formal project instruction (see Questions M-1 and M-2).

Licensee Action: Resolved

It is common A/E practice to implement detailed evaluation procedures only after the design has progressed sufficiently to provide somewhat complete data. B&R guidelines were adequate for work prior to the detailed evaluation. Subsequent to the Quadrex review, B&R prepared draft TRD, "Criteria and Methodology for Evaluation of Postulated Pipe Break and Crack Effects." This draft TRD was intended to provide the additional guidelines required.

Bechtel will develop additional guidance to complete the detailed evaluation of pipe break effects as discussed in Section 6 of Work Package EN-601.

References: EN-601

NRC Inspection Results: The NRC staff inspector verified that the referenced work package addressed evaluation of pipe break effects. Bechtel's plans to develop additional guidance to complete the evaluation of pipe break effects were acceptable.

This item is considered closed.

Quadrex Finding No.: 4.5.3.1(d)

More specific guidelines are needed for criteria to delete lines from analysis, and consideration must be given to potential secondary effects, such as pipe whip or jet impingement on the IVC or the MAB (see Questions M-3, M-4, M-5, M-10, and M-26).

Licensee Action: Dispositioned

Bechtel agrees with the Quardex assessment that the effects of high energy pipe ruptures in areas outside but adjacent to safety equipment areas must be evaluated. Large high energy piping in the turbine building is a potential problem due to jet and whip impact on the IVC.

Postulated rupture of large high energy piping within the TGB may be capable of causing damage to safety-related equipment located in adjacent areas due to either direct effects (whip and jet impingement) or indirect effects (major structural damage). As the Quadrex finding suggests, these situations must be evaluated to ensure that protection criteria are met. (See also item 4.5.3.4.(z)). Resolution will be provided upon issuance of the STP Systems Interaction Design Guide.

References: EN-601

NRC Inspection Results: This finding is on the Action Item List. Discussions were held with licensee and Bechtel personnel involved in the resolution. Bechtel's commitment to issue a STP Systems Interaction Design Guide is adequate. Subsequent evaluations using the issued design guide will be followed up at a later date as part of the licensing review. See Appendix A.

For purposes of the Quadrex Report review, this item is closed.

Quadrex Finding No.: 4.5.3.1(e)

Use of the 10° half angle may not be appropriate for jet impingement effects (see Question M-4).

Licensee Action: Resolved

The model is both conservative and appropriate.

References: EN-619

NRC Inspection Results: See resolution for 4.5.2.1(a)

This item is considered closed.

Quadrex Finding No.: 4.5.3.1(f)

Generally, dynamic analysis is required for all superpipe runs (see Question M-6).

Licensee Action: Dispositioned

The current STP design employs the superpipe concept for the steam generator blowdown and for MS and FW piping within the IVC. Subsequent to the Quadrex review, dynamic analysis of MS and FW piping was completed by Teledyne. Further action is required to resolve this finding since no evidence was found of dynamic analysis for the SGBD lines.

Resolution will be provided upon completion of the dynamic analysis of SGBD lines.

References: EN-601

NRC Inspection Results: Resolution of this item is considered adequate. Followup of this item will occur in the future as part of the licensing review when the Steam Generator Blowdown Line dynamic analysis has been completed by Bechtel. See Appendix A. See also Finding 4.5.3.1(d).

For the purposes of the Quadrex report review, this item is closed.

Quadrex Finding No.: 4.5.3.1(g)

Responses to questions were sometimes inconsistent and contradictory, indicating a general lack of expertise with pipe rupture considerations (see Questions M-7 and M-8).

Licensee Action: Resolved

B&R had not begun design of whip restraints outside containment. Therefore, the consistency of responses and how they reflect on B&R expertise in the design of whip restraints is not material to Bechtel's task of completing this work. No future action is required to resolved this finding.

References: EN-601

NRC Inspection Results: The finding pertains to B&R responses. BPC personnel contacted indicate a knowledge of pipe rupture considerations.

This item is considered closed.

Quadrex Finding No.: 4.5.3.1(h)

Not all of the criteria stated for the "no break zone" appear to be applicable to STP (see Question M-9).

Licensee Action: Resolved

Attachment M-9c to the B&R response is intended to illustrate the generic concept of break exclusion zone. It applies to cases with a single isolation valve (main steam) as well as those with additional valves (main feedwater). Therefore, the B&R response showing a second valve in phantom is correct and the Quadrex finding is invalid. No further action is required to resolved this finding.

STP project determined that the Quadrex finding is invalid based on a misunderstanding of the information in Attachment M-9c. Based on the Quadrex assessment, the Bechtel Task Force recommended a change. Since the original finding was invalid, the project team has determined that B&R's "no break zone" was correct.

References: EN-601

NRC Inspection Results: The staff reviewer examined B&R report L010RR064A and attachment 9-A of Quadrex Question M-9. There seems to be no discrepancy in the definition of "no break zone."

This item is considered closed for purposes of the Quadrex Report review. However, this item will be reviewed during the FSAR review in accordance with SRP 3.6.2. See Appendix A.

Quadrex Finding No.: 4.5.3.1(i)

B&R does not plan to look at field installed instrument lines for interaction analysis (see Question M-10).

Licensee Action: Dispositioned

The fact that impact on instrument lines must be evaluated was recognized by B&R. All safety-related raceway, small bore piping and instrument tubing, was to have been routed in the engineering office with dimensional tolerances specified for field installation. Draft TRD, "Criteria and Methodology for Evaluation of Postulated Pipe Break and Crack Effects for South Texas Nuclear Power Plant Unit No. 1," dated August 12, 1981, describes "as-built verification" to account for field modifications to the routing.

Impact on instrument lines will be evaluated by Bechtel as discussed in Section 6 of Work Package EN-601. A hazards review of safety-related instrument lines will be performed during the normal course of work. Use will be made of the identified "safe areas" for instrument sensing line routing. Resolution will be provided upon issuance of the STP System Interaction Design Guide.

References: EN-601

NRC Inspection Results: After discussions with licensee and Bechtel personnel involved in the assessment and resolution of this item; the inspector concluded the resolution was adequate. Engineering Work Package EN-601 was reviewed and found to contain a discussion on this item. Subsequent NRC followup as part of the licensing review will verify that this concern was resolved in the issuance of STP System Interaction Design Guide. See Appendix A. See also finding 4.5.3.4(v).

For the purposes of the Quadrex Report review this item is closed.

Quadrex Finding No.: 4.5.3.1(j)

B&R response on bi-linear idealization of restraint stiffness was unclear (see Question M-18).

Licensee Action: Resolved

Restraints outside the containment have not been designed. Quadrex agreed with the methodology used by EDS for idealization of the restraint stiffness. Methods similar to those used by EDS for idealization of the restraint stiffness will be used for the remainder of the restraint designs.

References: EC-181

NRC Inspection Results: Bechtel's response to this item was considered adequate by the staff reviewer. The referenced work package was reviewed by the inspector to ensure that this item was addressed.

This item is closed.

Quadrex Finding No.: 4.5.3.1(k)

Acceptance criteria for pipe whip are not well formulated (see Question M-26).

Licensee Action: Resolved

The assumption of no damage to piping impacted by a whipping pipe of smaller size and wall thickness is common industry practice, is accepted by the NRC, and is used by Bechtel. No further action is required to resolve this finding.

References: EN-601

NRC Inspection Results: From the information contained in B&R's reply to question M-26, it appears that the criteria used was found in the BTP ASB 3-1. Specifically, Appendix B of ASB-3-1 states that the energy level in a whipping pipe may be considered as insufficient to rupture an impacted pipe of equal or greater nominal pipe size and equal or heavier wall thickness. See also finding 4.5.3.1(c).

This item is considered closed.

Quadrex Finding No.. 4.5.3.2(1)

B&R does not have controlled criteria for maintenance access, ALARA or ISI (see Question M-26A).

Licensee Action: Resolved

B&R criteria contained in TRDs A509NQ002 and A509NQ005 are not adequate. B&R/HL&P re-reviews performed in accordance with the HL&P ALARA review manual are adequate and are being addressed in ongoing work.

B&R used "Equipment Removal & Personnel Access" drawings SK-0241-F-182 through 187 for review of space enveloped for access and servicing of equipment.

Bechtel (PSSG) has considered ISI requirements in "piping stress analysis criteria." Supports designed B&R will be reviewed against these requirements.

Bechtel is currently reviewing work package EP-930 as ongoing work to determine that the B&R ISI access criteria was adequately incorporated in the plant design. Also, Bechtel has issued "Specification for Preservice and Inservice Inspection Access Design" #4U010PS007, Revision 0.

References: EN-603

NRC Inspection Results: The staff inspector examined the Bechtel Specification issued on ISI. This specification, along with the Bechtel transitional engineering effort to review the plant design for incorporation of ISI access criteria, was found to be an acceptable resolution of this item. The referenced work package contained adequate information on the resolution of this item.

This finding is considered closed.

Quadrex Finding No.: 4.5.3.3(m)

No analysis has been performed; hence, FSAR commitment implementation cannot be confirmed. This situation is untimely (see Question M-2).

Licensee Action: Dispositioned

Issue 4.5.3.1(a) has a similar concern in that no pipe rupture analyses have yet been performed. FSAR Section 3.6 needs to be updated. The Work Package Action Item List will track until implementation.

Lack of early detailed review of pipe break effects outside containment is not expected to result in major problems. Pipe break effects outside containment will be evaluated by Bechtel. See Section 6 of EN-601. Resolution will be provided upon completion of evaluation.

References: EN-601

NRC Inspection Results: The inspector discussed the disposition of this item with Bechtel Engineering personnel. It was found to be adequate. The referenced work package was reviewed along with the action item list to assure this item was included. NRC followup as part of the licensing review will be done upon Bechtel's completion of their evaluation of pipe break effects outside containment. See Appendix A. Note: This finding is principally one of cost/schedule.

This item is closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.5.3.3(n)

Teledyne worst case basis for break selection can produce overly conservative results (see Question M-4).

Licensee Action: Resolved

The Teledyne analysis of MS and FW ruptures was performed for the purpose of design of five-way restraints and analysis of pipe stress within the break exclusion region. The analysis is acceptably conservative. No further action is required to resolve this finding.

References: EN-601

NRC Inspection Results: The only indicated impact will be on cost or schedule; not on plant safety.

This item is closed.

Quadrex Finding No.: 4.5.3.3(o)

The interface between EDS and B&R for determining acceptability of jet impingement loads appears to be weak; timely interchange and use of information is a problem (see Question M-4, EDS).

Licensee Action: Resolved

Structural targets are normally qualified for jet impingement loads in the final stages of the project. Targets will be evaluated as part of the system interaction hazards analysis program. Timely interchange of information between EDS and B&R is not applicable to Bechtel and no longer meaningful.

References: EN-601

NRC Inspection Results: This finding as related to timely interchange and use of information is not applicable to BPC. See findings 4.5.3.1(c) and 4.5.3.1(f).

This item is considered closed.

Quadrex Finding No.: 4.5.3.3(p)

The lack of preparation of a TRD for analysis procedures at this time indicates that the pipe rupture evaluation will be performed as a retrofit--a very costly and inefficient approach (see Question M-7).

Licensee Action: Resolved

Although not formally issued for project use, draft TRD, "Criteria and Methodology for Evaluation of Postulated Pipe Break and Crack Effects" was prepared by Westinghouse. This document received Westinghouse approval on August 12, 1981. Lack of early detailed review of pipe break effects outside containment is not expected to have major cost or schedule impact.

Additional engineering documents are necessary to complete the evaluation of pipe break effects, these are discussed in Section 6 of Work Package EN-601.

References: EN-601

NRC Inspection Results: The staff reviewer determined Bechtel's "System Interaction Design Guide" will reference the Westinghouse TRD. This finding is primarily one of cost and scheduling concern. Bechtel's response and plans are considered adequate.

This item is considered closed.

Quadrex Finding No.: 4.5.3.3(q)

Adequacy of procured equipment is questionable because pipe rupture effects have not yet been considered (see Questions M-4 and M-25).

Licensee Action: Dispositioned

Bechtel has established a system interaction work package which will, in part, establish a pipe break program. Vendor qualification requirements will be verified against the program criteria when the environmental conditions are defined. Recommendations will be presented accordingly.

Lack of early specification of these environmental conditions is not expected to have significant cost or schedule impact. Bechtel will evaluate accident enviromental conditions outside containment as discussed in Work Packages EN-602, EN-604 and in EN-601. The highest priority for detailed reviews of environmental conditions will be placed upon those in the IVC, since the most severe conditions outside containment are expected to occur there.

The EQ program described in EN-604 will provide for including environmental conditions developed as a result of pipe break analysis in considerations for qualification of safety-related equipment. Resolution will be provided upon issuance of the EQ program.

References: EN-601, 604, 619

NRC Inspection Results: This finding has been dispositioned and is dependent upon the results of the EQ Program. Through discussions with Bechtel personnel and review of referenced documents, the NRC reviewer considered the Bechtel disposition adequate and acceptable. This finding involves the cost/scheduling aspect of STP as well as the technical aspects. Followup of this item in conjunction with the Equipment Qualification Program will be done as part of the licensing review. This item is on the Action Item List.

For purposes of the Quadrex Report review, this item is considered closed.

Quadrex Finding No.: 4.5.3.3(r)

*Separation of tolerance values for installation of restraints appears to be unduly restrictive (see Question M-26C).

Licensee Action: Resolved

The basis of this finding is not clear. As indicated in finding 4.5.2.5(o) gap and final restraint position will be checked during functional testing as a part of the preoperational testing program. Installation tolerances will be closely observed during construction. The Civil/Structure discipline will design or review the existing design of rupture restraints, they will include tolerance criteria in rupture restraint fabrication and installation specifications. Final position will be checked during preoperational testing program.

References: EN-601

NRC Inspection Results: This item is not a safety issue. However, verification of restraints will be an ongoing portion of the FSAR review. See finding 4.5.2.5(o) and 4.5.3.1(c) for related items. Also see Appendix A.

This finding is considered closed for the purposes of the Quadrex Report review.

*"Separation" should be "specification."

Quadrex Finding No.: 4.5.3.3(s)

Potential overdesign of pipe whip restraints should be carefully examined (see Question M-7).

Licensee Action: Resolved

Restraints outside the containment have not been designed. B&R/EDS design philosophy has resulted in conservative pipe whip restraints in Unit 1 inside the containment. Some of this conservatism was recognized by EDS/B&R and in the Unit 2 designs, the restraints were being simplified and some eliminated with the use of additional analysis. Continued review of the B&R design will occur as a normal course of work.

References: EC-181, 135

NRC Inspection Results: This item was reviewed by the staff inspector and determined to be a case of conservatism that might impact cost, but would not constitute a safety issue. See finding 4.5.3.1(a) and 4.5.2.3(g) for information on the overall design approach.

This item is closed.

Quadrex Finding No.: 4.5.3.4(t)

Interference resolution process seems to be slow (see Question M-26A).

Licensee Action: Resolved

Interference resolutions will be processed by scheduled model review meetings involving all disciplines. In addition, the Model Shop will issue a list of all interferences to the disciplines involved, and placed on a model action items list. This list will be monitored and all action items not answered by the assigned date will be placed on the exceptions list from project for additional tracking. The slow resolution of interferences is not relevant.

References: EP-702, 703, 709

NRC Inspection Results: The staff inspector discussed this finding with Bechtel personnel in the Model Shop area and determined that the plan for resolution will aid in improving timeliness of interference resolutions. Bechtel will process interference resolutions during normal engineering work. However, this item is basically of a scheduling nature and not a safety issue.

Resolution of this item is adequate and is considered closed.

Quadrex Finding No.: 4.5.3.4(u)

B&R's assumption that pipe whip response inside containment does not produce pipe stresses outside containment may not be valid (see Question M-1).

Licensee Action: Resolved

Since containment penetrations are designed to function as full anchors it is not expected that loads due to a rupture inside containment will exceed those for which the outside piping is qualified due to a rupture outside containment. Bechtel considers the B&R approach acceptable (Also, refer to evaluation of Quadrex Item 4.5.2.1(d)). No further action is required to resolve this finding.

References: EN-601

NRC Inspection Results: The staff reviewer discussed this item with appropriate Bechtel engineering personnel. This finding is not considered a safety concern as it is unlikely that a pipe rupture inside the containment will cause unacceptable stresses in the piping outside the containment. Containment penetrations are designed as full anchors. The resolution is considered adequate. See 4.5.2.1(d).

This item is considered closed.

Quadrex Finding No.: 4.5.3.4(v)

B&R does not plan to routinely review existing interaction matrices to account for field changes (see Question M-3, EDS).

Licensee Action: Resolved

B&R recognized the need to review field changes. "As-built verification" was incorporated in the TRD to be used for final detailed review both inside and outside containment.

Field changes will be evaluated as part of Bechtel's evaluation of pipe break effects as discussed in Section 6 of Work Package EN-601.

References: EN-601

NRC Inspection Results: This finding was discussed with Bechtel engineering personnel. Field changes and their system interactions will be monitored by Bechtel. The resolution is considered adequate.

This item is closed.

Quadrex Finding No.: 4.5.3.4(w)

Specific measures to mitigate flooding and compartment pressurization may be required (see Question M-4).

Licensee Action: Resolved

Due to the minimum number and small size of high energy lines outside the reactor containment building, subcompartment pressurization is not expected to be a serious problem. In cases where future analysis shows that pressurization may be excessive, measures to limit mass and energy release are expected to provide more practical solutions than addition of blowout panels.

Additional protection against flooding due to high or moderate energy line breaks may be required in some plant areas. Typically, this is provided by features such as water-tight doors, curbs, equipment pedestals, water level detection and penetration seals. These features can generally be added late in the design without serious cost and schedule impact.

Additional measures required to mitigate the effects of compartment pressurization and flooding will be fully evaluated by Bechtel. See Section 6 of Work Package EN-601. No further action is required to resolve this finding.

References: EN-601

NRC Inspection Results: The staff reviewer concluded that the resolution of this finding was adequate. This conclusion is based on interviews with Bechtel engineering personnel and review of EN-601. See finding 4.6.4.1(b) and 4.8.2.4(11).

This item is closed.

Quadrex Finding No.: 4.5.3.4(x)

Separation and protective enclosures for environmental effect mitigation should be verified for adequacy (see Question M-5).

Licensee Action: Dispositioned

Lack of early review of pipe break effects outside containment is not expected to result in serious problems. An evaluation will be made as described in EN-602, EN-604, and Section 6 of EN-601. No analysis has been completed to date by B&R for moderate energy line breaks. These analysis will be completed and then the adequacy of mitigating measure for environmental effects will be reviewed. Completing the EN-604 effort is dependent on the issuance of the Systems Interaction Design Guide. Resolution will be provided upon issuance of the STP Systems Interaction Design Guide.

References: EN-601, 602, 604, 619

NRC Inspection Results: Bechtel's resolution of this item is adequate. The referenced Work Package Final Reports were reviewed and verified as containing this item. NRC follow-up as part of the licensing review will be performed to verify issuance of the STP Systems Interaction Design Guide. See Appendix A.

For purposes of the Quadrex Report review, this item is closed.

Quadrex Finding No.: 4.5.3.4(y)

Methods to be used to determine pump and valve interface loads should be evaluated for adequacy (see Questions M-6 and M-8).

Licensee Action: Resolved

System Work Package EN-601 (Hazards Analysis) will include a pipe break evaluation. This will include, in part, identification of the location of all safety-related mechanical equipment (pumps, heat exchangers, etc.). Isometrics are then prepared and a stress analysis is performed on each high energy line in order to determine the required locations of postulated pipe breaks as well as their type. Next an illustration is prepared showing zones of influence and transmitted to the disciplines for their input regarding impactees (targets) that might fall in these zones of influence. Stress analysis then determines if the targets (pumps, valves, pipes, etc.) can accommodate the impingement loads. Unacceptable loads are identified as action items to be resolved. The above procedure is discussed in detail in the Hazards Evaluation Procedure Desk Instruction and Attachment B-8 thereto, and is the vehicle for noting unacceptable loads.

Bechtel will contact the vendors whenever pump and valve interface loads exceed the allowables. Time history analysis may be performed, to determine more accurate interface loads. This will be done on a case-by-case basis using the Hazards Evaluation Procedure Desk Instruction.

References: EN-601

NRC Inspection Results: The NRC staff inspector reviewed the Hazards Evaluation Procedure Desk Instruction, "Evaluation Procedure for High Energy Line Break Analysis, Missiles, Flooding, and Water Spray." This instruction covered the areas of pipe whip, jet impingement, flooding internal missile protection and water spray effects. It contained detailed methodology for analysis of the preceding areas, assigned responsibilities, and specified requirements for documentation. Standard forms were included as appendices.

The resolution to this item is adequate and considered closed.

Quadrex Finding No.: 4.5.3.4(z)

TGB uncontrolled whip should be evaluated for secondary effects (see Question M-10).

Licensee Action: Dispositioned

Postulated rupture of large high energy piping within TGB may be capable of causing damage to safety-related equipment located in adjacent areas due to either direct effects (whip and jet impingement) or indirect effects (major structural damage). As the Quadrex finding suggests, these situations must be evaluated to ensure that protection criteria are met. Resolution will be provided upon issuance of the System Interaction Design Guide.

References: EN-601

NRC Inspection Results: The staff reviewer interfaced with Bechtel engineering personnel and determined that the resolution was adequate. The work package final report was reviewed for content of the referenced item. NRC followup as part of the licensing review will be performed to verify issuance of the System Interaction Design Guide. See Appendix A.

For this report the item is considered closed.

Quadrex Finding No.: 4.5.3.4(aa)

Restraint type selection criteria may need to be improved (see Question M-12).

Licensee Action: Resolved

Restraints outside the containment have not been designed. Rigid, yielding and crushable type restraints were planned to be used. These are the three normal accepted types in the industry. The choice of which type to use in a specific location generally depends on the geometry. Bechtel does not consider that a special document for restraint type selection is needed.

References: EC-181

NRC Inspection Results: The staff inspector reviewed the Bechtel Design Guide C-2.50 (Draft 6/24/82) for the design of whip restraints and determined it to be adequate with respect to definition of restraint types. Bechtel resolution of this item was considered adequate.

This item is considered closed.

Quadrex Finding No.: 4.5.3.4(bb)

Load combination details need to be improved (see Question M-13).

Licensee Action: Resolved

Restraints outside the containment have not been designed. Load combinations for pipe whip restraint (used by EDS inside containment) are consistent with general industry practice and are acceptable.

References: EC-181

NRC Inspection Results: The staff reviewer interfaced with Bechtel engineering personnel and found their assessment and resolution of this finding adequate. The referenced work package report was reviewed for inclusion of this item. Detailed load combinations are specified in B-TOP-2, Revision 2 (5/74), which has been approved by NRR.

This item is considered closed.

Quadrex Finding No.: 4.5.3.4(cc)

Project procedure details for pipe whip energy balance method should be provided (see Question M-16).

Licensee Action: Dispositioned

EDS has prepared a procedure for use of the energy balance method for STP whip restraint design. No further action is required to resolve this finding. Bechtel STP will use the Bechtel Project System Interaction Design Guide for guidance on pipe whip load analysis when issued. Resolution will be provided upon issuance of the STP System Interaction Design Guide.

References: EN-601

NRC Inspection Results: The staff reviewer questioned Bechtel Engineering personnel involved in the assessment and resolution of this finding. The referenced Work Package EN-601 and Action Item List were reviewed for verification that these items were included. NRC followup as part of the licensing review will be performed to verify issuance of the STP System Interaction Design Guide. The disposition is considered adequate. See Appendix A.

For the purposes of the Quadrex Report review, this item is closed.

Quadrex Finding No.: 4.5.3.4(dd)

Improved material specifications should be developed (see Question M-18).

Licensee Action: Resolved

U-bars have not been fabricated nor procured.

EDS/B&R intended to use GE "off-the-self" U-bars. EDS design was compatible with the design parameters in the GE catalog.

References: EC-103

NRC Inspection Results: The staff inspector reviewed the referenced work package, and the referenced Volume II Question, M-18. It was determined that Bechtel's assessment and evaluation is adequate. This finding is basically one of cost where Quadrex felt that restricting procurement to GE catalog specs would prevent other manufacturers from supplying material. See Finding 4.5.2.3(h).

This item is considered closed.

Quadrex Finding No.: 4.5.3.4(ee)

B&R methodology for out-of-plane loading was unclear (see Question M-19).

Licensee Action: Resolved

Restraints outside the containment have not been designed.

EDS procedures did not consider out-of-plane loading on the U-bars. This is an accepted industry practice.

References: EC-181

NRC Inspection Results: Through questioning Bechtel engineering personnel, the staff inspector determined that BPC's assessment and evaluation are adequate. Also see finding 4.5.2.1(c).

This item is considered closed.

Quadrex Finding No.: 4.5.3.4(ff)

Deflection acceptance criteria was not addressed by B&R (see Question M-24).

Licensee Action: Resolved

Bechtel uses the same deflection acceptance criteria, which is based on the limits provided in Paragraph III.2.a in USNRC Standard Review Plan 3.6.2. The finding is a note that B&R did not address the question in their response. In the response to question M-13, EDS cites the recommendation of the NRC Standard Review Plan. This is an observation by Quadrex that B&R did not address the question in their response.

References: EN-619

NRC Inspection Results: The staff reviewer determined that Bechtel's resolution is acceptable; however, as this is an activity important to safety, it will be evaluated as part of the licensing review. See Appendix A.

For purposes of the Quadrex Report review, this item is closed.

Quadrex Finding No.: 4.5.3.4(gg)

Existing structural and embed designs may not be adequate due to unnecessarily high pipe whip loads (see Question M-24).

Licensee Action: Resolved

Pipe whip restraints outside containment have not been located. As a part of the normal design process, the existing embeds and structural steel will be evaluated for actual design loads. (See EC-135 and EC-181).

References: EC-103, 181, 135

NRC Inspection Results: From the review of the referenced work packages and holding discussions with Bechtel engineering personnel, the NRC reviewer determined that the resolution of this item was adequate. Bechtel will analyze all embeds and structural steel during normal design reviews for pipe whip loads. Results of this analysis will be reviewed at a later date. See Appendix A.

This item is considered closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.5.3.4(hh)

The procedure for specifying the desired restraint location was unclear (see Question M-26A). Final restraint position should not be determined solely by analysis (see Question M-26B).

Licensee Action: Dispositioned

Guidance on appropriate location of pipe whip restraints will be provided by Bechtel's Systems Interaction Design Guide. Bechtel concurred with the Quadrex statement. The final restraint position should be determined during hot functional testing as a part of the preoperational testing program. Resolution will be provided upon issuance of the STP Systems Interaction Design Guide.

References: EN-619

NRC Inspection Results: As stated in the Bechtel Project Evaluation, the final restraint positions will be determined during hot functional testing. This activity will be confirmed during the licensing review of the Systems Interaction Design Guide. See Appendix A.

This item is considered closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.5.5.1(a)

NRC Standard Review Plan criteria for active components requires that operability under simulated service conditions be demonstrated by testing or a combination of testing and analysis. Two possible concerns were noted (see Questions M-50, M-51, and M-52).

(1) All active pumps were demonstrated operable by analysis.

(2) Certain valves are required to be operable during pipe rupture. Valve operability under these loads was demonstrated analytically.

Licensee Action: Dispositioned

The qualification documentation for all safety-related equipment will be reviewed and the status documented. Additional qualification work needed will be identified. Where existing equipment is determined to be lacking adequate qualification documentation, appropriate testing and/or analysis will be performed. The qualification or motor operated valves and active pumps testing requirements are clarified by the NUREG-0588 recommendations and the IEEE Standard. Refer to Item 4.5.5.1(b) for additional discussion relative to the necessity to review STP component qualification against the appropriate Standard Review Plan. Resolution will be provided upon issuance of the environmental program described in EN-604.

References: EN-604, 619

NRC Inspection Results: The staff inspector determined the assessment and disposition of this item to be adequate. It was identified in the AIL.

For the purposes of this report, the item is considered closed. NRC followup as part of the licensing review will be performed to verify issuance of the environmental qualification program as developed by Bechtel. See Appendix A.

Quadrex Finding No.: 4.5.5.1(b)

Brown and Root used the Westinghouse definitions of transients and plant design events. However, for all systems, Brown and Root utilized a 1 to 1 correlation of plant design events to ASME service level stress allowables. Thus, all normal plant design events were equated to ASME Service Level A stress allowables, plant upset events were equated to ASME Service Level B stress allowables, etc. This correlation may not be valid for systems such as ECCS where a pipe rupture condition (plant faulted event) is usually defined as a Service Level B load. This could be of rather significant impact on piping, pipe supports, and components for affected systems (see Question M-29).

Licensee Action: Dispositioned

Bechtel concurs that a one-to-one correlation of plant design events and ASME service level stress allowables is not considered appropriate for some systems by the NRC. In particular, an evaluation of the impact of potential licensing review by the NRC utilizing the criteria of SRP 3.9.3, Appendix A (July 1981) will be performed. This document in conjunction with SRP 3.10 (July 1981) represents the latest NRC position relative to the assignment of appropriate service stress limits and requirements for operability assurance testing. Based upon this licensing evaluation, an STP position will be developed in order to provide current project criteria for design load combinations and/or operability testing requirements. It is within the scope of EN-604 to evaluate and develop appropriate qualification requirements. Resolution will be provided upon completion of the licensing evaluation of Standard Review Plan 3.9.3.

References: EN-601, 604

NRC Inspection Results: The inspector reviewed the referenced work package report and Action Item List for verification of proper documentation. The disposition was determined to be adequate. It is identified in the IAL.

For the purposes of this report, this item is closed. NRC follow-up as part of the licensing review will be performed to verify licensing evaluation of Standard Review Plan 3.9.3. See Appendix A.

Quadrex Finding No.: 4.5.5.1(c)

Although vendor design calculations and data submittals were receiving a technical review by Brown and Root staff, there are concerns about the adequacy of B&R's review (see Questions M-30, M-49, M-50, and M-51) and the general lack of documentation regarding the depth and findings of such reviews (see Question M-41).

Licensee Action: Resolved

B&R's adequacy of reviews is no longer applicable. Vendor documents are being reviewed by Bechtel as part of the Transition Program in accordance with QE-002. This Phase A review of vendor calculations/data is to a level commensurate with the technical significance of the system. The vendor calculations not reviewed during Phase A will be reviewed during Phase B on a system-by-system basis. EDP-4.58 provides specific guidelines on the performance of reviews and documentation of reviews of vendor documents. This procedure will be used for the review of all vendor documents.

Quadrex identified nine items which they feel need to be addressed for Specification 2R019NS014-D. Seven of the nine items mentioned above are either not applicable or have already been addressed and resolved by B&R. Two of the items will require additional review during Phase B. These items address evaluation of sloshing during a seismic event and loads on the 24" RWST nozzle.

References: EM-412; EDP-4.58; QE-002

NRC Inspection Results: The staff inspector reviewed the referenced Bechtel procedures and considered them adequate for the resolution of this finding. B&R's actions are no longer applicable. See 4.3.2.4(t) for additional information.

This item is considered closed.

Quadrex Finding No.: 4.5.5.1(d)

The MS SRV calculation was designated as non-safety related. Typically, this system is considered safety related (Seismic Category I - see Question M-47).

Licensee Action: Resolved

Bechtel will treat the MS SRV calculation as safety-related. It is scheduled for completion by December 30, 1982. EDP-4.37 will be used. All calculations are treated as though they were safety-related.

References: EM-450; EDP-4.37

NRC Inspection Results: The staff inspector reviewed Bechtel Engineering Procedure EDP-4.37 and determined it was adequate for resolution of this item. Also see Finding 4.2.2.1(a). QE-002 also ensured that all calculations will be reviewed.

This item is considered closed.

Quadrex Finding No.: 4.5.5.1(e)

Brown and Root seemed somewhat uncertain as to the definition of active versus passive valves and pumps (e.g., are they required to operate following an earthquake or pipe rupture?). This will significantly impact procurement and qualfication of these components (see Questions M-49 and M-51).

Licensee Action: Dispositioned

Definitions for active/passive ASME Section III valves are not addressed in the specifications. The specifications will be revised in accordance with Regulatory Guide 1.48.

Further investigation, during Phase B, is required to determine if the stated definitions were inconsistently applied in the procurement documents and to what extent qualification of these valves may be impacted. If it is determined that components are adversely impacted, the specification shall be revised and the components will be replaced or modified as deemed necessary. Relative to pumps see response to Item 4.5.5.1(a). Resolution will be provided upon issuance of superseded specification.

References: EJ-367

NRC Inspection Results: The staff inspector questioned Bechtel engineering personnel and determined that the disposition of this item was adequate.

For the purposes of the report this item is considered closed. NRC followup as part of the licensing review will be performed to verify that necessary specifications have been revised. See Appendix A.

These specifications were reported to be:

2Z449ZS006-D ASME Section III Solenoid Valves
2Z439ZS210-D ASME SEction III Control Valves
2Z459ZS230-D Pressure Safety and Relief Valves, Class 2 & 3

Quadrex Finding No.: 4.5.5.1(f)

Licensing acceptability of ANSI N278.2.4 should be confirmed (see Question M-50).

Licensee Action: Dispositioned

It is not Bechtel practice to use ANSI N278.2.4 draft 3, dated January 1978, as a basis for general acceptance of a 2:1 ratio for qualification of inactive valves. A 2:1 ratio for qualification of valves is questionable and should be reviewed. Seismic qualification will be performed and reviewed as part of the overall equipment qualification program. The draft ANSI N278.2.4 has been voided. Work on the subject has been reassigned to ANSI B16 committee and, if approved, will be ANSI B16.41. Resolution will be provided upon issuance of the equipment qualification review program.

References: EJ-367; EN-619

NRC Inspection Results: Bechtel's assessment and disposition of this item is considered adequate. It has been included in the Bechtel AIL. See generic finding 3.1(h).

For the purposes of this report the item is closed. NRC licensing review will be performed to verify the issuance of the Equipment Qualification review program. See Appendix A.

Quadrex Finding No.: 4.5.5.1(g)

Containment penetrations were procured to a primary plus secondary membrane plus bending stress allowable for upset loads of 3.3 S_m. This is in violation of the ASME Section III and Section VIII stress allowable of 3.0 S_m. It is unknown if this error was promulgated to other components (see Question M-30 and M-39).

Licensee Action: Resolved

B&R corrected the typographic error in the containment mechanical penetration Specification 2C099N[illegible]4-E/PCN#4. This error has not been promulgated to other components. Further, the penetrations were procured to a stress allowable of 3.0 S_m.

References: None

NRC Inspection Results: The staff inspector determined that Bechtel's resolution is adequate.

This item is closed.

Quadrex Finding No.: 4.5.5.2(h)

B&R directly used the W plant design events for the outside containment scope. No review was made to upgrade the transient categorization for plant availability or economic considerations (see Question M-28).

Licensee Action: Resolved

The transition program and procedures provide for the review and evaluation of the design relative to plant availability and economic considerations and the subsequent reissuance of design criteria.

References: EN-619

NRC Inspection Results: The inspector discussed this item with appropriate Bechtel Engineering personnel and determined that the resolution of this item is adequate based on the fact that this finding is principally one of economic considerations.*

This item is considered closed.

*BTF ASSESSMENT (Document 11) (Presented for information): It is desirable to perform system transient analyses for design events beyond those specified by the NSSS in order to ascertain the impact of plant availability. Such analyses are initiated after preliminary physical configurations of the systems have been completed. Our experience indicates that the results of these analyses seldom require major modifications.

Quadrex Finding No.: 4.5.5.2(i)

W specified startup/shut down cycles may not be sufficient for a 40 year plant life (see Question M-31).

Licensee Action: Resolved

This is an observation and the number of cycles appears reasonable and in accordance with industry practice.

References: STP FSAR, Section 3.9.1 (Table 3.9-8)

NRC Inspection Results: This item was discussed with HL&P licensing personnel. Initial review of the FSAR table 3.9-8 indicate that the problem could exist. While the staff reviewer generally concured with the BPC conclusion, this item will be reviewed at a later date as part of the NRR licensing review. See Appendix A.

For purposes of the Quadrex Report review this item is considered closed.

Quadrex Finding No.: 4.5.5.3(j)

ISI appeared adequate for the reviewed penetrations except for two cases (see Question M-36).

Licensee Action: Resolved

B&R stated that they had identified the potential problem involved in performing ISI on penetrations M-46 and M-48 due to minimal access.

Bechtel has reviewed the design of M-46 and M-48 penetrations for the ISI accessibility. These designs have been found inadequate. They are being replaced by integrally forged penetrations as indicated in containment mechanical penetrations Specification 2C090RS1000.

References: EN-619

NRC Inspection Results: This item was reviewed by the staff inspector and determined to be adequately resolved. However, the replacement of these penetrations will be examined at a later time. See Appendix A.

This item is considered closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.5.5.3(k)

The selection of valve and pump seismic design loads of 3 "g" horizontal and 2 "g" vertical seems overly restrictive and will result in over support of the piping system (see Questions M-49 and M-51).

Licensee Action: Resolved

This is not a safety concern, but a comment that a cost savings may occur from the use of actual as opposed to envelope loads. An evaluation for possible cost savings will be done.

References: EC-101; EN-619

NRC Inspection Results: The NRC staff reviewer questioned Bechtel engineering personnel and concluded that this item was adequately assessed and resolved. This item is basically an economic concern and does not present a safety issue.

This item is closed.

Quadrex Finding No.: 4.5.5.4(1)

Concrete heating effects should be verified (see Question M-33).

Licensee Action: Dispositioned

B&R practice to require mechanical penetration vendors to perform complete thermal analysis and submit these for review is an acceptable industry practice. There may not be any technical problems with the heating of concrete; however, (1) the related specifications will be verified to confirm that vendors do perform and submit thermal analysis for review, and (2) the concerned discipline will review the vendor information and transmit heat loads to other related disciplines for verification of allowable stresses for these heat loads. Resolution will be provided upon completion of review of specifications for vendor thermal analysis.

References: EC-103

NRC Inspection Results: The NRC staff inspector questioned the Bechtel engineering personnel involved in the assessment and disposition of this item. It was determined that the disposition was adequate based on the commitment to review specifications and the subsequent discipline review.

For the purposes of this report this item is considered closed. NRC followup as part of the licensing review will be performed to verify the review of related specifications for vendor thermal analysis. See Appendix A.

Quadrex Finding No.: 4.5.5.4(m)

The analytical methods, models and computer codes appeared to be generally adequate. One notable exception was that Brown and Root was assuming many terminal components (penetrations, vessels, etc.) are rigid anchors, when in fact they could have significant flexibility (see Question M-35). This assumption could have significant impact on affected piping stress analyses.

Licensee Action: Resolved

The assumption of "terminal components as rigid anchors" is generally acceptable but reviews will be performed on a case by case basis. No further action is required on this issue.

References: EN-601

NRC Inspection Results: The staff inspector questioned Bechtel engineering personnel involved in the evaluation and resolution of this item. The inspector determined that this item was evaluated and resolved adequately and concurs that no further action is required.

See BTP ASB 3-1, Appendix A. Each B&R calculation will receive a review by Bechtel personnel. See also Findings 4.2.2.1(a), 4.5.2.1(d), and 4.5.3.4.(u).

This item is considered closed.

Quadrex Finding No.: 4.5.5.4(n)

The rationale for excluding stress calculation in the transition region from the CCW pump pipe to flued head needs to be re-examined (see Question M-39).

Licensee Action: Dispositioned

B&R stated that upon their review of the subject vendor calculation they noted the exclusion of calculated stresses in the pipe to flued heat transition region . This exclusion was identified as a discrepancy to the vendor and B&R requested that the subject stress intensities be included in the vendor report. Bechtel will followup on this item in the design review phase of the penetrations. Resolution will be provided upon completion of review of calculation.

References: EN-619

NRC Inspection Results: The staff inspector found the proposed disposition to be adequate.

For the purposes of this report the item is closed. Further NRC followup will be conducted to verify that the review of the referenced calculation was made. See Appendix A.

Quadrex Finding No.: 4.5.5.4(o)

Review and verification of the RWST vendor report needs to be completed (see Question M-41).

Licensee Action: Resolved

Bechtel will review the RWST vendor's report and comment accordingly.

References: None

NRC Inspection Results: Bechtel's commitment to review the RWST vendors report is deemed an acceptable resolution to this item. The RWST is the sole source of ECCS water during an accident. Its importance requires a followup review by the NRC. See Appendix A.

This item is considered closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.5.5.4(p)

Valve opening and closing rates are incompletely specified (see Question M-48).

Licensee Action: Dispositioned

Valve opening and closing rates were specified based on Westinghouse criteria; however, these characteristics will be examined in Phase B to confirm that system design requirements are met. Specification data sheets will then be revised as necessary. Resolution will be provided upon issuance of revised Specification data sheets.

References: EN-619

NRC Inspection Results: The staff inspector found the disposition to be adequate. See generic finding 3.2(m).

For the purposes of this report the item is closed. Further NRC followup will be conducted to verify that the issuance of revised specification data sheets has been accomplished. See Appendix A.

Quadrex Finding No.: 4.5.5.4(q)

It appears that The Brown and Root staff is not reviewing revised technical licensing requirements (NUREG's, IE Bulletins, Regulatory Guides, etc.), assessing their impact on STP and recommending a resolution to HL&P (see Question M-30).

Licensee Action: Resolved

The practice used by B&R was assessed as being reasonable. Past issues of licensing requirements are being reviewed during the transition. Procedures are in effect to assure future licensing requirements are reviewed, assessed, and resolved. Bechtel Engineering Department Procedures provide for the review and assessment of licensing requirements. See EDP 2.13, Section 5.4(i) and EDP 2.16, Section 3.5(a). A new procedure has been written and is undergoing review for approval that addresses the review of IE Bulletins, etc. The title of the new procedure is "Review and Tracking of NRC Bulletins, Circulars, Information Notices, and Generic Letters." This procedure provides for recommending resolutions to HL&P. Past issues of Bulletins, Circulars, and Notices were reviewed to determine if the concerns had been considered and findings are documented in Discipline Work Packages as part of the transition activity.

References: EN-600; EDP-2.13, 2.16

NRC Inspection Results: The staff inspector examined the referenced procedures and the Bechtel Work Package Report pertaining to the review of licensing documents. The staff inspector found that the evaluation and resolution of this finding were adequate.

This item is considered closed.

Quadrex Finding No.: 4.5.5.4(r)

A significant problem concerning the various plant operating states and environmental conditions appeared in that there is no comprehensive system by system review to ensure that design operating characteristics will be met (see Questions M-31 and M-48).

Licensee Action: Resolved

EDP 4.26 "Interdisciplinary Design Review" requires review to assure that all design requirements are met. EDP-4.27 "Design Verification" requires review to provide additional assurance that system designs meet the design requirements.

References: EDP 4.26, 4.27

NRC Inspection Results: The staff inspector reviewed the referenced Bechtel Engineering Department Procedures. They established an adequate review plan for ensuring that all design requirements will be met. The resolution of this item was adequate.

This item is considered closed.

Quadrex Finding No.: 4.5.5.4(s)

For a given valve vendor, and for a given type of valve (e.g., butterfly), not all valve sizes need be tested. Brown and Root criteria was that the tested valve must be within a diameter ratio of 2:1 of the STP procured valve (e.g., a 16" valve test could qualify all valves from 8" diameter to 32" diameter). This acceptance criteria may be too wide (see Question M-50).

Licensee Action: Dispositioned

Bechtel will review each valve actuator for proper sizing during Phase B work. Resolution will be provided upon completion of review.

References: EJ-367

NRC Inspection Results: See finding 4.5.5.1(f). The disposition is considered adequate.

For purposes of the Quadrex Report review, this item is closed. It will be reviewed however, in conjunction with finding 4.5.5.1(f) at a later date. See Appendix A.

Quadrex Finding No.: 4.5.5.5(t)

Some overconservatisms exist in the mechanical design, but they do not appear to be unreasonable (see Question M-35).

Licensee Action: Resolved

The assessment given for the questions states the combining of dynamic loads for pipe penetrations on an absolute basis is acceptable for licensing but results in a conservative design. The financial impact is not large. The B&R approach of combining the loads on mechanical containment penetrations from piping inside and outside is a conservative but reasonable approach. Bechtel considers the B&R approach acceptable. No further action is required to resolve this finding.

References: EN-601, 619

NRC Inspection Results: This item is of a cost impact and does not constitute a safety concern.

This item is closed.

4.6 NUCLEAR ANALYSIS/MECHANICAL ANALYSIS FINDINGS

4.6 NUCLEAR ANALYSIS/MECHANICAL ANALYSIS FINDINGS SUMMARY

Section 4.6 of the Quadrex Report contained an evaluation of B&R's Nuclear Analysis Group and Mechanical Group. Evaluation of nuclear analysis efforts involved an analysis of NUS as well as B&R. The capability of the Nuclear Group to contribute to STP design and analysis was questioned by Quadrex.

Nuclear Analysis (Section 4.6.2.1(a) through 4.6.2.4 (v))

The main thrust of the Quadrex assessment in this discipline area is one of failure to plan and perform an adequate nuclear analysis program. Bechtel's response indicated that the STP comprehensive design review will be sufficient to identify all needed analyses.

There are 22 findings in this area. The completed resolution of seven of these will be reviewed at a later time. (Appendix A)

Mechanical Analysis (Section 4.6.4.1(a) through 4.6.4.5(l)

In general, Quadrex found that the Mechanical Analysis Group's work was adequate. Of the twelve findings identified, five will need to be reviewed at a later date. (Appendix A)

All Quadrex findings have been adequately resolved/dispositioned. No reportable finding (10 CFR 50.55(e)) were identified in this section.

Quadrex Finding No.: 4.6.2.1(a) (Note: This finding contained two line items.)

(1) Nuclear Analysis did not control the use of temperature values issued for equipment design, nor is there any analytical basis for temperatures used outside of containment (see Question N-15).

(2) The use of saturation temperatures rather than actual temperatures inside containment is not conservative in all cases as there has been no analysis performed to support the implied assumption that equipment will not respond to actual temperatures. This approach is not in accordance with IEEE-323 which requires qualification to actual temperatures (see Question N-1).

Licensee Action: Dispositioned (Both line items)

(1) Bechtel is currently reviewing the appropriate documents (such as the FSAR, SDD's, etc.) during the Phase A transition effort and will continue to evaluate them during Phase B. If it is determined during this review that there are any assumed values, for equipment qualification not supported by acceptable analysis, Bechtel will perform the qualification analyses. These analyses will use the techniques recommended in NUREG 0588 and will be performed during the normal course of ongoing work.

The temperature values for equipment qualification were controlled by the issuance of a TRD. Bechtel will review the calculations for adequacy to ensure that the values used for qualification are supported by analysis. Where analysis is lacking they will be performed by Bechtel

The Environmental Qualification (EQ) program is to be established which will establish control of requirements and, in conjunction with the EN-604 effort provide for consistency and appropriateness of qualification parameters used for equipment qualification. The EQ program is scheduled on the work package Action Item List.

(2) Bechtel is currently reviewing the appropriate documents (such as the FSAR, SDDs, etc.) during the Phase A transition effort and will continue to evaluate them during Phase B. If it is determined during the review that there are any assumed valves for equipment qualification not supported by acceptable analyses, Bechtel will perform the qualification analyses. These analyses will use the techniques recommended in NUREG 0588.

This NUREG recommends that the actual temperature of the break compartment atmosphere will be used in the analysis. The heat transfer to the equipment is calculated using the greatest convection, condensation using 4x Tagami correlation or condensation using 4x Uchida correlation. When a condensing

Quadrex Finding No.: 4.6.2.1(a) continued

heat transfer coefficient is used, the saturation temperature is appropriate in the heat transfer equation and when a convective heat transfer coefficient is used, the total (actual) temperature is appropriate.

The temperature values for equipment qualification were controlled by the issuance of a TRD. Bechtel will review the calculations for adequacy to ensure that the values used for qualification are supported by analysis. Where analysis is lacking they will be performed by Bechtel.

The EQ program will establish control of requirements and, in conjunction with the EN-604 effort provide for consistency and appropriateness of qualification parameters used for equipment qualification. Resolution will be provided upon establishing the environmental qualification program described in EN-604.

References: EN-604, 601, 602, 603

NRC Inspection Results: (Note: This finding is composed of two line items) (1) Bechtel correctly points out that NRC has accepted use of saturation temperature in the past, but requires extensive analyses. Bechtel will perform analyses, as required, including the criteria of NUREG 0588, which is appropriate.

(2) EN-604, Appendix E, paragraph 2.0 states that BPC equipment specifications will include descriptions of the seismic and environmental qualification requirements. Evaluation and appropriate actions will be taken by Bechtel. BPC's approach to establish the EQ program in EN-604 is acceptable. Also see Finding 4.3.2.1(i) for additional information.

This item is considered closed for purposes of the Quadrex Report review. However, this area will be reexamined in a followup inspection after issuance of the above documents. Reexamination will also occur during the normal licensing review in accordance with SRP 3.11 (NUREG 0800). See Appendix A.

Quadrex Finding No.: 4.6.2.1(b)

There is an insufficient number of environmental analyses in place, and those analyses previously done contained many errors. The only environmental analysis performed by B&R contained a gross error (see Question N-13). Obvious errors were also discovered in an NUS analysis for inside containment (see Question N-1). The only NUS analysis currently valid is the containment environmental analysis for a LOCA (see Question N-1).

There is no currently valid mass energy release or environmental analysis for outside of containment (see Question N-3). The few analyses previously performed were not for currently postulated breaks and/or contained errors (see Question N-3 and N-13). Brown and Root was uncertain of any need to perform analyses for the high energy lines in the MAB (see Question N-3). The failure to perform any valid environmental analyses outside of containment is untimely, and could possibly result in either retrofit in the MAB or incorrectly designed equipment in the IVC.

A review of work performed by or under the direction of the Nuclear Analysis Group indicates problems or the potential for problems in all areas analyzed, namely, environmental analysis, reactor-shield wall annulus pressurization analysis, verification of release of environmental data, essential cooling pond analysis, and battery room hydrogen concentration. Except for a containment heat sink surface areas analysis, and an NUS LOCA environmental analysis (see Question N-1), there were no analyses found that were sufficient, correct and current. Other analyses were either obsolete, insufficient in basis, or contained errors (see Questions N-1, N-2, N-8, N-10, N-11, N-12, N-15, N-17, and N-25).

Licensee Action: Resolved

The thermal-hydraulic analyses (pressurization and temperature) performed by Brown & Root and NUS are currently being reviewed by Bechtel. For those cases where analyses that are required have not been done or are found to be inadequate, Bechtel will perform the analyses. Pressurization calculations will be done as well as thermal analyses for equipment qualification for all cases where there is a high energy line break which could affect safety-related systems or systems required to safely shut down the plant.

The transition program and work package review plans pursuant to QE-002 provides for its review of all calculation for adequacy and provides for the determination of additional calculations that may be required. The concern is addressed by EN-604 relative to calculations which pertain to equipment qualification. Further, a program is in place, as described in Appendix E of EN-619, that provides for the review of the B&R calculations and CPVR's to verify their appropriateness and correctness. Calculations that are found to be inadequate will be redone in accordance with EDP-4.36 or 4.37.

Quadrex Finding No.: 4.6.2.1(b) (cont)

References: EN-604, 619; EDP-4.36, 4.37

NRC Inspection Results: Bechtel's disposition of this finding as documented in EN-619 and EN-604, is reasonable and adequate. This resolution involves a commitment to perform analyses as determined by the comprehensive design review currently being performed under QE-002, the transition program. See also 4.6.2.1(a).

This item is considered closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.6.2.1(c)

Nuclear Analysis has failed to scope, perform, or have analyses performed that should have been completed (including correction of reports containing obsolete or erroneous analysis) given the present state of STP design and construction.

Licensee Action: Resolved

Engineering Department Procedure (EDP) 2.16 describes the design functions of the various disciplines and their responsibilities for supporting the work of each other. EDP-3.10 describes the methods of planning and scheduling the work. EDP-4.25 describes the requirements for interfaces between the disciplines and external entities for coordination of design activities. EDP-4.26 describes the requirements for design reviews among the various engineering disciplines. This group of procedures together with others which describe the planning, execution and control of the design activity require that necessary analyses are identified, scheduled, and performed in a timely manner consistent with the project engineering and construction schedules during the normal course of ongoing work.

References: EDP-2.16; 3.10; 4.25; 4.26

NRC Inspection Results: This finding primarily refers to the manner and timeliness with which B&R nuclear analyses were being performed. Bechtel's referenced EDPs were reviewed. These procedures, when fully implemented, should prevent this type of failure from recurring. The staff reviewer agreed with the finding resolution.

This item is considered closed.

Quadrex Finding No.: 4.6.2.1(d)

An identification of Nuclear Analysis calculations needed to support other disciplines was not evident (see Question N-11).

Licensee Action: Resolved

Engineering Department Procedure (EDP) 2.16 describes the design formations of the various disciplines and their responsibilities for supporting the work of each other. EDP-3.10 describes the methods for planning and scheduling the work. EDP-4.25 describes the requirements for interfaces between the disciplines and external entities for coordination of design acitivities. EDP-4.26 describes the requirements for design reviews among the various engineering disciplines. This group of procedures together with others which describe the planning, execution and control of the design activity provide the guidance such that necessary analyses are identified, scheduled, and performed in a timely manner.

References: EDP-2.16; EDP-3.10; EDP-4.25; EDP-4.26

NRC Inspection Results: The staff reviewer confirmed that the combination of referenced EDPs provided for adequate interface, identification, and control of design functions. Through adherence to these procedures, any required calculations should be identified, recorded, performed in a scheduled manner, and adequately reviewed. (It should be noted that a nuclear analysis discipline is not identified separately in the BPC organization.)

This item is considered closed.

Quadrex Finding No.: 4.6.2.1(e)

(1) The annulus pressurization analysis performed by NUS was well modeled but used an inappropriate computer program (RELAP3). They should have used COMPARE as they had done earlier for another plant. (2) Brown and Root should have pursued re-analysis as the annulus pressurization analysis is an input to structural analyses. Both of these analyses require considerable elapsed time, as does NRC approval of the results. The failure to submit such an analysis in a timely manner could cause licensing delays or retrofits. B&R does not appear to be sufficiently concerned about the timeliness of analysis in relation to construction schedules or licensing (see Question N-2).

Licensee Action: Resolved

(1) NUS has performed a subcompartment analysis for the annulus using the COMPARE computer code. However, due to pending design changes in the upper region of the reactor cavity, the calculation was neither checked nor approved, nor were forces and moments on the reactor vessel or primary shield wall calculated. Bechtel is beginning, immediately, a re-analysis of the annulus using the computer code COPDA, the Bechtel Standard Computer Program used for subcompartment analyses.

(2) The annulus pressurization analysis normally receives extensive review by the NRC and the impact of revisions to the analysis must be well planned to provide consistency of the complete plant design. The analysis-design process is iterative, so this will be an ongoing activity. The use of RELAP3 was appropriate. New analysis will use NRC accepted code.

References: BN-TOP-4, Revision 1, October 1977

NRC Inspection Results: (Note: This is a two part (two line item) finding.)

RELAP3 may or may not be acceptable, depending on the specific case. However, NRC review is usually accomplished by running a confirmatory analysis with NRC's COMPARE code. As long as an applicant's design is more conservative than the NRC analysis, it is not important which code is used. Preliminary conservatism will probably make a late reanalysis acceptable. It was noted that BN-TOP-4, Subcompartment Pressure and Transient Analysis, will be used. Bechtel's resolution was acceptable.

This item is considered closed.

Quadrex Finding No.: 4.6.2.1(f)

Awareness of the proper methodology for handling potential flow paths during environmental analysis was not evident (see Question N-8).

Licensee Action: Resolved

In reviewing the NUS calculations which superseded the Brown & Root calculations, Bechtel has found that the methodology was satisfactory.

Bechtel agrees with this analyses methodology and will continue to follow it. In general, for subcompartment analyses, node boundaries are selected where substantial restrictions to flow exist and flow paths are included so as to be most conservative for the room and break being considered.

References: EN-602; BN-BTOP-4; EDP-5.34

NRC Inspection Results: The basis for proper methodology was contained in BN-B-TOP-4, Subcompartment Pressure and Transient Analysis. EDP-5.34, Project Quality Program Indoctrination and Training, provided the requirements to keep design personnel aware of project requirements. The staff reviewer agreed with the resolution.

Note: There are several "awareness" type findings in the Nuclear Analysis area. These findings are Quadrex Corporation's assessment of B&R personnel. As such, these findings are no longer meaningful. Implementation of the Bechtel EDPs, and their training program, should preclude weaknesses of this type from recurring.

This item is considered closed.

Quadrex Finding No.: 4.6.2.1(g)

Awareness of the need to model makeup supplies of water for long term environmental analysis was not evident (see Question N-10).

Licensee Action: Resolved

Long-term mass and energy releases in the IVC due to an 8-inch feedwater bypass line break and a 4-inch auxiliary feedwater pump turbine supply line break were analyzed by NUS. In both of these cases, makeup supplies of water were considered in the development of the model.

In the case of the 8-inch feedwater bypass line break, the auxiliary feedwater makeup supply was analyzed. The flow from the 500,000 gallon condensate storage tank via the auxiliary feedwater system after isolation was considered as part of this analysis.

In the case of the 4-inch auxiliary feedwater pump turbine supply line break, makeup supply from the condensate storage tank was also considered. In this analysis, it was assumed that the auxiliary feedwater is initiated at the time of isolation and continues for a period of ½ hour at which time operator action is assumed to isolate this system.

As Bechtel continues to review B&R and NUS calculations and as new calculations are performed, consideration will be given to other makeup supplies of water for long-term environmental analyses as required.

References: EN-602; ANSI/ANS 58.2-1980

NRC Inspection Results: ANSI/ANS 58.2-1980, (old ANSI N176), Design Basis for Protection of Light Water Nuclear Power Plants Against Effects of Postulated Pipe Rupture, is the basis used by Bechtel for makeup water supply analysis. Personnel are kept aware of requirements through training. The staff reviewer agrees with the resolution.

This item is considered closed.

Quadrex Finding No.: 4.6.2.1(h)

Awareness of W trip logic for MSIVs appeared weak (see Question N-11).

Licensee Action: Resolved

Interface between the disciplines for Bechtel STP is addressed in EDP-2.16, 4.25, 4.26, and 4.27. These procedures help identify responsible groups and should minimize uncertainty with respect to those who should be aware of information.

References: EDP-2.16, 4.25, 4.26, and 4.27

NRC Inspection Results: This finding is a Quadrex assessment of B&R personnel and is no longer meaningful. Implementation of Bechtel EDPs should preclude repetition of the basis for this finding. See 4.6.2.1(f) for additional information.

This item is considered closed.

Quadrex Finding No.: 4.6.2.1(i)

Nuclear Analysis did not appear to be sufficiently knowledgeable in the area of valve performance and qualifications (see Question N-12).

Licensee Action: Resolved

Interface between the disciplines for Bechtel STP is addressed in EDP-2.16, 4.25, 4.26, and 4.27. These procedures help identify responsible groups and should minimize uncertainty with respect to those who should be aware of information.

References: EDP-2.16, 4.25, 4.26, and 4.27

NRC Inspection Results: This finding is a Quadrex assessment of B&R personnel and is no longer meaningful. See finding 4.6.2.1(f).

This item is considered closed.

Quadrex Finding No.: 4.6.2.1(j)

Analysis for a double ended break rather than a crack break disagrees with a FSAR commitment (see Question N-13).

Licensee Action: Dispositioned

NRC requirements for the design of pipe break exclusion zones was still evolving in 1975 when the STP preliminary design was being developed. As stated in Report No. L010RR064, "Dynamic Effects of Postulated Pipe Failures Outside the Containment," the STP position was that full credit would be taken for break exclusion zones in the MS and MFW piping. It was not until 1977 that NRC insisted that STP design the IVC for a single area MS or MFW rupture event though the piping design met the criteria for break exclusion with the IVC.

The first analysis of IVC pressurization was based on a double-ended rupture because mass and energy release data was not available from Westinghouse for a single area rupture. B&R stated in a conference on February 24, 1982, that analyses were later performed for a single area break and that this is the present basis for the IVC design. Response to FSAR Question 010.18 needs to be revised to reflect the current design. Consideration of the latest NRC Review Criteria recommended in the SRP (NUREG-0800) is also planned for Phase B of the transition.

References: EN-601

NRC Inspection Results. This is a continuing item that will be resolved at a later time. This area will be reviewed as part of the licensing review requirements of NUREG 0800. Tracking of FSAR commitments and NRC questions will be performed. The FSAR will be reviewed by NRR at the proper time. See Appendix A.

This item is considered closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.6.2.1(k)

B&R does not appear to be sufficiently aware of high energy lines in the MAB (see Question N-13).

Licensee Action: Resolved

Lack of early detailed analysis of postulated pipe ruptures outside containment is not expected to result in serious problems due to severe environments for safety-related equipment or overpressurization of structures.

B&R stated they were aware of the high energy lines in the MAB, but B&R's priority efforts were concentrated on high energy line breaks that lie in the isolation valve cubicle (IVC) and their analyses are ongoing.

References: EN-601

NRC Inspection Results: This finding was related to B&R's activities and, in relation to Questions N-3 and N-14, appears to be a matter of opinion. BPC will be aware of this specific requirement through the design revision effort of QE-002. See 4.6.2(f) for "awareness" portion of this finding.

This item is considered closed.

Quadrex Finding No.: 4.6.2.1(1)

B&R stated that documents are not issued without verified analysis. However, SDD 4E010EQ004-A, "Qualification of Class 1E Equipment," was issued without any reasonable analytical basis (see Question N-15). Only a fortunate series of coincidences will prevent a situation in which some equipment is overdesigned and other equipment is underdesigned.

Licensee Action: Dispositioned

Either analyses or engineering judgment may be a reasonable basis for including specific data in a design document; however, if engineering judgment is utilized, it should be justified as adequate or be analytically verified later in the project. Bechtel is reviewing the equipment qualification calculations for areas inside and outside of the containment. For those areas where analyses were not performed or where analyses that were performed are found to be inadequate, further analyses will be performed.

References for the environmental parameters are listed in SDD 4E010EQ004-A. The adequacy of calculations which pertain to equipment qualification is being determined. Those found to be inadequate will be reanalyzed and the associated environmental conditions updated. For parameters without analytical support, calculations will be generated.

References: EN-602, 604

NRC Inspection Results: Resolution of this item will be provided upon issuance of the superceded SDD. See also 4.6.2.1(a). This area will be reviewed again at a later date.

This item is considered closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.6.2.1(m)

Differences in ECP initial temperature assumptions were observed between Nuclear Analysis and Heavy Civil (see Question N-17).

Licensee Action: Resolved

An NUS Analysis of the ECP was issued on February 17, 1982. This analysis used meteorological data to establish an initial ECP temperature prior to LOCA. Bechtel Mechanical/Nuclear staff (San Francisco) is currently reviewing the report. Discrepancies or inconsistencies with ECP initial temperatures will be resolved. Remaining work is discussed under Item 4.6.2.1(n).

References: EM-406

NRC Inspection Results: Detailed review and reanalysis where necessary is to be done by Bechtel. This is a reasonable course of action. Results of Bechtel's effort will be reviewed by the NRC staff in the normal course of the OL review. See Appendix A.

This item is considered closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.6.2.1(n)

Assumptions regarding the availability of various heat sinks under varying plant conditions should be re-examined (see Question N-17).

Licensee Action: Dispositioned

Due to the STP environmental conditions, there have been questions raised concerning the ability to keep the ECP temperature below the technical specification limit of 95°F. The technical specifications may have to be amended and/or some equipment may have to be requalified, if an increase in the limit results in predicted post LOCA temperatures exceeding equipment design temperatures. The review of existing analyses and assumptions is scheduled for completion by September 30, 1982. Changes to the design, or other engineering follow-on activity resulting from the review will be accomplished as a normal engineering design activity. Resolution will be provided upon completion of the evaluation.

References: EM-406

NRC Inspection Results: The staff reviewer determined that the review of existing analyses and assumptions had not been completed by the end of the Quadrex Report review effort. Detailed review is being performed by Bechtel. The results will be considered in the normal course of the OL review. See Appendix A.

For purpose of the Quadrex review, this item is considered closed.

Note: On October 19, 1982, (subsequent to the inspection period covered in this report) HL&P notified RIV of a potentially reportable 50.55(e) item concerning a review of the essential cooling pond (ECP) analysis. The temperature of the supply water from the ECP may exceed the maximum limits as specified by the manufactures for the safety-related ECWS and CCWS equipment. The potential 50.55(e) item will be closed out by RIV at a later time.

Quadrex Finding No.: 4.6.2.1(o)

(1) The battery room hydrogen analysis did not address the true problem of hydrogen concentration near the top of the room. (2) This analysis was not properly classified as safety related (see Question N-25).

Licensee Action: (1) Dispositioned; (2) Resolved

(1) Per the assessment/action plan Bechtel will be revising the design criteria and evaluating the B&R, NUS, and OPS calculations to this criteria. Bechtel will determine if ducting is adequate to remove any hydrogen concentration near the top of the battery room. Evaluations indicate a 2 percent concentration of hydrogen could exist, which is acceptable. Resolution will be provided upon completion of evaluation.

(2) All calculations are to be treated with the same degree of concern and care as though they were safety-related. Bechtel Procedures EDP-4.34, 4.36, 4.37, and 4.43 are used for reviewing, checking, and verifying computer programs and calculations.

References: EM-551; EDP-4.34, 4.26, 4.37, and 4.43

NRC Inspection Results: (Note: This finding was addressed in two line items.)

(1) The staff reviewer confirmed that a detailed review was being performed by Bechtel. The results of this review, including technical specifications and equipment qualifications, will be examined as a normal part of the OL review. See Appendix A.

(2) See finding 4.8.2.1(d).

This item is considered closed.

Quadrex Finding No.: 4.6.2.2(p)

B&R's plan to analyze all high energy lines in the IVC and MAB, and to seismically support all non-safety-related lines does not appear to be either reasonable or cost effective and the results of this decision appear to be compromising plant access and maintainability (see Question N-3).

Licensee Action: Resolved

While the accessibility of plant systems is a legitimate concern, the conservative seismic treatment of nonsafety-related equipment is not an untried nor uncommon approach. Problems which are inherent in such an approach; e.g. cost, construction difficulties, limited operability and access are also common whenever conservative design philosophies are implmented. Bechtel's recommendations for the program to be used for the remaining work are presented in Section 6.0 of the EN-601 Work Package. Included in this program are features to attempt to provide the best match between simplified design and construction practices versus minimized cost and accessibility problems.

As stated in BPC specification 4U010PS007 dated July 6, 1982, Bechtel Engineering will provide resolution of access problems. The commitment is prudent. Bechtel will attempt to minimize cost.

Reference: EN-601

NRC Inspection Results: The basis of this finding is one of cost and schedule. EN-601 contains an appropriate approach to resolve this concern. Plant access and maintainability will be considered.

This item is considered closed.

Quadrex Finding No.: 4.6.2.3(q) (This is a two line item finding.)

(1) The chosen analysis methods were often inadequate, such as in the areas of environmental and hydrogen concentration analysis. (2) Inadequate computer codes were used for environmental and annulus pressurization and analyses (see Question N-2). The environmental analysis results are not properly reflected in SDD 4E010EQ004-A.

Licensee Action: (1) Resolved

Bechtel is currently reviewing the Brown and Root pressure/temperature calculations for adequacy of analysis methods and for correctness. Among the items examined will be the computer codes used in the analyses and the appropriateness of their use. In those cases where required calculations were not performed or they are found to be inadequate, Bechtel will perform the calculations using appropriate Bechtel Standard Computer Programs. For example, in the case of containment and subcompartment analyses the computer programs used are COPATTA and COPDA , respectively. The work package review plans developed pursuant to transition Procedure QE-002 provide for evaluating the appropriateness of chosen calculation methods. Appendix E of EN-619 describes the program in place for determining the adequacy of computer codes.

(2) Dispositioned

The thermal-hydraulic analyses performed by Brown & Root are being reviewed by Bechtel. For those cases where analyses that are required have not been done or are found to be inadequate, Bechtel will perform the analyses during the normal course of ongoing work. Pressurization calculations will be done as well as thermal analyses for equipment qualification for all cases where there is a high energy line, a break that could affect safety-related systems or systems required to safely shut down the plant. During the work package review, related documents such as SDDs and the FSAR, will be examined to ensure that they are consistent with the analyses (i.e., they reflect the major assumptions and the analyses results).

As B&R or NUS calculations are given final acceptance as a result of Bechtel's review, or as new calculations are generated, the equipment qualification values will be substantiated or updated. Resolution will be provided upon issuance of EQ program.

References: EN-602, 604

NRC Inspection Results: (This finding was addressed in two line items.)
(1) Bechtel has committed to review all calculations and analyses as part of the transition program. If omissions or inadequacies are identified,

Quadrex Finding No.: 4.6.2.3(q) (cont.)

analyses will be performed with appropriate codes. See finding 4.2.2.1(a)(2) Environmental qualification design values will be revised as necessary. Bechtel's proposed disposition is acceptable. See findings 4.3.2.1(c), 4.3.2.1(i), and 4.4.2.1(c).

This finding is considered closed based on the followup of the referenced findings.

Quadrex Finding No.: 4.6.2.3(r)

Failure to perform needed analyses in a timely manner can lead to retrofits and compromise access aspects of the plant design (see Questions N-3, N-4, N-5, and N-14).

Licensee Action: Resolved

Engineering Department Procedure (EDP) 2.16 describes the design functions of the various disciplines and their responsibilities for supporting the work of each other. EDP-3.10 describes the methods for planning and scheduling the work. EDP-4.25 describes the requirements for interfaces between the disciplines and external entities for coordination of design activities. EDP-4.26 describes the requirements for design reviews among the various engineering disciplines. This group of procedures together with others which describe the planning, execution and control of the design activity require that necessary analyses are identified, scheduled and performed in a timely manner.

References: EDP-2.16; 3.10, 4.25, 4.26; EN-602

NRC Inspection Results: This finding is principally concerned with cost and schedule. Implementation of the referenced EDP's should preclude untimely analyses and minimize access problems.

This item is considered closed.

Quadrex Finding No.: 4.6.2.3(s)

B&R's response to an NRC question regarding hydrogen concentration was not timely (see Questions N-25 and H-27).

Licensee Action: Resolved

No action necessary.

References: None

NRC Inspection Results: No action required.

This item is considered closed.

Quadrex Finding No.: 4.6.2.4(t)

Evidence of a thorough review of W data by B&R was not provided (see Questions N-4, N-9, N-12, and N-18).

Licensee Action: Resolved

Westinghouse is not a vendor for the AE but for the utility (HL&P). Westinghouse performs calculations under contract to the utility taking responsibility for them and transmits the results and, at best, the assumptions that went into the calculation, but not the calculation itself. The AE can check the data supplied by the NSSS vendor for "reasonableness" only and cannot, without the calculation, do a thorough design review. Bechtel will continue to review the assumptions provided by Westinghouse (through HL&P) and will check the data to see that it is reasonable.

The work package review plans developed pursuant to the transition procedure QE-002 provide for the evaluation of design interfaces and data including that of consultants and Westinghouse. (See also Nuclear Systems comments on Generic Finding 3.1(g)). Review of data is addressed in EDP-2.16, 4.25, 4.26, 4.27, 4.46, and 4.49.

Bechtel will review W data as it is provided in accordance with Bechtel EDP procedures.

References: EDP-2.16, 4.25, 26, 4.27, 4.46, and 4.49

NRC Inspection Results: The staff reviewer confirmed that review of data by Bechtel is adequately addressed in the referenced procedures. See also Generic Finding 3.1(g).

This item is considered closed.

Quadrex Finding No.: 4.6.2.4(u)

The impact of a much higher localized temperature for the outside containment concrete is not known (see Questions N-13 and C-4).

Licensee Action: Resolved

Past Bechtel experience indicated that the temperature effects due to pipe rupture on the concrete is very minimal. It will take a very long time for the heat to actually penetrate the concrete walls and slabs to produce significant loads. Therefore, this concern does not affect the concrete design. The temperature effects of a fuel oil fire in the diesel generator building (DGB) are known and have been considered in the design of the DGB. Temperature effects due to jet impingement are not normally considered, only pressure effects.

References: EC-111

NRC Inspection Results: The effects of localized higher temperatures on concrete as described in Questions N-13 and C-4 are negligible. The resolution is acceptable to the NRC staff reviewer.

This item is considered closed.

Quadrex Finding No.: 4.6.2.4(v)

The analysis of the essential cooling pond (ECP) failed to consider all design bases (see Question N-17). Quadrex calculations made during review of the analysis indicated that during shutdown of one unit, operation of the other unit would be in violation of technical specifications. Furthermore, no analysis was performed of the most severe ECP load, which is simultaneous normal shutdown of both units. Under these conditions, it is possible that operating limits of the ECW pumps may be exceeded. It should be noted that there are many scenarios which can require simultaneous shutdown of two units; in fact, concurrent trip of multiple units at one site has occurred in the past.

Licensee Action: Resolved

Bechtel will review the ECP design criteria and calculations. Currently, Bechtel staff is reviewing the NUS ECP thermal analysis. Following these efforts, the adequacy of the technical specifications and impact on equipment qualifications will be evaluated. The review of existing analysis and assumptions is scheduled for completion. Changes to the design, or other engineering follow-on activity resulting from the review, will be accomplished as a normal engineering design activity.

References: EM-406

NRC Inspection Results: In discussions with HL&P and Bechtel personnel, the NRC reviewer determined that the analysis had commenced. A new temperature of 95°F will be used (Technical Specification limit) instead of 105°F previously used. The licensee action is considered appropriate. However, the analysis will be reviewed by the NRC upon completion. See Appendix A.

For purposes of the Quadrex Report Review, this finding is considered closed.

Quadrex Finding No.: 4.6.4.1(a)

(1) The ECW and CCW systems and their components appear to be well designed (see Questions N-16 and N-19 through N-21). All modes of operation have been accounted for; however, the plant operating states and environmental conditions may be changed as a result of further plant analyses. (2) A complete FMEA including the effects of pipe rupture, in combination with a single active component failure, has not been performed (see Question N-19). Such an analysis, however, is generally part of an outside of containment pipe rupture effort, which has not been performed yet and is the responsibility of others. However, the ability to achieve safe shutdown under this postulation was demonstrated by the Mechanical Group.

Licensee Action: (1) Resolved (2) Dispositioned

(1) Not an issue. This is a projection/observation.

(2) Bechtel will perform FMEA's for the ECW and CCW systems. Failure modes and effects analysis will be performed by Bechtel for all safety-related systems. Failure modes and effects associated with in-plant hazards events will be formally documented as part of the detailed reviews discussed in Section 6 of EN-601. Resolution will be provided upon issuances of the FMEA program.

Reference: EN-601, 604; EM-403, 406

NRC Inspection Results: (Note: This finding consists of two parts: (1) is resolved, (2) is dispositioned.)

(1) The NRC staff reviewer agreed with Bechtel's conclusions.

(2) Bechtel agreed that further plant analyses may cause changes. The FMEA analyses will be examined by the NRC upon completion as part of the licensing review. A complete list of FMEA's was included in EN-601. See finding resolution for 4.3.2.1(d).

For purpose of the Quadrex Report review, this finding is considered closed, however, it will be reviewed at a later date upon completion of Bechtel's FMEA program. See Appendix A.

Quadrex Finding No.: 4.6.4.1(b)

(1) There appears to be no flooding problem in the ECCS pump room (see Question N-23). Verification of this would require a detailed evaluation of all building flow paths and piping layouts which is beyond the scope of this (Quadrex) review. The analysis was thorough and well done with two exceptions. The first exception was a 44% nonconservative error that carried through the entire calculation. Even with this error, there is sufficient margin that no flooding problems should occur from the lines examined. (2) The second exception was use of a 7 level designation (verification not required) rather than a safety related verified calculation.

Licensee Action: Resolved (both line items)

(1) The calculation was correct. No additional action necessary. Bechtel is reviewing the Equipment Floor Drain System for design adequacy. It is noted that DER 82-004 has been issued on the level instrumentation for the SIS pump cubicle sumps. The level switches should be safety-related and seismic Category I. Adequacy of existing STP protection against internal flooding will be fully evaluated by Bechtel as discussed in Section 6 of the EN-601. (2) Bechtel will review the calculations and revise the seven digit TPNS on the calculations cover sheet to reflect the appropriate safety designation as required. This action is in addition to reviewing the calculations for technical adequacy in accordance with EDP-4.37.

All calculations are treated with the same degree of concern and care as though they were safety-related. Bechtel procedures EDP-4.33 and 4.37 provide for reviewing, checking, and verifying calculations. Further, Appendix E of EN-619 describes the program for review of B&R calculations and related CPVR's to assure their adequacy.

References: EM-402; EN-601, 619; EDP-4.33, 4.37

NRC Inspection Results: (Note: This finding has two line items.) The staff inspector reviewed the referenced Work Packages and EDPs as verification of this item. See finding 4.2.2.1(a) for information on review of computer codes and calculations.

DER (Deficiency Evaluation Report) 82-004 has resulted in a construction deficiency report (50.55(e)) concerning the classification of the leak detection system in the SIS/CSS (Safety Inspection System/Containment Spray System) pump cubicles. This was initially reported on July 1, 1982, and was the result of BPC design review and not directly related to this Quadrex finding.

The resolution is considered adequate and for purposes of this report the item is closed.

Quadrex Finding No.: 4.6.4.1(c)

Formal FMEA methodology and single failure analysis guidelines do not exist (see Question N-19).

Licensee Action: Dispositioned

FMEA's will be performed by Bechtel for all safety-related systems. Failure modes and effects associated with in-plant hazards events will be formally documented as part of the detailed reviews discussed in Section 6 of EN-601. See also the evaluation for 4.6.4.1(a). Resolution will be provided upon issuance of the FMEA program.

References: EN-601

NRC Inspection Results: The staff inspector determined that the proposed Bechtel disposition is adequate. Further NRC followup as part of the licensing review will be performed to verify issuance of the Failure Modes and Effects Analysis Program (FMEA). See finding 4.6.4.1(a) and Appendix A.

This item is considered closed with respect to the Quadrex Report review.

Quadrex Finding No.: 4.6.4.3(d)

There has been a lack of timeliness in performing certain feedwater system analyses (see Questions N-26, N-28 and N-31). However, work in progress indicates this is now being corrected.

Licensee Action: Dispositioned

The feedwater system will be reviewed, including analyses, and comments will be provided as appropriate. Resolution will be provided upon completion of work package effort.

References: EM-451; 452

NRC Inspection Results: The inspector concluded that this was an issue involving timeliness of activities and does not constitute a potential safety issue.

This item is closed.

Quadrex Finding No.: 4.6.4.4(c)

The ECW and CCW systems have the unusual feature of the inside loop (CCW) operating at a higher pressure than the outside (ECW) loop. The purpose of this design is to prevent in-leakage of brackish water into the CCW system since this brackish water could stress corrode portions of the primary coolant boundary. The current design has the potential of creating a state regulatory problem due to possible chromate release. The potential for radiation release is minimized by a radiation monitoring system that will isolate a leaking CCW heat exchanger (see Question N-19).

Licensee Action: Resolved

Resolution of the chromate issue is pending the HL&P/State/EPA regulatory authorities. As applicable, Bechtel mechanical and controls will review the ECW/CCW systems to determine the optimum locations and type of chromate monitors or grab samples. The use of a chemical additive other than chromate will be considered.

Additionally, it appears that the ECW and CCW radiation monitoring systems are inadequate, because (1) the system does not provide for continuous monitoring of each train, and (2) the system is not capable of detecting radioactivity in the ECW system. Accordingly, Bechtel will review in detail and recommend any necessary modifications to the ECW/CCW radiation monitoring systems during Phase B.

References: EM-403, 406

NRC Inspection Results: The inspector questioned Bechtel engineering personnel on this item and subsequently concluded that HL&P's evaluation and resolution is adequate. The chromate issue is not an NRC concern. The results of the proposed review for leak detection system will be examined during the normal OL review. See Appendix A.

For purposes of the Quadrex Report review, this item is considered closed.

Quadrex Finding No.: 4.6.4.4(f)

No consideration was given to valve performance qualification requirements near break locations (see Question N-12).

Licensee Action: Resolved

Operability of a valve subjected to severe environmental and process conditions associated with a pipe rupture can only be assumed, for the purpose of safety analysis, if the valve is qualified for operation under these conditions. As Quadrex points out, the manufacturer's qualification reports must be carefully reviewed to determine if they adequately demonstrate qualification for the STP systems application.

Because of the single failure criterion, only a few valves are assumed to perform essential functions during or after being subjected to postulated pipe rupture accident conditions. These typically include valves for MS and MFW containment isolation and certain RCS branch connections. These cases will be identified during the detailed review to be performed by Bechtel. Qualification for these conditions will be completed under the program discussed in Work Package EN-604.

References: EN-601, 604

NRC Inspection Results: The inspector questioned Bechtel engineering personnel involved in the assessment and resolution of this item. The licensee resolution is adequate. Upon completion of the Equipment Qualification Program for these specific conditions, this item will be rereviewed. See Appendix A. See finding 4.6.4.1(a) also.

For purposes of the Quadrex Report review, this item is considered closed.

Quadrex Finding No.: 4.6.4.4(g)

The elevated ECP temperatures occurring during a shutdown should be investigated for effects on the operation of the system and acceptable temperature operating range of the ECW pumps (see Question N-17). The ECP temperature analysis performed by the Nuclear Analysis Group did not consider the bounding cases and may also have a non-conservative initial condition error.

Licensee Action: Resolved

Bechtel agrees with the Quadrex finding. Bechtel will review the ECP design criteria and calculations. Currently, Bechtel staff is reviewing the NUS ECP thermal analysis. Following these efforts, the adequacy of the ECW system will be determined and Bechtel will evaluate any impact on interfacing systems.

References: EM-406

NRC Inspection Results: This finding was reviewed by the NRC staff reviewer. Bechtel Engineering Personnel were questioned with respect to its status and resolution. It was determined that the planned resolution was adequate. Equipment will be qualified to any new temperature requirements. This item will be reexamined upon completion of Bechtel review. See finding 4.6.2.1(n) for additional information. Also see Appendix A.

This item is considered closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.6.4.4(h)

The Mechanical Group has been working with Westinghouse on the generic steam generator auxiliary feedwater water hammer problem. The STP feedwater system is designed to preclude or minimize the potential for occurrence of this type of water hammer. A study is in process by a Rice University professor to evaluate all potential water-hammers in the condensate and feedwater system. Design modifications and/or loads analysis will be made if the results of this study show them to be required (see Question M-33).

Licensee Action: Resolved

No response is necessary. Bechtel will be evaluating STP for water hammer in response to Unresolved Safety Issue (USI) A-1.

References: EM-408

NRC Inspection Results: This item was reviewed and it was determined that the assessment and resolution are adequate. Bechtel will be evaluating STP for water hammer in response to unresolved safety issue A-1.

This item is closed.

Quadrex Finding No.: 4.6.4.4(i)

No plan to perform a dynamic analysis of the FW system was evident (see Question N-28).

Licensee Action: Resolved

No separate response is necessary. It is noted that Bechtel will be performing an HELB analysis. If this effort indicates a dynamic analysis of the FW system is necessary, then Bechtel will provide recommendations accordingly.

References: EM-451, 452

NRC Inspection Results: See 4.6.4.3(d)

This item is considered closed.

Quadrex Finding No.: 4.6.4.4(j)

FW pump low flow recirculation line valve noise and wear can be anticipated (see Question N-31).

Licensee Action: Dispositioned

Bechtel will evaluate this issue reviewing proper types of control valves or control valve/orifice combinations. A thorough review of this problem will take place in Phase B. FW pump low flow recirculation line valves will be evaluated for noise and wear and if required new valves will be procured to replace the valves impacted with excessive noise and wear. Resolution will be provided upon completion of review.

References: EM-451, 452

NRC Inspection Results: Bechtel's evaluation and disposition are considered to be adequate. This is not a safety issue.

This item is closed.

Quadrex Finding No.: 4.6.4.5(k)

The division of responsibilities for similar flow and heat transfer analyses between Heavy Civil, Nuclear Analysis, and Mechanical Analysis of the component cooling water (CCW), emergency cooling water (ECW) and the essential cooling pond (ECP) has the potential to cause design interface problems in these systems (see Question N-16). In fact, a previously discussed error (see Question N-17) in the ECP analysis by the Nuclear Analysis Group may effect components designed and analyzed by the Mechanical Group (see Question N-20).

Licensee Action: Resolved

NUS has completed a thermal analysis of the ECP. Following a review by Bechtel, changes to the CCW, ECW, etc., will be proposed as necessary.

The B&R division of responsibilities and interface problems are no longer pertinent. Bechtel practices and procedures are now applicable. EDP-2.16 defines the division of responsibilities and EDP-4.25 defines interface responsibilities and functions.

References: EM-403, 406, EN-619, EDP-2.16, 4.25

NRC Inspection Results: See also 4.6.2.4(v)

The staff inspector reviewed the referenced procedures and determined that they adequately described the functions and responsibilities of Bechtel personnel involved in these areas of analysis. The resolution commitments are adequate, therefore, this item is closed.

Quadrex Finding No.: 4.6.4.5(1)

The various pumps have large NPSH margins and the NPSH calculations were well done with the following exceptions. In certain analyses, frictional, temperature and velocity head effects were considered negligible and were not calculated. These should have been calculated in case other factors change (i.e., an out of specification pump) so the true margin is known. Additionally, the pump vendors NPSH interface was not defined. This is a very common error, but it has caused problems elsewhere (see Questions N-20, N-22 and N-28).

Licensee Action: Resolved

Bechtel agrees with the Quadrex finding and is reviewing the calculations. Particular attention will be given to those calculations where the NPSH margins are small. Comments to the calculations will be identified in the system work package final reports issued per the schedule. Those calculations not received during Phase A will be reviewed during Phase B.

Reference: QE-001

NRC Inspection Results: The NRC reviewer questioned Bechtel engineering personnel involved in the assessment and resolution of this item. It was determined that the resolution of this item is adequate based on the planned review of calculations.

This item is considered closed.

4.7 PIPING AND SUPPORT/STRESS ANALYSIS FINDINGS

4.7 PIPING AND SUPPORT/STRESS ANALYSIS FINDINGS SUMMARY

Section 4.7, Piping and Supports/Stress Analysis Findings, addressed the areas of mechanical piping and piping support design and analysis. There were a total of 41 findings divided into two groups.

Findings 4.7.2.1(a) through 4.7.2.5(p). These 16 findings were related to EDS design and analysis of inside containment piping and supports. In general, Quadrex found the in-containment design analysis technically adequate.

Findings (4.7.3.1(a) through 4.7.3.4(y)). These 25 findings were related to piping and supports outside containment. Quadrex found that, due to the limited amount of work actually performed by B&R, that it was difficult to provide an accurate assessment of technical adequacy.

All findings were found to be adequately resolved and are considered closed. Three findings in the first group were found to be of sufficient importance to schedule them for a rereview and ten of the outside containment findings will be followed up on a later date.

No reportable items were identified in this section.

Quadrex Finding No.: 4.7.2.1(a)

The FSAR should be corrected since no modal analysis is done (see Question P-7).

Licensee Action: Dispositioned

"On a mode-by-mode basis" statement should be removed from Sections 3.7.3.8 and 3.7.3.9 from FSAR since it is not used in the piping analysis for differential seismic motion of the supports. Also "the most severe floor response spectrum: should be changed to the "enveloping response spectrum." Nuclear licensing will track. Resolution will be provided upon revision of the FSAR.

References: EN-600

NRC Inspection Results: This item is on the Action Item List for resolution. The FSAR tracking system is considered adequate to perform this task.

FSAR correction is not a safety issue and thus, this item is considered closed.

Quadrex Finding No.: 4.7.2.1(b)

EDS stated that they do not review the FSAR for changes or accuracy; this interface may present licensing problems (see Question P-7).

Licensee Action: Resolved

Bechtel Procedure EDP-4.23, Section 3.5, provides for review by the NSSS Supplier for those changes originated by Bechtel. Bechtel has the responsibility for assuring subcontractors work is properly reflected in the FSAR in accordance with EDP-2.13 and 4.23. Responsibility for changes and accuracy of the FSAR is HL&P's not EDS's. Procedures are in place that provide for consultant reviews of changes.

References: EN-600; PLP-03 (9/30/81); EDP-2.16, 4.23

NRC Inspection Results: The staff reviewer determined that HL&P's procedure PLP-03, FSAR Change Notices, controls the issue of and assigns responsibilities for, changes to the FSAR. Bechtel's work for the FSAR corrections is assigned in the appropriate EDPs.

This item is closed.

Quadrex Finding No.: 4.7.2.1(c)

The FSAR needs to address EDS's methodology for Class 1 components (see Question P-9).

Licensee Action: Dispositioned

Section 3.9.3.3 - "Design and Installation Details for Mounting of Pressure Relief Devices" of FSAR will be updated to include use of dynamic time history analysis to determine the response of the piping system as an option to static load method. A similar statement will be added to Section 3.9.1 for ASME Class 1 components. Nuclear licensing will track until the issue is closed out. Finding resolution will be provided upon revision of the FSAR.

References: EN-619

NRC Inspection Results: This is a dispositioned item. The resolution is acceptable. See also findings 4.7.2.1(a) and 4.7.2.1(b).

This item is considered closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.7.2.1(d)

EDS's use of high stiffness (default values) for pipe supports gives unconservative results compared to actual stiffness values (see Question P-12).

Licensee Action: Resolved

EDS and B&R used the same stiffness criteria to design supports. In performing piping stress analysis, EDS used computer program default stiffness values, but B&R used the minimum stiffness values from the criteria. B&R stated that they conducted a parametric study which showed that use of high stiffness values used by EDS did not yield results significantly different than obtained by B&R using more representative support stiffness values. Bechtel will review this study in detail.*

This study affects only rotational stiffness of anchors. If the B&R study is accepted by Bechtel then the Project Team will review all piping analysis and anchor designs against the stiffness values as per this study. Reanalysis or redesign if required, will be performed. Since all anchors are on hold, very little impact is expected on the anchors. If the above study is not accepted by Bechtel, then the deviations will be handled on a case-by-case basis.

References: EN-619; Evaluation of Calc. No. 5L 340JC 9819-0; 5L010RQ1002, App. A, pg. 41

NRC Inspection Results: The staff reviewer found that the piping analysis will be reperformed utilizing Bechtel's criteria for actual anchor/support stiffnesses. Bechtel's criteria has been previously used and accepted by NRC on many projects. In addition, the Bechtel stiffness requirements for anchor stiffness assures that an overlap procedure is not required as the piping subsystems are analyzed from anchor to anchor. The resolution is adequate.

This item is considered closed.

*Note: The B&R study has been reviewed and accepted by Bechtel subsequent to the writing of this licensee action statement.

Quadrex Finding No.: 4.7.2.1(e)

Applicability of MEB-6 to STP vintage plants needs to be determined (see Question P-16).

Licensee Action: Dispositioned

Bechtel will undertake licensing and design reviews in order to develop an STP position for addressing this issue. Refer to Finding 4.5.5.1b.

If current NRC criteria on the correlation of service level stress limits to design basis events is applied to STP, then plant faulted conditions may need to be considered as normal conditions for certain systems and review and reanalysis of these systems will be required. Options available for operability testing will also have to be investigated. Resolution will be provided upon development of position on Standard Review Plan 3.9.3, Appendix A (July 1981).

References: EN-601

NRC Inspection Results: Bechtel's disposition is acceptable to the staff reviewer as an ongoing activity. However, the latest requirements of SRP 3.9.3 must be used. Also see finding 4.7.3.1(f).

This item is considered closed for purpose of the Quadrex Report review. It will be subject to review during normal FSAR licensing review. See Appendix A.

Quadrex Finding No.: 4.7.2.1(f)

The FSAR should be corrected to reflect EDS's modified spectra method used in the simplified method (see Question P-24).

Licensee Action: Dispositioned

The FSAR Section 3.7.3.1.4 on the simplified method needs the following correction. "No contribution is taken due to multimodes because higher modes have been proven to be insignificant," should be changed to "contribution would be taken due to multimodes if higher modes proved to be significant." Resolution will be provided upon revision of the FSAR.

References: EN-619, 600

NRC Inspection Results: This finding is in the AIL and will be corrected in the FSAR.

It is considered closed. It is not a safety issue.

Quadrex Finding No.: 4.7.2.3(g)

EDS's procedure for transmitting important information may not eliminate the use of outdated information in analyses (see Question P-4).

Licensee Action: Resolved

Design verification process in accordance with Plant Design Pipe Stress and Supports Group Review Plan and Work Packages will assure that no outdated information becomes the basis of Bechtel accepted design. The most recent information will be obtained and incorporated in all new designs. EDS's procedure and interface with B&R is no longer pertinent. Bechtel EDP-4.25 provides for adequate interface with consultants and other entities. Further, the transition program provides for the review of all designs prior to reissuance.

References: EDP-4.25

NRC Inspection Results: Bechtel EDPs provide for adequate interface with consultants and contractors.

This item is considered closed.

Quadrex Finding No.: 4.7.2.3(h)

Combining the results of SSE SAM loads and inertia loads by Absolute Sum may be overly conservative (see Questions P-7 and P-18).

Licensee Action: Resolved

Bechtel agreed that above method is overly conservative

As indicated in the "Piping Stress Analysis Criteria" SRSS (Square Root of the Sum of the Squares) method will be used to combine the results of SSE inertia and SAM loads.

References: EN-619

NRC Inspection Results: Bechtel's resolution of using SRSS to combine the results of SSE inertia and SAM loads is acceptable to the staff reviewer.

All existing pipe supports will be standard for SSE SAM loads and movements. If these loads exceed the faulted capacity of the support, then the support will be redesigned. Also see finding 4.7.3.1(h).

This item is considered closed.

Quadrex Finding No.: 4.7.2.3(i)

EDS should have been aware of increased valve acceleration capability and should have prevailed upon B&R to revise the criteria (see Question P-8).

Licensee Action: Resolved

EDS was given allowable valve acceleration criteria by B&R, valve vendors used the same allowable accelerations for qualifying the valves. Therefore, Bechtel will use the same allowables and include them in the "Piping Stress Analysis Criteria." Vendors may be contacted if higher allowable accelerations are necessary.

References: EN-619

NRC Inspection Results: Bechtel's resolution does not raise any safety concerns and is acceptable.

This item is closed.

Quadrex Finding No.: 4.7.2.3(j)

10° half expansion angle is overly conservative for jet load evaluations (see Question P-20).

Licensee Action: Resolved

Use of the 10° half angle expansion model is an accepted industry practice. For targets located near the rupture location more realistic expansion models will reduce the calculated impingement loading for flashing water jets. Since only a limited amount of analysis of jet impingement effects has been completed so far, strict adherence to the 10° expansion model has not resulted in extensive overdesign. Bechtel will sometimes use expansion models other than 10° half angle when justified by jet thermodynamics to aid in target qualification.

References: EN-601

NRC Inspection Results: See finding 4.5.2.1(a)

This item is closed.

Quadrex Finding No.: 4.7.2.3(k)

Symmetrical baseplate design approach may need to be altered due to construction interferences; EDS procedures may not adequately analyze bolt pullout loads for non-symmetrical baseplates (see Question P-30).

Licensee Action: Resolved

Bechtel agreed with Quadrex that construction interferences may require a number of baseplates to be modified and that the EDS should have used an approved baseplate flexibility computer program to cover nonsymmetrical loading.

PSSG will use Bechtel's computer program to perform baseplate design for nonsymmetrical loading for new work at the design stage. At the as-built stage, if any EDS designed symmetrical base plate becomes nonsymmetrical due to construction interference, Bechtel's baseplate computer program will be utilized to check the design.

References: EN-619

NRC Inspection Results: The staff reviewer considers the approach and resolution to this item acceptable. Bechtel's computer program accounts for baseplate flexability and meets the requirements of IE Bulletin 79-02. This program will be used for nonsymmetrical baseplates design. If EDS designed symmetrical baseplate becomes nonsymmetrical due to construction modifications, Bechtel's computer program will check the design.

This item is closed.

Quadrex Finding No.: 4.7.2.4(1)

The use of different support stiffness values by B&R and EDS should be assessed (see Question P-12).

Licensee Action: Resolved

EDS and B&R used the same stiffness criteria to design supports. In performing piping stress analysis, EDS used computer program default stiffness values, but B&R used the minimum stiffness values from the criteria. B&R stated that they conducted a parametric study which showed that use of high stiffness values used by EDS did not yield results significantly different than obtained by B&R using more representative support stiffness values. Bechtel will review this study in detail by August 28, 1982.

This study affects only rotational stiffness of anchors. If the B&R study is accepted by Bechtel then BPC will review all piping analysis and anchor designs against the stiffness values as per this study.

Re-analysis or redesign if required, will be performed. Since all anchors are on hold, very little impact is expected on anchors. If the above study is not accepted by BPC, then the deviations will be handled on a case-by-case basis.

References: EN-619

NRC Inspection Results: See finding 4.7.2.1(d).

This item is considered closed.

Quadrex Finding No.: 4.7.2.4(m)

Confirmation of support self weight excitation basis should be obtained (see Question P-32).

Licensee Action: Resolved

For a low seismic activity area such as STP, consideration of self-weight excitation is not a requirement. In addition, support designs on STP have to meet stiffness requirements provided the Piping Stress Analysis Criteria (5N170RQ001). The stiffness requirements assure support natural frequencies to be high enough to put them beyond the peak region of the building seismic response spectra. This will reduce the effect of self-weight excitation and make it insignificant.

References: EN-619

NRC Inspection Results: See finding 4.7.3.4(x).

This item is closed.

Quadrex Finding No.: 4.7.2.4(n)

Improved documented guidance by EDS in categorization of linear from plate and shell elements appears to be needed (see Question P-36).

Licensee Action: Resolved

Bechtel will use only linear type supports on STP. Linear attachment welds criteria will be used from the "Pipe Support Design Manual, STP Addendum." The Bechtel Pipe Support Design Manual does not allow plate and shell type supports. For designs done by B&R, EDS, and NPSI, the attachment welds will be reviewed and reclassified as linear type welds, if required.

References: EN-619

NRC Inspection Results: See finding 4.7.3.4(y). The "Pipe Support Design Manual" adequately addresses this finding.

This finding is considered closed.

Quadrex Finding No.: 4.7.2.4(o)

EDS's criteria for jet load evaluations on unbroken piping systems is not adequate with respect to supports (see Question P-20).

Licensee Action: Resolved

Bechtel agrees with the Quadrex assessment that supports for essential piping should be designed for loads from jet impingement on the piping. EDS has stated that only six stress problems involve qualification of the piping for jet loads. These problems will be reanalyzed by Bechtel prior to release of any new construction work on the affected piping and supports.

Bechtel disagrees with Quadrex that jet impingement on the supports themselves requires analyses. Because essential piping is protected against direct impingement effects, there is little likelihood of unacceptable damage due to impingement on unprotected supports. Jet impingement loads on the unbroken piping systems will be considered in the faulted condition load on the previously designed supports. If these loads exceed the faulted capacity of the support, then the support will have to be redesigned.

References: EN-601

NRC Inspection Results: The Bechtel resolution is considered adequate by the staff reviewer. Further evaluation of this specific area will be done during the FSAR review.

This item is closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.7.2.5(p)

Differences in assumed friction factors for support design purposes were noted (see Question P-33).

Licensee Action: Resolved

Different friction factors were utilized by EDS and B&R. B&R used the following friction factors: f(for steel to steel) = 0.45 and f(for lubrite or teflon) = 0.15 which are conservative.

Bechtel will follow the same friction factors used by EDS and include them in the "Pipe Support Design Manual, STP Addendum" which are as follows: f(for steel to steel) = 0.3 and f(for lubrite or teflon) = 0.1.

References: EN-619

NRC Inspection Results: The proposed friction factors and their use will be fully evaluated during the FSAR review. See Appendix A.

For purposes of Quadrex Report review, this item is considered closed.

Quadrex Finding No.: 4.7.3.1(a)

B&R has not yet developed a criteria for jet impingement protection on unbroken piping systems (see Question P-20). A future TRD is planned.

Licensee Action: Dispositioned

B&R recognized the need for criteria for protection of unbroken piping against jet impingment. The draft TRD, "Criteria and Methodology for Evaluation of Postulated Pipe Break and Crack Effects," addresses this; however, it refers to a supplementary TRD and computer program for details. These supplementary documents have not been completed.

Because of the small number of high energy lines located outside containment and the amount of separation provided in the STP design, very little piping outside containment will require qualification for jet impingment loads. Project documents to be develoned by Bechtel will include appropriate criteria for protection of piping against jet impingement. No other action is required to resolved this finding. Resolution will be provided upon issuance of the System Interaction Design Guide.

References: EN-601

NRC Inspection Results: The System Interaction Design Guide is in the process of being prepared. This area will be examined as part of the licensing review when Bechtel's work has been completed. The approach is acceptable to the staff reviewer. See Appendix A.

For purposes of the Quadrex Report review, this item is considered closed.

Quadrex Finding No.: 4.7.3.1(b)

Approximately 50% of the reviewed SDDs do not yet contain system operating temperatures (see Question P-1).

Licensee Action: Resolved

SDD's TRD, etc., are being reviewed during Phase A of the transition for the inclusion of operating temperatures and revisions to SDD's are being listed as action items or work-to-go in the system work packages, in accordance with the transition procedure (QE-002) and discipline plans for review of system work packages. The transition program will result in the reissuance of SDD's in accordance with EDP-4.1 for STP covering requirements for design criteria.

References: EN-601; EDP-4.1

NRC Inspection Results: QE-002 required a review of all systems. Work packages will include a listing of SDDs requiring revision. The transition program provided for the reissue of SDDs under Bechtel procedure EDP-4.1. This resolution is acceptable.

This item is considered closed.

Quadrex Finding No.: 4.7.3.1(c)

FSAR paragraph 3.7-17 is inconsistent with the B&R stated basis for separation of simplified method versus response spectra method (see Question P-1).

Licensee Action: Dispositioned

The FSAR will be updated to reflect the criteria selected by Bechtel. Resolution will be provided upon revision of the FSAR.

References: EN-600; EN-619

NRC Inspection Results: This item has been included in the WP Action Item List. Details will be provided in the FSAR update. This will be reviewed during the normal FSAR review.

For purpose of the Quadrex Report review, this item is considered closed.

Quadrex Finding No.: 4.7.3.1(d)

Lack of overall coordination from a piping systems standpoint was observed (see Questions P-1 and P-3). It appears possible that the numerous requirements associated with complex safety-related piping system may not be thoroughly satisfied. It is recommended that B&R consider a "system engineer" approach.

Licensee Action: Resolved

Bechtel's EDP-4.25 and 4.26 provide for interfacing among disciplines. Bechtel Mechanical Discipline will have a responsible system engineer for each system. He will interface with other responsible disciplines to coordinate requirements.

References: EP-702, 703, 709; EDP-4.25, 4.26

NRC Inspection Results: The staff reviewer confirmed that Bechtel procedures (EDP-4.25 & 4.26) adequately resolve this finding. They provide for coordination of disciplines.

This finding is considered closed.

Quadrex Finding No.: 4.7.3.1(e)

There was no indication that environmental conditions used by W for equipment qualification were coordinated with those used by B&R (see Question P-3).

Licensee Action: Dispositioned

A reevaluation of all safety-related equipment relative to seismic and environmental qualification is in process. EN-604 will develop an EQ program to establish uniform criteria for equipment qualification. Resolution will be provided upon establishment of the environmental qualification program.

References: EN-604

NRC Inspection Results: See finding 4.6.2.1(a) for resolution of this item. EN-604 contained a description of the environment qualification program. This item will be reviewed upon issuance of that program. NRC followup action will examine the EQ program. See Appendix A.

This item is considered closed for purpose of the Quadrex Report review.

Quadrex Finding No.: 4.7.3.1(f)

The decision to not apply the recommendations of the NRC MEB-6 position was made in 1976 (see Question P-16). It is possible that the NRC may impose some of these requirements as they have on other plants ahead of STP.

Licensee Action: Dispositioned

If the latest NRC position as reflected in SRP 3.9.3, Appendix A, is considered applicable to STP as is to be determined by a licensing evaluation, then plant faulted conditions may have to be considered as normal conditions for certain systems and review and reanalysis of these systems will be required. Options for operability testing will also have to be evaluated.

Bechtel will undertake licensing and design reviews in order to develop an STP position on the applicability of current NRC criteria on these matters. Resolution will be provided upon completion of evaluation of applicability of current NRC criteria.

References: EN-619

NRC Inspection Results: The disposition of this item is acceptable to the staff.

The appendix to SRP 3.9.3 (formerly MEB-6) is applicable to STP and will be evaluated during the FSAR review. See Appendix A.

This item is considered closed for purpose of the review of the Quadrex Report.

Quadrex Finding No.: 4.7.3.1(g)

The FSAR should be corrected to delete the reference to mode-by-mode analysis and enveloping of response spectra (see Question P-7).

Licensee Action: Dispositioned

The statement "on a mode-by-mode basis," should be removed from Sections 3.7.3.8 and 3.7.3.9 of the FSAR since it is not used in the piping analysis for differential sesimic motion of the supports. Also "the most severe floor response spectrum" should be changed to "the enveloping response spectrum." Nuclear licensing will track until the issue is closed out. Resolution will be provided upon revision of the FSAR.

References: EN-619

NRC Inspection Results: See 4.7.2.1(a). This item is considered closed. A safety problem is not at issue here.

Quadrex Finding No.: 4.7.3.1(h)

The decision to ignore SSE SAM loads as a primary load on pipe supports should be re-examined (see Question P-7).

Licensee Action: Resolved

According to "Piping Stress Analysis Criteria" SRSS method will be performed to combine the results of SSE inertia and Seismic Anchor Motion (SAM) loads. SAM (SSE) will be considered in finding the spring hanger working range movement and pipe support clearances. All existing pipe supports, including spring hangers, will be studied to incorporate the loads and movements. If these loads exceed the faulted capacity of the support, then the support will have to be redesigned. See evaluation for 4.7.2.3(h).

References: EN-619

NRC Inspection Results: This item will be further evaluated during the FSAR review. However, Bechtel's analysis techniques appear to be adequate. See finding 4.7.2.3(h).

This item is considered closed for purposes of Quadrex Report review.

Quadrex Finding No.: 4.7.3.1(i)

The lack of consideration of FW water hammer is not adequate (see Question P-21).

Licensee Action: Resolved

Bechtel agrees with the Quadrex assessment that FW water hammer needs to be analyzed. Discussion of this issue is provided in Work Packages EN-610 and EM-452. Recent experience shows that the water hammer scenario, resulting from rapid check valve closure due to a postulated upstream pipe rupture, is a difficult problem the resolution of which may lead to significant system design changes. FW water hammer analysis will be started on a priority basis to evaluate the present design in detail See 4.1.4.4(h)

References: EM-451, 452

NRC Inspection Results: The resolution of this item is considered acceptable. A program is in place to conduct FW analysis. NRR will review the analysis when completed as part of the licensing review. See finding 4.1.4.4(h).

This item is closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.7.3.1(j)

The adequacy of the Site Review Board procedures and the qualifications of its members could not be determined; decisions reached by this Board can be extremely significant (see Question P-26).

Licensee Action: Resolved

The review board was a B&R entity whose functions will now be performed by Bechtel.

Reference: EN-619

NRC Inspection Results: The NRC staff reviewer verified that the functions of the former site review board are included within the Bechtel organization and its normal design functions.

This item is considered closed.

Quadrex Finding No.: 4.7.3.1(k)

B&R assumptions for seismic to nonseismic boundary anchors are probably unconservative and difficult to technically justify as adequate (see Question P-29).

Licensee Action: Resolved

Bechtel agrees with the finding. The design of all anchors is being reviewed. The interface anchors will be designed for loads equivalent to the upper bound collapse moment limits of the piping, as is stated in the Piping Stress Analysis Design Criteria (SN17ORQ001). This is required only for those anchors which separate Seismic Category I and Nonseismic interfaces.

Reference: EN-619

NRC Inspection Results: Bechtel's proposed design review techniques and plan for review of all anchor designs appears adequate.

This item is considered closed.

Quadrex Finding No.: 4.7.3.2(1)

B&R does not appear to be sufficiently involved in assuring that adequate design margins are provided to meet the best estimate of actual cyclic duty to avoid fatigue failures (see Question P-2).

Licensee Action: Resolved

PSSG will confirm the number of thermal cycles for each system for the Mechanical and Nuclear groups. Using these data, PSSG will perform fatigue analysis wherever required as per ASME Section III Code. The Piping Stress Analysis Criteria (SN170RQ001) require that prior to issuance of Class 2 and 3 piping analysis, estimates of cyclic duty will be confirmed.

References: EN-619

NRC Inspection Results: Bechtel's resolution appears adequate. MEB (NRR) will further evaluate this item during the FSAR review. See finding 4.5.5.2(i). See Appendix A.

This item is considered closed for purpose of the Quadrex Report review.

Quadrex Finding No.: 4.7.3.2(m)

An unsatisfactory design for the IVC interface supports/restraints for main steam and feedwater lines appears possible (see Question P-6). A study of other plant designs and incorporation of a better design is recommended.

Licensee Action: Dispositioned

Bechtel is reviewing the design and will make any appropriate recommendations for design changes. Resolution will be provided upon completion of review.

References: EN-619

NRC Inspection Results: The IVC is under a complete redesign effort. The approach appears reasonable to the staff reviewer. This item will be reviewed in detail during the FSAR review. See Appendix A.

This item is considered closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.7.3.2(n)

Inservice inspection and maintenance access considerations may not have been given adequate attention during the design and analysis of pipe whip restraints (see Question P-17). The assumption of minimum yield strength to define pipe bending behavior appears to have led to restraints being located to close to straight pipe (and) to fitting welds and the inclusion in the design of unnecessary restraints (see Questions M-10 and M-12). Documented guidance on ISI was available to B&R, but was not formally used in the design process (see Question P-17).

Licensee Action: Resolved

Inservice inspection and maintenance access considerations are considered in Bechtel's "Pipe Support Design Manual STP Addendum" and "Piping Stress Analysis Criteria." The rupture restraint locations determined by EDS Nuclear will be reviewed against Bechtel criteria for ISI and maintenance access by the Civil/Structural discipline. If any modifications are required, then these will be implemented.

References: EN-619

NRC Inspection Results: The NRC staff concurs that verification of access problems can be determined only after correct restraint location and installation procedures have been finalized. This area will be reviewed at a later date as part of the licensing review. See related findings in Quadrex Finding Section 4.9. See Appendix A, also.

For purposes of the Quadrex Report review, this item is considered closed.

Quadrex Finding No.: 4.7.3.2(o)

The requirement for seismic support of non-safety high energy piping in the MAB appears to be adversely compromising equipment accessibility (see Question P-29).

Licensee Action: Resolved

The conservative seismic treatment of nonsafety-related equipment is not an untried nor/uncommon approach. Problems inherent in such an approach, e.g. cost, access, etc., are also common whenever conservative design philosophies are implemented. Programs are usually put in place to minimize these problems. Bechtel's recommendations for a program are presented in Section 6.0 of EN-601 Work Package. Included in this program are features to attempt to provide the best match between simplified design and construction practices versus minimized cost and accessibility problems. Bechtel will follow the approach recommended in EN-601; i.e, nonsafety-related piping shall be supported seismically in seismic category I buildings. Exceptions to this rule will be taken when equipment accessibility is a problem. Such cases will be evaluated on a case-by-case basis.

References: EN-601, 619

NRC Inspection Results: Bechtel's approach is acceptable to the staff reviewer. However, whenever no seismic supports are used, failure analyses of the related piping is required. Further evaluation will be performed during the FSAR review. See Appendix A.

For purposes of the Quadrex Report review, this item is considered closed.

Quadrex Finding No.: 4.7.3.3(p)

Allowable valve acceleration limits, 2.1g, are too low and will result in excessive restraints (see Question P-8).

Licensee Action: Resolved

It is our opinion that because the plant site is in a very low seismic zone, the limits will not create any excessive restraints. Furthermore, Quadrex stated that they did not identify any area where the piping system had any excessive number of supports in order to accommodate the STP allowable valve accelerations.

References: EN-619

NRC Inspection Results: This does not appear to be a problem. The resolution is acceptable to the staff reviewer.

This item is considered closed.

Quadrex Finding No.: 4.7.3.3(q)

No tolerances are define for restraint orientation, and a more definitive criterion is needed for re-analysis of piping systems for small changes in equipment weights, wall thickness, or routing (see Question P-22).

Licensee Action: Resolved

Pipe restraints will be installed as per tolerances given in "Piping Stress Analysis Criteria" and "Pipe Support Field Fabrication and Installation Specification." Bechtel will evaluate these small changes by engineering judgment for their significance on completed analysis. If significant impact is judged, then reanalysis will be performed. Otherwise, changes will be noted and will be considered in the final as-built analysis. More definitive criteria will not be adopted.

References: EN-619

NRC Inspection Results: The resolution is considered adequate to the staff reviewer. Further evaluation if required, will be performed during the FSAR review. See Appendix A.

For purpose of the Quadrex Report review, this item is closed.

Quadrex Finding No.: 4.7.3.4(r)

B&R indicated that very little dynamic analysis had been accomplished thus far on major piping systems (see Question P-6).

Licensee Action: Resolved

Dynamic analysis may be performed in selected cases to reduce the overconservatism in support loads which is generally obtained by performing static analysis. As stated in response to 4.7.3.1(c), computer analysis will be performed as the design evolves.

References: EN-619

NRC Inspection Results: Refer also to finding 4.7.3.1(c). The resolution is considered adequate by the staff reviewer. Details of the dynamic analysis will be provided in the FSAR update.

This item is considered closed.

Quadrex Finding No.: 4.7.3.4(s)

B&R was unable to provide documentation outlining their bases for selecting valve end loads (see Question P-6).

Licensee Action: Resolved

B&R's selection of valve end loads was based on an industry survey. These loads were included in the specifications for procurement. This approach was reasonable. Bechtel (PSSG) will follow manufacturer's valve specifications to select valve end loads.

References: EN-619

NRC Inspection Results: This technique for selecting valve end loads is considered appropriate and adequate.

This item is considered closed.

Quadrex Finding No.: 4.7.3.4(t)

B&R has not documented how relative displacements will be analyzed (see Question P-7).

Licensee Action: Resolved

Bechtel (PSSG) will follow controlled document "Piping Stress Analysis Criteria" (5N190RQ001) for relative displacement procedure.

Reference: EN-619

NRC Inspection Results: B&R's document 5N190RQ001 has been superceded by Bechtel's document 5N190RQ1002. The finding is acceptable based on the adequacy of the procedure.

This item is considered closed.

Quadrex Finding No.: 4.7.3.4(u)

More formal documentation should be prepared for support stiffness values used in piping analyses (see Question P-12).

Licensee Action: Resolved

Bechtel will follow controlled documents such as Pipe Support Design Manual, STP Addendum, and Piping Stress Analysis Criteria for support stiffness values.

References: EN-619

RC Inspection Results: Specific support stiffness values were found by the staff reviewer in Appendix A of the Pipe Support Design Manual, Document 5L010RQ1002.

This item is considered closed.

Quadrex Finding No.: 4.7.3.4(v)

An inconsistency in the treatment of SSE SAM displacements was noted between the B&R responses (see Questions P-7 and P-18).

Licensee Action: Resolved

The approach taken by B&R was more conservative.

Bechtel (PSSG) will follow "Piping Stress Analysis Criteria" which states that SSE SAM (Seismic Anchor Motion) load shall be considered in support design in faulted condition.

References: EN-619

NRC Inspection Results: See finding 4.7.3.1(h)

This item is considered closed.

Quadrex Finding No.: 4.7.3.4(w)

Formal documentation of B&R's Stress Group design process and practices were not evident (see Question P-19).

Licensee Action: Resolved

Bechtel (PSSG) will follow controlled document "Piping Stress Analysis Criteria" to perform stress analysis of piping systems.

References: EN-619

NRC Inspection Results: B&R's activities are no longer an issue. Bechtel's document 5L010RQ1002 (Rev. Q, 8/9/82), Piping Stress Analysis Criteria, was utilized and adequately resolves this finding.

This item is considered closed.

Quadrex Finding No.: 4.7.3.4(x)

Support self weight excitation has not been considered (see Question P-32).

Licensee Action: Resolved

For a low seismic activity area, such as STP, consideration of self-weight excitation is not a requirement. In addition, support design on STP have to meet stiffness requirements provided in B&R's Piping Stress Analysis Criteria (5N170RQ001). The stiffness requirements assure support natural frequencies to be high enough to put them beyond the peak region of the building seismic response spectra. This will reduce the effect of self-weight excitation, and make it insignificant.

References: EN-619

NRC Inspection Results: The resolution is adequate. Per Bechtel's evaluation, support self-weight excitation is not significant in low seismic activity areas such as South Texas. The staff reviewer agreed.

This item is considered closed.

Quadrex Finding No.: 4.7.3.4 (y)

The proper ASME NF weld classification for pipe support interfaces should be re-examined (see Question P-36).

Licensee Action: Resolved

Bechtel will use only linear type supports on STP. Linear attachment welds criteria will be used from the "Pipe Support Design Manual, STP Addendum" (STP/PSM).

The Bechtel Pipe Support Design Manual (PSM-1) does not allow plate and shell type supports. For designs done by B&R, EDS, and NPSI, the attachment welds will be reviewed and reclassified as linear type welds, if required. The Bechtel pipe support design criteria complies with ASME NF.

References: EP-701

NRC Inspection Results: The proposed solution is adequate based on requirements of the Pipe Support Design Manual and the review of designs done by B&R, EDS, and NPSI.

This item is considered closed.

4.8 RADIOLOGICAL CONTROL FINDINGS

4.8 RADIOLOGICAL CONTROL FINDINGS SUMMARY

The Radiological Controls findings centered on those related to specific features of plant design that would have an effect on radiation exposure to plant personnel and the offsite population. The review by Quadrex included the ALARA program, shielding, radiation monitoring systems, HVAC systems, containment and buildup of radioactive materials, and decontamination.

Quadrex concluded that the B&R Radiological Control design program was not adequate. General design criteria were found to be adequate, but appropriateness of design inputs were questioned. Some design inputs (transient and accident conditions) were limited and sporadic.

There were 38 findings identified in the Radiological Controls area. Fourteen of these findings are scheduled for rereview at a later time (See Appendix A). Two findings (4.8.2.1(a) and 4.8.2.1(d)) were reported as a potential 50.55(e) matters. The former was reported on March 16, 1982, and the latter on May 8, 1982. All Quadrex findings in this area have been adequately resolved, and for purposes of the Quadrex Report review are considered closed.

Quadrex Finding No.: 4.8.2.1(a)

The instrument air piping, between the valves actuated by redundant radiation monitors and the valves that divert air flow through safety-related filter trains in the FHB HVAC exhaust subsystem, does not meet the single failure criterion (see Question R-6).

Licensee Action: Resolved

Deficiency Evaluation Report 82-001, Section IV, states that the safety of operation is not adversely affected and the final design of installation details is not approved nor released for construction. The DER also concludes that the design configuration is not reportable per 10 CFR 50.55(e). Further, design changes were made by B&R to eliminate any further concerns. A review of all safety-related P&ID's for application of the single failure criterion to instrument air lines was conducted. Based on this review it was concluded that the finding is not generic nor is it a significant safety issue.

References: Deficiency Evaluation Report (DER) 82-001

NRC Inspection Results: This item is also discussed in 4.3.2.1(a). A potential 50.55(e) report was made on March 16, 1982. Later HL&P determined it was not reportable. HL&P's DER 82-001, which documented the evaluation of the potential 50.55(e) report, was reviewed by the staff inspector. It was found to contain evaluation statements as indicated in the above Bechtel resolution.

This item is considered closed for purposes of the Quadrex Report review, however, the potential 50.55(e) report will be closed by RIV.

Quadrex Finding No.: 4.8.2.1(b)

(1) No procedures exist that define the minimum qualification requirements for ALARA reviewers. (2) Some design drawings have been reviewed and signed off for ALARA. There is limited evidence that proper follow-up has occurred to verify incorporation of ALARA specified designs (see Question R-1).

Licensee Action: (1) Resolved (2) Dispositioned

(1) No regulatory requirements specify that the minimum qualification for ALARA reviewers must be defined and documented. Bechtel has developed ALARA design implementation, review guides and check lists for use by ALARA reviewers which provide the basis for project specific implementation. In addition, HL&P has developed an ALARA Training Program which is being used by Bechtel to train ALARA reviewers. The selection of ALARA reviewers is made by the Engineering Group Supervisors.

(2) Findings of the B&R/HL&P re-reviews will be evaluated and closed out as part of the normal ongoing ALARA review, as will be documented in the STP Project Engineering Directive on ALARA. Results of completed B&R/HL&P re-reviews will be developed during the normal course of ongoing work.

References: EN 603; PED 011

NRC Inspection Results: (Note: This finding contained two line items.) Bechtel's Project Engineering Directive (PED 011, Revision 0, August 31, 1982) "ALARA Directive" has been issued. It defined the procedures to be followed for the STP ALARA review. HL&P's "ALARA Design Review Manual" has been reviewed and accepted by Bechtel. The ALARA training program has been instituted. This program was reviewed by the staff inspector and discussed with responsible HL&P/Bechtel personnel. Bechtel personnel have received required ALARA training. The overall ALARA program will be reviewed at a later time. See Appendix A.

This item is considered closed.

Quadrex Finding No.: 4.8.2.1(c)

Modification of the MAB HVAC system to eliminate filter media needs to be reexamined (see Questions R-5 and R-29).

Licensee Action: Dispositioned

Although the current design meets Appendix I, Bechtel is evaluating the filter system requirements based on recent NRC recommendations. EN-600 and ongoing work will provide reviews of dose calculations during the normal course of design evolution. Resolution will be provided upon completion of evaluation of filter system requirements. See the Work Package Action Item List.

References: EM-552; 603

NRC Inspection Results: The current design meets 10 CFR Part 50 Appendix I. However, Bechtel is performing an evaluation of the filter system requirements based on radiological dose calculations. Dependent on the results of this evaluation, Bechtel Mechanical will determine the technical necessity for MAB HVAC filters. This issue was included in the Action Item List. The outcome of this evaluation will be reviewed at a later time as part of the licensing review. See Appendix A.

For purposes of the Quadrex Report review, this item is considered closed.

Quadrex Finding No.: 4.8.2.1(d)

B&R's position that shielding calculations are not safety-related needs to be re-examined (see Question R-7). Several shielding analyses were performed by NUS; however, there is no indication that B&R has verified this work. Standard models and codes have been used in analyses performed by B&R, yet B&R exhibited a lack of familiarity with and understanding of the codes. A re-review of plant shielding is necessary to ensure that analysis results are properly reflected in design (see Questions R-11, R-12, and R-14).

Licensee Action: Resolved (Four line items are included in this finding.)

(Line Item 270) All calculations are created with the same degree of concern and care; i.e., all calculations are treated as though they are safety-related. All previous calculations by B&R are being reviewed to assure adequacy and accuracy in accordance with BPC's program to finalize B&R calculations. See Appendix E of EN-619. EDP Procedures EDP-4.34, 4.36, 4.37, and 4.43 are used for reviewing, checking, and verifying computer programs and calculations.

(Line Item 271) Verification of the NUS analyses is not required. Also, NUS-performed shielding calculations are generally of a preliminary, PSAR nature which, for the most part, have been superseded by later B&R calculations. Where this is not the case, items will be addressed or verification calculations performed in accordance with Bechtel EDP 4.37. In either case, a comparison of calculation models and source terms with present design (or as-built) values will be performed.

(Line Item 272) The finding is not supported. A review of the RHR and VCT shielding models used by B&R does show familiarity by B&R analysts with models used for QAD-PSA or QAD-CYL. Further, the finding is no longer relevant since B&R is no longer involved in STP analyses. BPC will review past analyses for adequacy (see line item 270 above).

(Line Item 273) The review of plant shielding was the purpose of Work Package EN-603. Results of the review indicate that the bulk shielding is adequate. The required ongoing work of review, analyses and calculations will be performed in accordance with EDP 2.13, 2.16, 4.25, 4.26, 4.27, 4.36, and 4.37.

References: See finding 4.2.2.1(a) and 4.2.2.1(b)

NRC Inspection Results: See finding 4.2.2.1(a) and (b). The resolution were considered adequate. This item was (line 2.7.3) reported as a potential 50.55(e) item on May 8, 1981. Subsequently, HL&P considered the finding was not reportable.

This item is considered closed for purposes of the Quadrex Report review. However, Region IV will verify the potential 50.55(e) report on a later date.

Quadrex Finding No.: 4.8.2.1(e)

B&R has not correlated radiation zones to the shielding design and shielding design has not adequately considered ISI requirements or the potential locations for temporary shielding (see Question R-10).

Licensee Action: Dispositioned

A general review will be performed for the radiation zone drawings in TRD A509NQ005. The application of the radiation zones and discussion of access requirements, including ISI, will be presented in each calculation. Anticipated operational modes other than normal power operations will be explicitly considered and/or identified. Resolution will be provided upon issuance of revised Radiation Zone Drawings. See the Work Package Action Item List.

References: TRD 9A509NQ005-C; EN-603

NRC Inspection Results: It was verified by the staff reviewer that Bechtel will use revised source terms specifically for SfP for reviewing and revising the radiation zone drawings in TRD A509NQ005. The application of the radiation zones, and discussion of access requirements, will be presented in each calculation. These calcuations will take into account operational modes other than normal power operations. This issue was dispositioned pending issuance of revised Radiation Zone Drawings. This finding will be reexained at a later time as part of the licensing review. See Appendix A.

For purposes of the Quadrex Report review, this item is considered closed.

Quadrex Finding No.: 4.8.2.1(f)

Radiation zone drawings based on accident conditions have not been prepared (see Question R-30).

Licensee Action: Dispositioned

Post-accident (EN-607) radiation zones will be developed for the entire plant in response to NUREG-0737 recommendations. Radiation zone drawings will be revised. See also 4.8.2.4(s). Resolution will be provided upon issuance of revised Radiation Zone Drawings.

References: EN-603; 607

NRC Inspection Results: Using accident source terms, Bechtel will revise the radiation zone drawings to indicate post-accident radiation zones. See finding for 4.8.2.4(s) for detailed information. This finding will be reexained as part of the licensing review. See Appendix A.

This item is considered closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.8.2.1(g)

A design basis governing removable concrete block walls was not evident (see Question R-11).

Licensee Action: Resolved

A design basis governing removable concrete block walls will be developed as part of the normal plant design effort. This work will consist of developing criteria in EN-603 to assure that the following concerns are addressed:

1. Radiation streaming at wall joints.
2. Hazards analysis.
3. Maintenance considerations.
4. ALARA review.
5. Structural design.

References: EC-103; EN-603

NRC Inspection Results: Bechtel agreed with this Quadrex finding. TRD 9A909NQ005-C (paragraph 4.2.2.6) defined that "removable shielding" is equivalent to "removable block walls." This TRD is to be superceded by an equivalent Bechtel design document. See 4.8.2.2(1) for additional information. The resolution is acceptable to the staff reviewer.

This item is considered closed.

Quadrex Finding No.: 4.8.2.2(h)

No guidelines or procedures exist on how to develop the ALARA review document list. Procedure STP-DC-016-C, used as a B&R guideline document for ALARA review, is very general and superficial in nature. This document needs to be revised to include more in-depth review requirements and guidelines for specific structures, systems, and component design drawings. Sections 5 through 8 of the HL&P ALARA Design Review Manual provides identification of pertinent ALARA review items.

Licensee Action: Resolved

This description of review requirements for structures, systems, and components will be outlined in the STP Project Engineering Directive on ALARA. Work Package EN-607 addresses the concerns relative to post-accident conditions.

Resolution was provided by issuance of the STP Directive on ALARA.

References: EN 603; PED 011

NRC Inspection Results: The directive on ALARA (PED 011) has been issued. It was confirmed that PED 011 contains adequate review requirements for structures, systems, and components. The ALARA review is an ongoing effort. See also finding 4.8.2.1(b).

This item is considered closed.

Quadrex Finding No.: 4.8.2.2(i)

B&R reviews of plant design from an ALARA viewpoint have not been adequate (see Questions R-1 and R-2).

Licensee Action: Resolved

The re-reviewed ALARA program initiated by B&R/HL&P addressed this lack of previous ALARA considerations. Bechtel will continue an ALARA program as an ongoing effort.

References: EN 603

NRC Inspection Results: See finding 4.8.2.1(b) and 4.8.2.2(h).

This item is considered closed.

Quadrex Finding No.: 4.8.2.2(j)

Sufficient evidence was not provided by B&R to indicate that maintenance, test, and inspection requirements have been incorporated from an ALARA standpoint. During a review of the STP model, several layout and design features were observed which will likely compromise these activities. Some of these problems included improper orientation of valves, very restrictive access for maintenance on piping, valves, and other components, potential crud traps in piping and valves, radiation streaming through penetrations, etc. (see Questions R-2 and R-9).

Licensee Action: Resolved

The B&R/HL&P re-review program is adequate and has addressed these ALARA concerns and the ongoing Bechtel program will continue this effort.

References: EN-603

NRC Inspection Results: The ALARA Design Review manual and the ALARA Directive addresses maintenance, test, and inspection requirements. See finding 4.8.2.2(h)

This item is considered closed.

Quadrex Finding No.: 4.8.2.2(k)

There is no documented basis for locating electrical outlets, breathing air connections or lighting (see Question R-9).

Licensee Action: Resolved

These are specifically addressed in the STP Project Engineering Directive on ALARA.

References: EN-603

NRC Inspection Results: The staff reviewer confirmed that the STP ALARA Directive contained requirements for locating electrical outlets, breathing air connections and lighting. See finding 4.8.2.1(b).

This item is considered closed.

Quadrex Finding No.: 4.8.2.2(1)

The radiation shielding TRD does not address the use of removable shielding (see Question R-11).

Licensee Action: Resolved

Bechtel has design guidance that specifically addresses design for use of removable shielding.

References: EN-603

NRC Inspection Results: Bechtel will develop a design basis governing removable concrete block wall shielding as part of the normal plant design effort. The "concrete equivalency of block walls for shielding" is addressed in Bechtel's Nuclear Standard of ALARA and in Bechtel's ALARA Directive. See finding 4.8.2.1(g).

This finding is closed.

Quadrex Finding No.: 4.8.2.2(m)

(1) An identification of radioactive piping outside containment was not evident (see Question R-12). (2) Verification that radioactive piping is properly routed through pipe chases is necessary (see Question R-10).

Licensee Action: Resolved

(Line Item 282) Generally, a list of radioactive piping outside the containment is not generated; however, marked up P&IDs will be issued as a normal course of design evolution.

(Line Item 283) This is addressed in the STP Project Engineering Directive on ALARA.

References: EN-603

NRC Inspection Results: (This finding is addressed as two line items.) Radioactive piping ALARA considerations for identification and piping routing were covered in the ALARA Directive as confirmed by the staff reviewer. The resolution was acceptable.

This finding is considered closed.

Quadrex Finding No.: 4.8.2.2(n)

Criteria for streaming through shield penetrations do not appear to have been implemented (see Questions R-7 and R-13).

Licensee Action: Resolved

TRD AS09NQ005 will be superseded and implemented on STP in accordance with EDP-4.1 as part of the normal plant design effort.

See evaluation for 4.8.2.1(g). Criteria will be developed as part of the normal plant design effort.

References: EN-603

NRC Inspection Results: Shield penetrations are included in the ALARA Directive. See finding 4.8.2.1(g) and 4.8.2.2(j).

This item is considered closed.

Quadrex Finding No.: 4.8.2.2(o)

There is no evidence that a thorough design review relative to crud buildup has been conducted (see Question R-15).

Licensee Action: Resolved

Crud buildup has been addressed in the re-review program of B&R/HL&P and will continue to be a consideration in the ongoing ALARA review program. The concern is also addressed by the STP Project Engineering Directive on ALARA which will be issued.

References: EN-603

NRC Inspection Results: The ALARA directive has been issued. Review for crud buildup is included. This was confirmed by the staff reviewer.

This item is considered closed.

Quadrex Finding No.: 4.8.2.3(p)

Area Radiation Monitoring humidity conditions were not addressed in the specification, and will require a revised qualification program (see Question R-19).

Licensee Action: Resolved

Section 3.1 of the Radiation Monitoring System Specification identifies environmental conditions including humidity. A revision to the specification will be required to address environmental conditions for post accident monitoring resulting from post-TMI criteria. Work package EN 604 provides for the review of specifications and modifications required to adequately address environmental qualification.

References: EJ 306; EN 604

NRC Inspection Results: Radiation monitor environmental conditions, including humidity, were listed in Section 3.1 of the Radiation Monitoring System specification. This specification will be revised, to include environmental conditions for post accident monitors resulting from post-TMI criteria (as specified in Regulatory Guide 1.97). The resolution is acceptable to the staff reviewer.

This finding is considered closed.

Quadrex Finding No.: 4.8.2.4(q)

Radiation monitor calibration and alarm set-point considerations have not been adequately addressed (see Question R-3).

Licensee Action: Resolved

Alarm setpoints should be established at a later date when more plant data and information is available. This area is normally addressed during the preparation of the final plant technical specifications.

References: EJ-306

NRC Inspection Results: The radiation monitor calibration and alarm set-point considerations were addressed during the preparation of final plant technical specifications. These areas will be reviewed at a later date when more plant data and information is available as part of the licensing review. See finding 4.8.2.2(ff)

This issue is closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.9.2.4(r)

An alternative guideline to the dollar/man-rem value has not been developed (see Question R-3).

Licensee Action: Resolved

There is no regulatory requirement to use a dollar/man-rem criterion for evaluating in-plant ALARA design features. Additionally, no industry-wide methodology for evaluation currently exists. Engineering judgment will be used based on Regulatory Guide 8.8.

References: EI 603; Bechtel ALARA Directive; HL&P ALARA Design Review Manual

NRC Inspection Results: There is no regulatory requirement to use a dollar/man-rem criterion for evaluating in-plant ALARA design features. HL&P has performed re-reviews on many systems using an ALARA procedure which is consistent with the guidelines of Regulatory Guide 8.8. Bechtel will perform an ALARA review on any system which has not been reviewed against HL&P's current ALARA procedure. Bechtel will resolve all outstanding findings from the ALARA reviews in the Phase B effort. See finding 4.8.2.1(a).

This item is considered closed.

Quadrex Finding No.: 4.8.2.4(s)

No evidence was provided to indicate that specific plant modes and environmental conditions were systematically incorporated in design. Some limited effort has been performed on the RHR system; however, there is no evidence to indicate that the analysis was properly incorporated in the review (see Question R-4). Documentation outlining plant tour assumptions was not evident (see Question R-10).

Licensee Action: Dispositioned

A general shielding review will be performed and radiation zone drawings revised. Work Package EN 607 addresses the concern relative to post-accident conditions. Resolution will be provided upon completion of review. Plant tour assumptions will be established and documented subsequent to radiation zone drawing review.

References: EN-603, 607

NRC Inspection Results: Using updated source terms, Bechtel will review and revise STP radiation zone drawings. These revised zone drawings will consider access requirements. For areas requiring post-accident access, accident source terms will be used to develop post-accident radiation zone drawings. Plant tour assumptions will be established and documented subsequent to the radiation zone drawing review. This item is on the Bechtel Action Item List. This area will be examined during the normal licensing review. See finding 4.8.2.4(f). See Appendix A.

This item is closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.8.2.4(t)

Maintenance of negative pressure conditions in areas of potential airborne contamination has not been adequately addressed (see Question R-5).

Licensee Action: Resolved

A program is in place to resolve this concern. Bechtel will be revising the design criteria and evaluating the B&R, NUS, and OPS calculations to this criteria. BPC will ensure that pressure conditions in areas of potential airborne contamination is adequately addressed. Identification of areas of potential airborne contamination is provided by the Radiation Zone Drawings.

References: EM 552; EN 603

NRC Inspection Results: A program is in place to resolve this concern, as discussed in 4.4.2.1(a).

This item is closed.

Quadrex Finding No.: 4.8.2.4(u)

Basic criteria for controlled temperatures in work areas under extended maintenance conditions have not been implemented (see Question R-5).

Licensee Action: Dispositioned

An assessment program is in place and Bechtel will be revising the design criteria and evaluating the B&R, NUS, and OPS calculations to this criteria. Resolution will be provided upon issuance of revised criteria.

References: EM-552

NRC Inspection Results: This item was verified to be on the Action Item List. See finding 4.4.2.1(a). An assessment program had been implemented for HVAC, which will resolve this finding.

This item is considered closed.

Quadrex Finding No.: 4.8.2.4(v)

FMEA's from a radiological safety standpoint have not been performed (see Question R-6).

Licensee Action: Resolved

There is no regulatory requirement for performing FMEA's strictly for radiological safety. Rather, FMEA's are performed to cover overall safety concerns, including radiological considerations, as applicable.

References: EJ-306, EN-601

NRC Inspection Results: As stated, there is no NRC requirement. The STP program for FMEA's was addressed in EN-601, System Interaction and Integration. See finding 4.3.2.1(a)

This item is closed.

Quadrex Finding No.: 4.8.2.4(w)

B&R has not evaluated filter units for ease of access and minimizing exposures. There is no evidence of a B&R review of an NUS report on shielding of HEPA filters (see Question R-8).

Licensee Action: Dispositioned

The continuing ALARA program which includes access considerations is addressed in the STP Project Engineering Directive on ALARA. The NUS Report on shielding of HEPA fiters, STP-SA-A73, will be reviewed. Resolution will be provided upon completion of review of NUS report.

References: EN-603

NRC Inspection Results: The staff reviewer confirmed that the ALARA Directive includes filter units. This finding is on the Action Item List. The NUS report will be evaluated by Bechtel. The disposition was adequate to resolve the finding.

This finding is considered closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.8.2.4(x)

The Zone 1 radiation criteria may be overly conservative (see Question R-10).

Licensee Action: Resolved

This position is more conservative than that of many other Bechtel plants, was established by HL&P, reviewed and accepted by the NRC and is thus acceptable; however, Bechtel has recommended less restrictive criteria.

References: EN-603; TRD 9A509NQ005

NRC Inspection Results: B&R's Zone 1 radiation criteria of 0.25 mr/hr has been reviewed and accepted by the NRC. Bechtel considers this to be overly conservative and stated that a Zone I designation of 0.5 mr/hr would be allowable. This area will be examined as part of the licensing review. See Appendix A.

This issue is closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.8.2.4(y)

Evidence of the interfacing of shielding analyses through the Structural Group and into construction drawings was insufficient (see Question R-11).

Licensee Action: Resolved

The implementation of shield wall thickness requirements is the responsibility of the Civil/Structural Group. Nuclear will provide markup drawings for Civil to use in verification. Engineering department procedure EDP 2.16 Section 3.5.1d(3) provides for construction drawings to reflect shielding analyses input.

References: EN-603, 619

NRC Inspection Results: The staff reviewer confirmed that EDP-2.16 assigned appropriate responsibility for input to construction drawings for shielding.

This item is considered closed.

Quadrex Finding No.: 4.8.2.4(z)

Use of the proper source term for pipe chases should be verified (see Question R-12).

Licensee Action: Dispositioned

Source terms used for shielding are not consistently taken from TRD A509NQ005 and this TRD is out of date. Revised source terms have been obtained from Westinghouse and are currently being reviewed. Resolution will be provided upon issuance of superseded TRD.

References: EN-603

NRC Inspection Results: This item is included in the Action Item List. Disposition is considered adequate based on the planned action for review and subsequent issue of revised source terms. This finding will be reexamined at a later time as part of the licensing review. See finding 4.8.2.1(e) and Appendix A.

This item is closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.8.2.4(aa)

B&R review of NUS analyses was not evident (see Questions R-12 and R-14).

Licensee Action: Resolved

Where the NUS calculations are not superseded by B&R calculations, they will be addressed in accordance with Bechtel Procedure EDP 3.37. All calculations are being reviewed and statused by Bechtel during the STP transition.

References: EN-603

NRC Inspection Results: See 4.2.2.1(a)

This item is closed.

Quadrex Finding No.: 4.8.2.4(bb)

Adequacy of plugs, hatches and covers should be re-examined and verified (see Question R-17).

Licensee Action: Dispositioned

Criteria will be superseded by Bechtel design criteria and implemented on STP. The adequacy of plugs, hatches, and covers for shielding will be assessed as part of the shielding review of penetrations. Resolution will be provided upon issuance of Bechtel design criteria.

References: EN 603

NRC Inspection Results: Review of plugs, hatches and covers is required in the ALARA Directive. This item has been included in the Action Item List as confirmed by the staff reviewer.

This item is considered closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.8.2.4(cc)

No documented basis exists for selection of the range of a given Area Radiation Monitor (see Question R-19). B&R has not reviewed the criticality monitors to assure that all of the design requirements specified in 10 CFR 70.24 have been met.

Licensee Action: Resolved

The ranges of the Area Radiation Monitors are noted in the FSAR (Table 12.3.2-1). These ranges have been reviewed and accepted by the NRC and documentation of a basis for their selection is not required. Some ranges are being changed. ANSI/ANS-NPSSC 6.81 - 1981 was used for guidance on the review of the area radiation monitors. The design intent of the regulations 10 CFR 70.24 is met by the criticality monitors. However, the calculations associated with these monitors need to be redone in Phase B.

References: EJ-306

NRC Inspection Results: Bechtel has stated that ranges for the area radiation monitors will be verified in Phase B. The design intent of the criticality monitors at STP meets the criteria of 10 CFR 70.24. However, the calculations associated with these monitors (such as monitor alarm set points) will be redone in Phase B of the transition program. The resolution is acceptable to the staff reviewer.

This finding is closed.

Quadrex Finding No.: 4.8.2.4(dd)

An analysis of streaming through reach rod penetrations should be performed (see Question R-20).

Licensee Action: Resolved

Design analyses for typical penetration details are normally provided. Variations must be evaluated. Reach rod penetration streaming will be analyzed for each type of penetration and then reviewed for consistency with the ALARA program during the normal course of design evaluation.

References: EN-603; EDP-4.1; Shielding Calculation List

NRC Inspection Results: In accordance with EDP-4.1, Bechtel will provide revised criteria for streaming through shield penetrations and labyrinth entrances. Bechtel will then perform reach rod penetration streaming calculations for each type of penetration used at STP. The results of these calculations will be incorporated into the revised radiation zone drawings after being reviewed for consistency with the STP ALARA Directive. This resolution is acceptable to the staff reviewer. See finding 4.8.2.2(n).

This issue is considered closed.

Quadrex Finding No.: 4.8.2.4(ee)

B&R has not yet established how concerns regarding iodine plateout, and the location of probes in areas of uniform flow will be accomplished (see Questions R-22 and R-27).

Licensee Action: Resolved

This is an industry-wide concern, and using the guidance of ANSI N13.1-1969 is acceptable. Specific review of sampling system plateout must, of necessity, follow detailed layout.

References: EN-603; ALARA and Shielding Criteria

NRC Inspection Results: Bechtel will use the guidance of ANSI 13.1-1969 in locating probes in areas of uniform flow. This is an acceptable reference document. Specific review of sampling system plateout cannot be performed until a detailed layout of the sampling system is done.

This finding is considered closed.

Quadrex Finding No.: 4.8.2.4(ff)

Process and area radiation monitor provisions for detector replacement and in-situ calibration were not evident (see Question R-23).

Licensee Action: Dispositioned

Provisions for detector replacement and in-situ calibration require further evaluation in Phase B to assess adequacy. Calibration methods and procedures will be supplied by the radiation monitoring system vendor. Final monitor locations will take into account both calibration and replacement requirements. Resolution will be provided upon completion of evaluation.

References: EJ-306

NRC Inspection Results: This item is on the Action Item List. See related finding 4.8.2.4(cc). The planned disposition is acceptable to the staff reviewer.

This item is considered closed for purposes of the Quadrex Report review. However, it will be examined as part of the normal FSAR review. See Appendix A.

Quadrex Finding No.: 4.8.2.4(gg)

Qualification requirements, such as total integrated dose limits and durability, in purchase specifications should be reexamined (see Question R-25).

Licensee Action: Resolved

B&R had intended to re-examine the purchase specifications for equipment qualification requirements. A review of this type is included as a part of the Bechtel equipment qualification program. A task group is being formed with assigned responsibility for review of all safety-related equipment and the equipment environmental and seismic qualification programs. The group will provide a common basis for the review of all qualification programs and reports. The initial effort is to identify all safety-related equipment. Support will be provided to the group from the disciplines responsible for seismic response spectra, pressure, and temperature limits, and exposure to radiation, steam, and chemicals. The task group will determine the current qualification requirements for the project and review vendor qualification documents already submitted to determine if the vendor's qualification program is in compliance with the requirements for the project. For further equipment purchases, the specifications will be updated to reflect current environmental condition and qualification requirements. These task group efforts will provide consistency in the overall qualification review program. See 4.6.2.1(a). This activity is included as part of the Environmental Qualification Program.

References: EN-604

NRC Inspection Results: The program for equipment qualification will cover concerns expressed in the findings. See finding 4.6.2.1(a) and generic finding 3.1(b). The environmental program will be examined at a later date when the program has been completed as part of the licensing review. See Appendix A.

This item is considered closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.8.2.4(hh)

There is no evidence that all components requiring flushing and draining provisions have been considered (see Question R-28).

Licensee Action: Resolved

Flushing and draining provisions are normally incorporated as part of the ongoing design evolution of process systems using design criteria as guidance for location. Therefore, documented evidence of specific design decisions may not exist for all systems or components. The ALARA considerations will be addressed in the STP Project Engineering Directive on ALARA. The Work Package review plans, developed pursuant to the transition program procedure QE-002, includes consideration of flushing and draining provisions and are being evaluated during the transition program. For systems requiring flushing, design verification has been performed. Comments will be documented in Work Package Final Reports.

References: EN-603

NRC Inspection Results: Provisions for review of flushing and draining were contained in the ALARA Directive and the QE-002 Transition Program.

This finding is closed.

Quadrex Finding No.: 4.8.2.4(ii)

Adequacy of airborne contamination analyses should be addressed (see Question R-30).

Licensee Action: Dispositioned

Dose assessment calculations are currently being reviewed and results will be provided in Work Package EN-600. Resolution will be provided upon completion of review of calculations.

References: EN-603; ALARA and Shielding Criteria

NRC Inspection Results: This finding has been dispositioned and is on the Action Item List. After new air flow patterns are determined (See 4.8.2.4(t)), levels of airborne contamination will be determined. Dose assessment calculations to determine airborne activity levels will be reviewed and revised if necessary. The FSAR will be updated.

This finding is considered closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.8.2.4(jj)

A review should be performed to assure that curbs are provided wherever they are required (see Question R-26).

Licensee Action: Resolved

A review to assume curbs have been provided where necessary is incorporated in the ALARA review program.

References: EN-603

NRC Inspection Results: It was confirmed that the STP Directive on ALARA contained provisions to review for curbs.

This finding is closed.

Quadrex Finding No.: 4.8.2.4(kk)

No documented basis exists for the shield design of the counting room (see Question R-21).

Licensee Action: Dispositioned

No specific analyses for the counting room have been performed. This task will be initiated when shielding models have been compared to present design values. Resolution will be provided upon completion of analyses.

References: EN-603

NRC Inspection Results: This was a future task assigned to the AIL. It will be examined as part of the FSAR review at a later time. The disposition is adequate. This finding is considered closed for purposes of the Quadrex Report review. See Appendix A.

Quadrex Finding No.: 4.8.2.4(11)

Analysis of sump overflow is necessary (see Question R-24).

Licensee Action: Dispositioned

The action item referred to in the Bechtel Task Force response and the Quadrex assessment of Question R-24 has not been uncovered by an investigation by Bechtel and HL&P. Since it was discussed under the Radiological Control section, it is assumed the concern is about offsite dose from sump overflow, or occupational exposure (ALARA) from sump overflow. The rupture of large tanks in plant liquid waste systems would have a considerably larger effect than overflow of radwaste sumps and have been analyzed in FSAR Chapter 15. Provisions for control of contamination from sump overflow are addressed in the checklists for ALARA reviews both for control of the spread and subsequent cleanup of radiological contamination. See response to Finding 4.6.4.1(b), in which the response of Work Package EN-601 states that the adequacy of existing STP protection against internal flooding will be fully evaluated by Bechtel as discussed in Section 6 of the EN-601 Work Package Report. Resolution will be provided upon completion of EN-601 flooding evaluation.

References: EN-603, 601

NRC Inspection Results: This is a dispositioned item on the Action Item List. See findings 4.5.3.4(w) and 4.6.4.1(b). It will be reexamined at a later date. See Appendix A.

This item is considered to be closed for purposes of the Quadrex Report review.

4.9 IN-SERVICE INSPECTION AND MAINTENANCE ACCESS FINDINGS

4.9 IN-SERVICE INSPECTION AND MAINTENANCE ACCESS FINDINGS SUMMARY

The findings from this portion of the Quadrex Report concern a Technical Reference Document (TRD) 4U010PQ007-A and a review of the STP model with an examination for In-service Inspection (ISI) and access provisions. This was a special effort and not subject to the standard procedures followed for the other sections of the Quadrex Report.

Of the 23 ISI findings reviewed by the NRC inspector, four "dispositioned" findings have followup action indicated. All findings were satisfactorily closed with regard to the Quadrex Report review. See Appendix A.

Quadrex Finding No.: 4.9.1(a)

The B&R draft TRD contains an augmented ISI line list (Table I). All of the piping on this list is subject to 100% volumetric inspection of circumferential pipe welds exceeding one inch and longitudinal pipe welds sized four inches and lar . The draft TRD also contains the piping ISI boundary table (Appendix B) produced by Southwest Research (SWRI). Some lines, such as the Auxiliary feedwater lines, 4" AF-1005, 1006, and 1007, appear on the Table I list for 100% inspection and also on the piping boundary Table for exemption from inspection. As the Table I in the draft TRD appears to be the governing document, the piping ISI boundary table needs updating.

Licensee Action: Resolved

The TRD and ISI boundary tables have been superseded. Bechtel Specification 4U010PS007, Revision 0 provides the basis for design and construction requirements for ISI. Bechtel engineering shall be responsible for ISI access requirements, performance of the access program, and resolution of access problems. Table 1 (of B&R Draft TRD) was not the governing document. Both Table I and Appendix B were required, however the revised specification clarifies this issue.

References: Bechtel Specification 4U010PS007

NRC Inspection Results: The B&R documents have been superseded. Bechtel Specification 4U010PS007 is now the governing document for design and construction requirements for ISI. Bechtel engineering is responsible for ISI access requirements, performance of the access program, and resolution of access problems. Access requirements for ISI, maintenance, and ALARA are addressed in the evaluations for Findings 4.5.2.2(e), 4.8.2.1(b), and 4.5.3.2(1). The NRC reviewer agreed with Bechtel's resolution of this Quadrex concern.

This item is considered closed.

Quadrex Finding No.: 4.9.1(b)

Additionally, the draft TRD contains an access exception list (Appendix D) where access criteria have not been achieved. This exception list contains 414 welds on 213 spools. Some of these exceptions are close to meeting the criteria and some are not. A few lines shown on Table I for 100% ISI also appear on the exception list. For example, line 8" AF-1006 and line 30" MS-1003 are on both lists. This indicates that ISI may be difficult to perform due to reduced access.

Licensee Action: Resolved

The exception list was a preliminary list and has been deleted from the TRD. See Bechtel Specification 44010PS007, Revision 0. The exception list is an intermediate list only, and indicates where possible problems at various welds could exist. After evaluations are performed, a Special Problems List will be developed and the exception list eliminated. The Special Problems List will be developed during the normal course of design evolution to indicate problem areas that should be verified and resolved by the NDE contractor.

References: Bechtel Specification 4U010PS007

NRC Inspection Results: The NRC reviewer agreed with Bechtel/HL&P's resolution of this finding. See finding 4.9.1(a), 4.9.1(c), and 4.9.1(d). Action as indicated above will be monitored as a result of the general followup required for Section 4.9. See Appendix A.

This finding is considered closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.9.1(c)

There are a few minor problems with the draft TRD for ISI as follows:

(1) Special problems list (Appendix E) has not been included in the draft.

(2) The ISI engineer is to approve exceptions on page 7, second paragraph and to receive certification documents for the Ultrasonic (UT) calibration blocks; however, it is not clear who he is and where he is located.

Licensee Action: Resolved

The Special Problems List is a working list to be developed during the normal course of design evolution. This list will indicate expected problems with 100% volumetric examination, but actual determinations are to be made by walkdowns of the piping systems and resolution provided by the NDE contractor. (HL&P stated that the ISI engineer was located at the Crest Park facility.)

References: None

NRC Inspection Results: The NRC reviewer agreed with Bechtel's/HL&P resolution. The draft TRD is addressed in Finding 4.9.2(b). The status/location of the ISI engineer is no longer an issue.

This finding is considered closed.

Quadrex Finding No.: 4.9.1(d)

On the main steam line 30" MS-1001-GA2, support MS-1001-SS-05 appears to cover the weld or welds noted on the augmented list Table I for 100% inspection. If the support cannot be relocated, perhaps some maintenance access engineering could be performed to permit timely temporary removal of the support for ISI.

Licensee Action: Dispositioned

An evaluation will be made to determine if the support should be moved or made removable in order to allow for ISI. Resolution will be provided upon completion of review.

References: EN-619 (Action Item List)

NRC Inspection Results: This dispositioned finding will be tracked until final resolution is obtained. Progress is being monitored by the Nuclear Licensing Group. The NRC inspector agreed with the proposed action by the AE. Followup action will be taken.

For purpose of the Quadrex Report review, this item is considered closed.

Quadrex Finding No.: 4.9.2 (Volume 1, Page 4-94 and 4-95)

Review of the maintenance access engineering consisted of examination of the scale models, review of various plan and elevation drawings, and discussions with several HL&P engineers. Examination of the model indicated considerable effort early in the project to engineer maintenance access. However, as the design progressed, other priorities were given preference and maintenance space was reduced due to subsequently located components. For example, both Residual Heat Removal (RHR) heat exchangers 1A and 1B originally had space for unrestricted overhead tube bundle removal. A major main steam line pipe restraint structure now partially restricts tube bundle removal on exchanger 1A. Also, valve RH-060B on line 12" RC-1212 BBI has been located such that complete dismantling of the operator or removal of structural restraints appear necessary for valve maintenance. Space is severely limited around this valve.

Licensee Action: Dispositioned

Civil/Structural drawings 1-S-1667 and 1670 indicate that the structural restraint is removable for access to the RHR tube bundle. A review of the structural restraints will be performed to determine accessibility to valve RH-060B. Resolution will be provided upon completion of review.

References: EN-619 (Action Item List)

NRC Inspection Results: The NRC staff reviewer agreed with the proposed course of action.

For purposes of the Quadrex Report review, this item is considered closed. However, follow up review will be conducted to verify the specific resolution to these problems and the general progress of the ISI program. See Appendix A.

Quadrex Finding No.: 4.9.2(a)

One check valve on cold leg safety injection line 12" SI-1315-BBI has been located close to the main coolant loop tap whereas the other check valve is some distance away. Other similar taps into the main coolant loops have both check valves located some distance away. Both check valves should be located as near the main coolant loop as possible.

Licensee Action: Dispositioned

Plant design will evaluate the need to relocate check valve close to the main coolant loop. Resolution will be provided upon completion of review.

References: EN-619 Action Item List

NRC Inspection Results: The NRC reviewer concurred with AE's proposed resolution based on plans for evaluation of check valve's location.

This item is considered closed for purposes of the Quadrex Report review.

Quadrex Finding No.: 4.9.2(b)

Review of the pressurizer area indicated adequate room for removal of pressurizer heater elements and engineered space for work on the valve located at the top of the pressurizer. However, the concrete plugs in the pressurizer doghouse are located in the vertical wall rather than the roof which is usually preferred because it is much easier to remove heavy components with the polar crane. Personnel access to the top of the pressurizer is by ships ladder. If the roof plugs cannot be provided, a stiff leg or gin pole could be installed to permit lowering these pieces to the operating deck through the vertical wall opening. From our experience, the pressurizer relief and spray valves are high maintenance items.

Licensee Action: Dispositioned

The plugs in the vertical wall are intended to reduce blowdown pressure, not provide maintenance access. Valve movability will be reviewed during Phase B. Resolution will be provided upon completion of review.

References: EN-619

NRC Inspection Results: The NRC reviewer agreed with the proposed resolution of this item. The finding will be tracked and monitored by the Nuclear Licensing Group.

This item is considered closed.

Quadrex Finding No.: 4.9.2(c)

An aisle used for operator and maintenance access is severely restricted by pipe supports on a potable water line 3" PW-1002 in the M15A area as indicated by the model. A similar problem exists for the 4" EW-1303 line.

Licensee Action: Resolved

Having examined the model in area M15A, it appears that there is adequate aisle space for maintenance access.

References: EP-702, 703, 709

NRC Inspection Results: A review has been conducted and access was found to be adequate. The NRC reviewer concured in this resolution.

This item is closed.

Quadrex Finding No.: 4.9.2(d)

Maintenance and operator access problems will occur due to the elevated location of valves on line 3" WL-1206-W07 in area M15B. A similar problem is indicated in area M8B for vents on line 8" CC-1528-WA3.

Licensee Action: Resolved

Plant Design has reviewed subject valves and does not see a problem from a maintenance standpoint.

References: EP-702, 703, 709

NRC Inspection Results: This finding was reviewed under work packages EP-709, 702, and 703. It was determined by the staff reviewer that these are high point vents; access will be minimal; it is not a radiation area; and a ladder can be used to gain access.

The access is considered to be adequate. The NRC inspector agreed with Bechtel's conclusion.

This item is closed.

Quadrex Finding No.: 4.9.2(e)

The required maintenance on the component cooling pump coolers should be evaluated for space. From the model, space appears adequate for the motor rotor and impeller removal, but the cooler tube bundle pull space may be restricted.

Licensee Action: Resolved

A study for train separation is being done for the component cooling water pumps, and adequate space for maintenance and removal of the tube bundle will be supplied. Adequate space will be provided for actual plant components.

References: EP-702, 703, 709

NRC Inspection Results: The NRC reviewer agreed with BPC resolution of the finding. This is not a safety concern.

This item is considered closed.

Quadrex Finding No.: 4.9.2(f)

The area over the canned RHR pumps did not show facilities for pump removal and/or inspection on the model. The model was "cut" at this point, so detailed examination was not possible. We highly recommend overhead facilities for pump dismantling.

Licensee Action: Resolved

A monorail is located above the RHR pump for dismantling. See Drawing No. 1-N-5002.

References: EP-702, 703, 709

NRC Inspection Results: The monorail exists.

This item is closed.

Quadrex Finding No.: 4.9.2(g)

The pressurizer relief tank top access covers appear to have an overhead obstruction in the immediate vicinity. A minimum 2 foot clear area is recommended for removal of the covers.

Licensee Action: Dispositioned

An evaluation will be made to determine if the overhead obstruction should be deleted in order to facilitate removal of relief tank access covers. Resolution will be provided upon completion of evaluation.

References: EP-709

NRC Inspection Results: The NRC reviewer agreed with the proposed resolution.

For purposes of the Quadrex Report review, this item is considered closed.

Quadrex Finding No.: 4.9.2(h)

A 3" valve in line 3" RC-1106-BBI has very limited space for access. Valve stem removal may not be possible.

Licensee Action: Dispositioned

Plant Design will review the valve for access to remove valve stem and appropriate modifications will be made. Resolution will be provided upon completion of review.

References: EP-709

NRC Inspection Results: The NRC inspector agreed with the proposed action.

For purposes of the Quadrex Report review, this item is closed.

Quadrex Finding No.: 4.9.2(i)

Valve RH-019A on line 8 RH-110-BBI near RCP-1A has overhead obstruction. Valve stem removal may be a problem.

Licensee Action: Dispositioned

An evaluation will be made to determine if the valve should be relocated or obstruction removed. Resolution will be provided upon completion of evaluation.

References: None

NRC Inspection Results: The NRC staff reviewer agreed with the disposition.

For purposes of the Quadrex Report review, this item is closed.

Quadrex Finding No.: 4.9.2(j)

Reactor containment cooling fans located on elevation 52' have space restrictions for work on the motors and fans. Additionally, the access aisle getting to the fans is partially blocked.

Licensee Action: Dispositioned

Plant Design will review this problem in detail, and will interface with Mechanical to determine space requirements for maintenance of equipment. Plant Design will also interface with Electrical and Stress for relocation of cable trays and pipe supports. Resolution will be provided upon completion of review.

References: EM-555; EP-709

NRC Inspection Results: The NRC reviewer agreed with the proposed course of action.

For purposes of the Quadrex Report review, this item is considered closed.

Quadrex Finding No.: 4.9.2(k)

Some provision will be required to obtain access to the main steam valves located near the top of the steam generators

Licensee Action: Dispositioned

An evaluation will be made to determine if platforms should be provided for access to steam valves. Resolution will be provided upon completion of evaluation.

References: EP-709

NRC Inspection Results: The NRC inspector agreed with the proposed action.

For purposes of the Quadrex Report review, this item is considered closed.

Quadrex Finding No.: 4.9.2(1)

The model indicates that a structural member was notched to permit installation and/or maintenance of 2" CV-1144 on line 2" FW-1014-R3.

Licensee Action: Dispositioned

The structural member will be reviewed to assure adequacy. Resolution will be provided upon completion of review.

References: EN 619 (Action Item List)

NRC Inspection Results: The NRC reviewer agreed with the proposed course of action.

For purposes of the Quadrex Report review, this item is closed.

Quadrex Finding No.: 4.9.2(m)

Check valve SI-009C was tilted to a 45 degree angle on the model to permit maintenance access to the internals of the valve. Unless this is a special check valve, it will probably hang up during plant operation.

Licensee Action: Dispositioned

This problem will be resolved during Phase B of the transition program. The check valve will be repositioned and relocated, if required, to ensure proper operability. Resolution will be provided upon completion of review.

References: EP-709

NRC Inspection Results: The NRC reviewer agreed with the planned action. Resolution will be reviewed at a later date. See Appendix A.

For purposes of the Quadrex Report review, this item is considered closed.

Quadrex Finding No.: 4.9.2(n)

Check valve RC-047C has been installed upside down on the model. Again, overhead obstructions would not permit internal valve access and this valve will not function properly unless it is a special valve.

Licensee Action: Resolved

The valve listed by Quadrex does not exist on the model or in the composite drawings. In addition, no check valve was found on the model that was installed upside down.

References: EP-709

NRC Inspection Results: No check valve was found that was installed upside down when the reviewer inspected the model.

This item is closed.

Quadrex Finding No.: 4.9.2(o)

An HVAC duct is located under radwaste piping in the MEAB area on elevation 29'.

Licensee Action: Resolved

Plant Design will interface with HVAC and will resolve problems as required. There is no known criteria prohibiting the location of HVAC ducts under radwaste piping.

References: EP-702, 703, 709

NRC Inspection Results: The NRC reviewer agreed that there is no criteria prohibiting the location of HVAC ducts under radwaste piping.

This finding is closed.

Quadrex Finding No.: 4.9.2(p)

CV-517 is located over the HVAC duct and access appears to be difficult.

Licensee Action: Resolved

Plant Design has reviewed location and accessability to CV-517 and has found no problem.

References: EP-702, 703, 709

NRC Inspection Results: The NRC reviewer agreed that access is adequate.

This item is closed.

Quadrex Finding No.: 4.9.2(q)

It is difficult to determine precisely on the model, but it appears that numerous manual valve handwheels are blocked or are potential knuckle busters due to the close proximity of structural members.

Licensee Action: Resolved

Plant Design is aware of this potential problem and will resolve on a case-by-case basis.

References: None

NRC Inspection Results: The NRC reviewer agreed with Bechtel's action.

This item is closed.

Quadrex Finding No.: 4.9.2(r)

The reservoir makeup pumping structure is shown on drawing 9Y-50-0-H-4912-0. The bottom of the pump suction housing is shown at elevation -19 feet and the pump top flange is +21 feet for an overall length of 40 feet for the pump. However, the overhead crane hook will only rise 31 feet above the 21 foot elevation. Another ten or eleven feet on the crane structure would have permitted the pump to be pulled in one piece for maintenance and overhaul without the need for a portable crane. The circulating water pump structure on drawing 6-P-22-M-0029-2 appears to have the same situation. If a large portable crane was originally planned as onsite maintenance equipment, then the extra cost for the taller hoisting structures would not be worthwhile, unless of course, the portable crane access is restricted.

Licensee Action: Resolved

This issue involves maintenance and servicing problems of the reservoir makeup pump facility intake structure and circulating water intake structure crane. The hoisting structures are adequate because the preferred method is to disassemble the pump as it is hoisted rather than risk damage to the shaft by hoisting as a unit and laying it down in one piece.

References: EM-510

NRC Inspection Results: The NRC reviewer agreed with Bechtel's conclusion that the hoisting structures are adequate.

This item is closed.

Quadrex Finding No.: 4.9.2(s)

An excellent drawing has been prepared showing placement of all the dismantled turbine generator parts and the associated loading of the deck during TG overhaul.

Licensee Action: Resolved

This is not a negative issue. The drawing is excellent.

References: None

NRC Inspection Results: This is not an issue.

This item is closed.

Appendix A

List of Open Items

Appendix A

List of Open Items

This is a list of those Quadrex items that should receive final inspection/ verification for completions. They are listed by Quadrex paragraph number, finding title, and recommended assignment for final closing of the finding.

*Items dispositioned by Bechtel.

Quadrex Finding Number	Title	Close Out
3.1 Generic Findings		
3.1(h)	Equipment Reliability Requirements	RIV
4.1 Civil/Structural		
4.1.2.1(b)	C/S Data Evaluation - Missile	NRR
4.1.2.1(c)	SSE Analysis - TG Building	NRR
4.1.2.3(j)	Fuel Pool Design	RIV
4.1.2.3(m)	C/S Vendor Interface	RIV
4.1.2.4(o)	Tangential Shear Design Basis	RIV
4.1.2.4(q)	Dust Ring Calculation	RIV
4.1.2.4(r)	Lateral Capacity of Vertical Walls	RIV
4.1.2.4(t)	Building Structural Analysis	NRR
4.1.2.4(u)	Vertical Response Spectra	NRR
4.1.2.4(v)	Equipment Seismic Evaluation	RIV
4.2 Computer Codes		
4.2.2.1(a)	Computer Code Verification	RIV
4.2.2.1(b)	Safety-related Codes	RIV
*4.2.2.1(d)	FSAR/Program Summary Status	RIV
4.2.2.1(e)	Computer Calculation Control	RIV
4.3 Electrical/I&C		
4.3.2.1(a)	FMEA/Single Failure Criterion	RIV
*4.3.2.1(d)	Separation/Single Failure Criteria	RIV
*4.3.2.1(e)	Separation Barrier Requirements	RIV
*4.3.2.1(f)	Equipment Classification Document	RIV
*4.3.2.1(i)	Documented Operating Conditions	RIV
*4.3.2.1(m)	Manual Operation Basis	RIV

Quadrex Finding Number	Title	Close Out
4.3 Electrical/I&C (cont.)		
*4.3.2.1(n)	Isolation Devices	RIV
*4.3.2.3(p)	DC Battery Sizing	RIV
*4.3.2.4(v)	Equipment and System Monitoring	RIV
4.3.2.4(x)	Equipment Operation Verification	RIV
*4.3.2.5(cc)	Flamemastic/PVC Use	RIV
4.4 HVAC		
*4.4.2.1(a)	HVAC Design Basis	RIV
*4.4.2.1(b)	HVAC System Classification	RIV
*4.4.2.1(c)	Hydrogen Concentrations	RIV
*4.4.2.1(d)	HVAC Separation Requirements	RIV
*4.4.2.1(e)	Floor Drainage System	RIV
*4.4.2.4(j)	Basis for Ambient Conditions	RIV
*4.4.2.4(i)	Fire Hazards Analysis	NRR
*4.4.2.4(y)	Equipment and Floor Drain System	NRR
4.5 Mechanical		
4.5.2.4(m)	Stability Guidelines	NRR
*4.5.3.1(a)	Pipe Rupture Analysis	NRR
*4.5.3.1(d)	Pipe Whip Secondary Effects	NRR
*4.5.3.1(f)	Super Pipe Dynamic Analysis	NRR
4.5.3.1(h)	"No Break Zone" Criteria	NRR
*4.5.3.1(i)	Instrument Line Interaction	NRR
*4.5.3.3(m)	FSAR Commitments	NRR
*4.5.3.3(q)	Adequacy of Procured Equipment	NRR
4.5.3.3(r)	Restraint Tolerance Values	NRR
*4.5.3.4(x)	Enclosure Verification	NRR
*4.5.3.4(z)	TGB Uncontrolled Whip	NRR
*4.5.3.4(cc)	Pipe Whip Energy Balance	NRR
4.5.3.4(ff)	Deflection Acceptance Criteria	NRR
4.5.3.4(gg)	Structural and Embed Designs	RIV
*4.5.3.4(hh)	Restraint Location	NRR
*4.5.5.1(a)	Component Operability	NRR
*4.5.5.1(b)	Plant Systems Service Level	NRR
*4.5.5.1(e)	Active/Passive Valves & Pumps	NRR
*4.5.5.1(f)	ANSI N278.24	NRR
4.5.5.2(i)	W Specified Plant Cycles	NRR
4.5.5.3(j)	ISI Penetration Adequacy	RIV
*4.5.5.4(l)	Concrete Heating Effects	RIV
*4.5.4.4(n)	Stress Calculations	RIV
4.5.5.4(o)	RWST Vendor Report	RIV
*4.5.5.4(p)	Valve Opening and Closing Rates	RIV
*4.5.5.4(s)	Valve Test Criteria	RIV

Quadrex Finding Number	Title	Close Out
4.6 Nuclear Analysis		
*4.6.2.1(a)	Temperature Values in Design	NRR
*4.6.2.1(j)	FSAR Commitment	NRR
*4.6.2.1(l)	Verified Analysis	NRR
4.6.2.1(m)	ECP Initial Temperature Assumption	NRR
*4.6.2.1(n)	Heat Sink Availability	NRR
*4.6.2.1(o)	Battery Room Hydrogen Analysis	NRR
4.6.2.4(v)	ECP Analysis	NRR
*4.6.4.1(a)	FMEA	NRR
*4.6.4.1(c)	FMEA and Single Failure Criteria	NRR
4.6.4.4(e)	Chromate Release CCW/ECW	NRR
4.6.4.4(f)	Value Performance Qualification	RIV
4.6.4.4(g)	ECP Temperature Analysis	RIV
4.7 Piping and Supports		
*4.7.2.1(e)	Applicability of MEB-6	NRR
4.7.2.4(o)	Jet Load Evaluation	NRR
4.7.2.5(p)	Friction Factors	NRR
*4.7.3.1(a)	Jet Impingement Criteria	NRR
*4.7.3.1(e)	Equipment Qualification	RIV
*4.7.3.1(f)	MEB-6	NRR
4.7.3.1(h)	SSE SAM Loads	NRR
4.7.3.1(i)	FW Hammer	NRR
4.7.3.1(l)	Design Margins	NRR
4.7.3.1(m)	IVC Interface Supports and Restraints	NRR
4.7.3.2(n)	ISI and Maintenance Access	NRR
4.7.3.2(o)	MAB Seismic Supports	NRR
4.7.3.3(q)	Pipe System Supports and Restraints	NRR
4.8 Radiological Controls		
4.8.2.1(a)	Instrument Air System SF Criteria	RIV
*4.8.2.1(a)	Alara Program	NRR
*4.8.2.1(c)	MAB HVAC Filter Media	NRR
*4.8.2.1(d)	Shielding Calculations	RIV
*4.8.2.1(e)	Shielding Design	NRR
*4.8.2.1(f)	Radiation Zone Drawings	NRR
4.8.2.4(q)	RM Calibration and Setpoints	NRR
*4.8.2.4(s)	Plant Modes and Environmental Conditions in Design	NRR
4.8.2.4(x)	Zone 1 Radiation Criteria	NRR
4.8.2.4(z)	Source Term Verification	NRR
*4.8.2.4(ff)	ARM Detector Replacement and Calibration	NRR

Quadrex Finding Number	Title	Close Out
4.8 Radiological Controls (cont.)		
4.8.2.4(gg)	Purchase Specification Qualification Requirements	NRR
*4.8.2.4(kk)	Counting Room Shield Design	NRR
4.8.2.4(ll)	Sump Overflow Analysis	RIV
4.9 ISI and Access		
4.9.1(b)	Access Exception List	RIV
*4.9.1(d)	MS Support	RIV
4.9.2(Vol 1, pg. 4-94 & 4-95)	ISI Program	RIV
*4.9.2(m)	Check Valve SI-009C	RIV

Appendix B

Generic Finding Analysis

Appendix B

Generic Finding Analysis

Quadrex stated in their report that the generic findings were "applicable to most, if not all, of the disciplines involved in this (Quadrex design review program) study, and are based on the detailed evaluation of each discipline presented in - - - this report."*

There were seventeen findings in the Quadrex Report labeled generic. These findings were an overview of the disciplines involved in the Quadrex study. They focused on the policies, practices, and procedures with suggestions for remedial action.

The purpose of Appendix B is to examine this area in detail in regard to reportability and generic implications. Their impact upon plant safety and adequacy of their resolution are included in the individual finding review in Section 5.0. The generic findings are:

3.1a B&R System Level Integration
3.1b B&R Review of Engineering Data
3.1c Plant Operating Modes and Environmental Conditions
3.1d Safety-Related versus NonSafety-Related
3.1e FEMA and Single Failure Criteria Analysis
3.1f FSAR Commitment Tracking
3.1g Plant Design Bases
3.1h Equipment Reliability Requirements
3.1i Nuclear-Related Analysis
3.1j Final Design Verification
3.2k Plant Operation Criteria
3.2l Use of Plant Symmetry
3.2m Valve Opening and Closing Rates
3.2n Access Provisions
3.2o Test Provisions
3.2p Local Temperatures During Maintenance
3.2q Pipe Support Requirements

In EN-619 Bechtel suggested that the generic findings could be placed in one of four groups as follows:

(1)	Appropriateness of Initial Design Criteria	3.1(c), 3.1(g), 3.2(k) 3.2(m), 3.2(n), 3.2(o) 3.2(p)
(2)	Appropriateness of Methods, Procedures, and Documentation	3.1(a), 3.1(b), 3.1(d) 3.1(e), 3.1(f), 3.1(i) 3.1(j)
(3)	Overconservatism in Design	3.2(q)
(4)	Not a Generic Concern	3.1(h), 3.2(l)

They also stated that, with the possible exception of finding 3.2(1) there are no additional concerns in the generic findings that are not addressed in the specific discipline findings. The staff's review of the generic findings support this conclusion.

The Bechtel transition program was extensive and comprehensive. (See Section 2.3.4 for a discussion of this area.) It provided a means for a through review and status determination and the mechanism to include all identified defects into a corrective action system. The Bechtel Engineering Department Procedures (EDPs) (see Table 5) will be followed in the conduct of future design activities and should preclude recurrence of the findings resolved by the EDPs.

Included in this Appendix is a summary table of related findings (Table 8) and a detailed listing of those related findings as they are applied to the individual generic findings.

The seventeen generic findings had 216 related findings. Considering the reportability status of the individual findings, generic finding 3.1(d) included three potentially reportable items reporting on two areas, HVAC and computer codes verification. However, based on their relationship to the generic finding, these two items do not make the generic finding reportable.

Based on the above data, the staff concluded that this generic findings are not reportable under 10 CFR 50.55(e).

Table 8

Generic Related Finding Analysis

Generic Finding Number	No. Related* Findings (RF)	No. RF** Reportable	No. RF Not Reportable	No. RF*** Generic	No. RF*** Not Generic
3.1(a)	20	0	20	9	11
3.1(b)	27	0	27	4	23
3.1(c)	35	2	33	8	27
3.1(d)	22	3	19	14	8
3.1(e)	8	2	6	4	4
3.1(f)	13	0	13	3	10
3.1(g)	44	1	43	14	30
3.1(h)	3	0	3	1	2
3.1(i)	18	1	17	3	15
3.1(j)	4	0	4	0	4
3.2(k)	4	0	4	0	4
3.2(l)	0	--	--	--	--
3.2(m)	1	0	1	0	1
3.2(n)	9	0	9	2	7
3.2(o)	2	0	2	0	2
3.2(p)	2	1	1	1	1
3.2(q)	4	0	4	0	4

*Some related findings (line items) apply to more than one generic finding.

**There were only six potential reportable findings. They were considered to be applicable to more than one generic finding.

***Generic consideration of the related finding as determined by the staff.

Analysis Listing References: (The following notes apply to the detailed list headings on the following page.)

1/ Quadrex Report paragraph number
2/ Line Item Number from BPC Task Force Report
3/ Quadrex Ranking from Quadrex Report (See Table 1)
4/ Bechtel Task Force Category (See Table 3)
5/ STP Status of Finding (See paragraph 2.5)
R=Resolved D=Dispositioned
6/ NRC Evaluation (See paragraph 2.2)
R=Reportability (R=reportable; NR=Not reportable)
S=Safety Significant (S=safety significant; NS=nonsafety significant)
G=Generic (G=generic matter; NG=nongeneric matter)
7/ Remarks - self explanatory

Note: The data base for this analysis (identification of related findings) was extracted from WP EN-619, the Bechtel Task Force Report, and the Quadrex Report.

Quadrex Ranking - Most Serious Finding
3.1(a) B&R Systems Level Integration

Quadrex[1] Section	Line[2] Item	Quad[3] Rank	BTP Cat	STP[5] Status	NRC Evaluation[6] R	S	G	Remarks[7]
4.3.2.1(a)	48	1	6	R	NR	S	G	Design Assurance Group
4.3.2.1(b)	49	1	2	D	NR	S	G	TRD-Separation Criteria
4.3.2.1(c)	50	1	7	R	NR	S	G	TRD-Planning
4.3.2.1(d)	52	1	[illegible]	D	NR	S	G	Separation/Single Failure Criterion
4.3.2.1(h)	57	1	[illegible]	R	NR	S	G	Support System Identification
4.3.2.1(l)	62	1	6	R	NR	NS	NG	Pre-op/Testing Requirements
4.3.2.4(r)	68	4	6	R	NR	S	G	Technical Communications
4.4.2.1(d)	84	1	7	D	NR	S	G	HVAC Separation Requirements
4.4.2.1(d)	85	1	7	R	NR	S	G	HVAC Separation Requirements
4.5.2.2(e)	116	2	6	R	NR	S	NG	ALARA/ISI/Maint-Design
4.5.5.4(p)	180	4	5	D	NR	S	NG	Valve Closure Rates
4.5.5.4(r)	182	4	6	R	NR	S	NG	Review System
4.6.4.3(r)	206	3	4	R	NR	NS	NG	Timely Analysis Performance
4.6.4.5(k)	223	5	6	R	NR	S	NG	Design Interface
4.7.3.1(d)	244	1	7	R	NR	S	G	Lack of Coordination
4.7.3.2(m)	253	2	7	D	NR	S	NG	IVC Interface Supports
4.8.2.1(e)	274	1	6	D	NR	S	NG	Shielding Design
4.8.2.2(i)	278	2	6	R	NR	S	NG	ALARA Plant Design Review
4.8.2.4(s)	289	4	6	D	NR	S	NG	Plant Modes and Environmental Conditions
4.8.2.4(w)	294	4	4	D	NR	S	NG	ALARA-Filter Units

Quadrex Ranking - Most Serious Finding
3.1(b) B&R Review of Engineering Data

Quadrex Section	Line Item	Quad Rank	BTF Cat	STP Status	NRC Evaluation R	S	G	Remarks
4.1.2.1(a)	1	1	7	R	NR	S	G	Questioning Input Data
4.1.2.1(f)	7	1	6	R	NR	S	G	EDS Pipe Rupture Loading
4.1.2.3(j)	12	3	7	R	NR	NS	NG	Fuel Pool Design
4.1.2.3(m)	15	3	4	D	NR	NS	NG	C/S Vendor Interface
4.1.2.3(m)	16	3	5	D	NR	NS	NG	Fuel Pool Liner
4.1.2.4(n)	17	4	7	R	NR	NS	NG	Structural Data Transfer
4.3.2.1(j)	59	1	6	D	NR	S	NG	Vendor Decisions
4.3.2.1(j)	60	1	7	R	NR	S	NG	Specification Decisions
4.3.2.3(q)	67	3	6	R	NR	S	G	Guidance to Vendors
4.3.2.9(t)	70	4	7	R	NR	S	NG	Vendor Reviews
4.4.2.1(c)	83	1	6	D	NR	S	NG	Hydrogen Concentrations
4.4.2.2(h)	89	1	6	R	NR	S	NG	HVAC Operating Condition
4.4.2.4(i)	90	4	6	R	NR	S	NG	HVAC Design Inputs
4.4.2.4(o)	97	4	4	R	NR	S	NG	HVAC Fan Calculations
4.4.2.4(r)	100	4	6	R	NR	S	NG	Reactor Cavity Cooling
4.5.2.3(f)	117	3	7	R	NR	NS	NG	Jet Impingement Loads
4.5.3.3(o)	144	3	7	R	NR	NS	NG	Jet Imp.Loads Interface
4.5.3.4(hh)	164	4	6	R	NR	S	NG	Restraint Position
4.5.5.1(e)	167	1	4	R	NR	S	G	Vendor Design Review
4.5.5.4(o)	179	4	6	R	NR	S	NG	RWST Vendor Report
4.6.2.1(a)	185	1	4	D	NR	S	NG	Temp. Values in Design
4.6.2.1(m)	199	1	7	R	NR	S	NG	ECP Initial Temp. Assumption
4.6.2.4(t)	208	3	5	R	NR	S	NG	Review of Westinghouse Data
4.6.4.1(b)	213	1	7	R	NR	S	NG	Errors in Analysis
4.6.4.5(l)	224	5	4	R	NR	S	NG	Pump NPSH Calculations
*4.8.2.1(d)	271	1	7	R	NR	S	NG	Shielding Design Calculations
4.8.2.4(aa)	298	4	7	R	NR	S	NG	Review of NUS Analyses

*Initially determined to be potentially reportable by HL&P. Subsequently, it was evaluated to be non-reportable.

Quadrex Ranking - Most Serious Finding
3.1(c) Plant Operating Modes and Environmental Conditions Analysis

Quadrex Section	Line Item	Quad Rank	BTF Cat	STP Status	NRC Evaluation R	S	G	Remarks
4.1.2.1(e)	6	1	7	R	NR	S	G	C/S Responsiveness to NRC Requirements
4.3.2.1(i)	58	1	6	D	NR	S	NG	Documented Operating Conditions
4.3.2.4(x)	75	4	5	R	NR	S	NG	Equipment Operation Verificatic:
4.4.2.1(a)	81	1	1	D	R	S	G	Reported to NRC - HVAC Design Basis
4.4.2.1(b)	82	1	1	D	R	S	G	Reported to NRC - HVAC System Classifications
4.4.2.2(h)	89	2	6	R	NR	S	NG	Plant Cond - HVAC Design
4.4.2.4(j)	91	4	4	R	NR	S	NG	Basis for Ambient Conditions
4.5.2.3(i)	120	3	6	R	NR	NS	NG	Restraint Design
4.5.3.1(a)	128	1	7	D	NR	S	NG	Pipe Rupture Analyses
4.5.3.1(c)	132	1	7	R	NR	S	NG	Lack of Documents
4.5.3.4(x)	153	4	5	D	NR	S	NG	Enclosure Verification
4.5.5.1(b)	166	1	3	D	NR	S	G	Plant Systems Service Level
4.5.5.4(q)	181	4	6	R	NR	NS	NG	Revised Licensing Requirements
4.5 5.4(r)	182	4	6	R	NR	S	NG	Design Oper. Characteristics
4.6.2.1(a)	185	1	4	D	NR	S	NG	Temperature Values in Design
4.6.2.1(a)	186	1	6	D	NR	S	NG	Temperature Values in Equipment Design
4.6.2.1(b)	187	1	4	R	NR	S	NG	Environmental Analysis
4.6.2.1(c)	188	1	4	R	NR	S	NG	NUC Analysis Status
4.6.2.1(d)	189	1	4	R	NR	S	NG	NUC. Analysis Calculations Interface
4.6.2.1(e)	190	1	7	R	NR	S	NG	Annulus Pressure Analysis
4.6.2.1(f)	192	1	7	R	NR	S	NG	Flow Path Methodology
4.6.2.1(k)	197	1	6	R	NR	NS	NG	Opinion
4.6.2.1(m)	199	1	7	R	NR	S	NG	ECP Initial Temperature Assessment
4.6.2.1(n)	200	1	6	D	NR	S	NG	Heat Sink Availability
4.6.2.3(q)	204	3	4	R	NR	S	NG	Analysis Methods
4.6.2.3(q)	205	3	4	D	NR	S	NG	Analysis Methods
4.6.2.4(v)	210	4	2	R	NR	S	G	ECP Analysis
4.6.4.1(a)	211	1	6	R	NR	NS	NG	FMEA Comment
4.6.4.4(g)	219	4	2	R	NR	S	NG	ECP Temperature Analysis
4.6.4.5(k)	223	5	6	R	NR	S	NG	Design Interface
4.7.7.1(e)	229	1	4	D	NR	S	G	Applicability of MEB-6
4.7.3.1(b)	242	1	6	R	NR	S	G	System Operating Temperature
4.7.3.1(f)	246	1	4	D	NR	NS	G	NRC - MEB 6
4.8.2.4(s)	289	4	6	D	NR	S	NG	Design Plant Modes
4.8.2.4(u)	292	4	5	D	NR	S	NG	Work Area Temperature Criteria

Quadrex Ranking - Most Serious Finding
3.1(d) Safety-Related vs. Nonsafety-Related Distinctions

Quadrex Section	Line Item	Quad Rank	BTF Cat	STP Status	NRC Evaluation R	S	G	Remarks
4.1.2.1(d)	5	1	7	R	NR	S	G	C/S Design Methods
4.3.2.1(i)	6	1	7	R	NR	S	G	C/S Responsive to NRC Requirements
4.1.2.4(o)	18	4	3	D	NR	S	G	Tangential Shear Design Basis
4.2.2.1(a)	34	1	1	R	R	S	G	CPVR List
4.2.2.1(b)	35	1	4	R	NR	S	G	Safety-related Codes
4.3.2.1(h)	57	1	6	R	NR	S	G	Support System Basis
4.3.2.1(f)	54	1	6	D	NR	S	G	Equipment Classification Document
4.3.2.1(h)	57	1	6	R	NR	S	G	Support Systems Basis
4.3.2.1(m)	63	1	5	D	NR	S	NG	Remote Panel Operations Basis
4.4.2.1(a)	81	1	1	D	R	S	G	HVAC Design Basis - Reported to NRC
4.4.2.1(b)	82	1	1	D	R	S	G	Reported to NRC - HVAC
4.4.2.1(d)	84	1	7	D	NR	S	G	HVAC Separation Requirement
4.4.2.4(j)	91	4	4	R	NR	S	NG	Basis for Ambient Condition
4.4.2.4(q)	99	4	6	R	NR	S	NG	HVAC Support Design
4.5.3.1(i)	138	1	7	D	NR	S	G	Instrument Line Interaction Analysis
4.6.2.2(o)	201	1	6	D	NR	S	NG	Battery Room Hyd. Analysis
4.6.2.1(o)	202	1	2	R	NR	S	NG	Analysis Classification
4.6.2.2(p)	203	1	7	R	NR	NS	NG	IVC and MAB High Energy
4.6.4.1(b)	214	1	2	R	NR	S	NG	SR Calculation
4.7.2.1(e)	229	1	4	D	NR	S	G	Application MEB-6
4.7.3.1(f)	246	1	4	D	NR	NS	G	NRC-MEB-6
4.8.2.1(d)	270	1	2	R	NR	S	NG	Shielding Classification

Quadrex Ranking - Most Serious Finding
3.1(e) FMEA (Failure Modes and Effects Analysis)
and Single Failure Criterion Analysis

Quadrex Section	Line Item	Quad Rank	BTF Cat	STP Status	NRC Evaluation R	S	G	Remarks
4.3.2.1(a)	47	1	1	R	R	S	G	Determined to be not reportable by HL&P
4.3.2.1(d)	52	1	5	D	NR	S	G	Separation Criterion Single Failure
4.3.2.1(i)	58	1	6	D	NR	S	NG	Lack of Documents/Criteria (Observation)
4.4.2.1(d)	84	1	7	D	NR	S	G	HVAC Separation Requirements
4.6.4.1(a)	212	1	6	D	NR	S	NG	Changes due to Analysis
4.6.4.1(e)	215	1	6	D	NR	S	NG	FMEA Methodology
4.7.3.1(a)	241	1	6	D	NR	S	NG	Jet Impingement Criteria
4.8.2.1(a)	266	1	1	R	R	S	G	Instrument Air System Single Failure Criteria - determined to be not reportable by HL&P

Quadrex Ranking - Most Serious Finding
3.1(f) FSAR Commitment Tracking System

Quadrex Section	Line Item	Quad Rank	BTF Cat	STP Status	NRC Evaluation R	S	G	Remarks
4.1.2.1(e)	6	1	7	R	NR	S	G	Responsiveness to NRC Requirements
4.3.2.1(g)	55	1	6	R	NR	S	G	FSAR Commitment Tracking
4.3.2.1(j)	59	1	6	D	NR	S	NG	Specification Decision
4.3.2.1(k)	61	1	6	R	NR	S	G	NRC Requirements Update
4.4.2.1(f)	87	1	6	D	NR	S	NG	FSAR/HVAC Design Documents
4.5.5.1(g)	171	1	7	R	NR	S	NG	Containment Penetrations
4.6.2.3(s)	207	4	7	R	NR	S	NG	NRC Question Response
4.7.2.1(a)	225	1	6	D	NR	NS	NG	FSAR Modal Analysis
4.7.2.1(b)	226	1	7	R	NR	NS	NG	FSAR Interface
4.7.2.1(c)	227	1	7	R	NR	NS	NG	EDS-FSAR Methodology
4.7.2.1(f)	230	1	6	D	NR	NS	NG	EDS-MOD Spectra Analysis - FSAR Coordination
4.7.3.1(c)	242	1	6	D	NR	NS	NG	Separation Basis
4.7.3.1(g)	247	1	6	D	NR	NS	NG	FSAR Correction-Mode Analysis

Quadrex Ranking - Most Serious Finding
3.1(g) Plant Design Basis

Quadrex Section	Line Item	Quad Rank	BTF Cat	STP Status	NRC Evaluation R	S	G	Remarks
4.1.2.1(a)	1	1	7	R	NR	S	G	Structural Group
4.1.2.1(a)	2	1	6	R	NR	S	G	Structural Group
4.1.2.1(e)	6	1	7	R	NR	S	G	CIS Response to NRC Requirements
4.1.2.1(h)	10	1	6	R	NR	S	NG	Load Verifications
4.1.2.3(k)	13	3	7	R	NR	NS	NG	Containment Prestressing
4.1.2.3(m)	15	3	4	D	NR	NS	NG	Vendor Interface
4.1.2.3(m)	16	3	5	D	NR	NS	NG	Welding Procedure Review
4.1.2.4(n)	17	4	7	R	NR	NS	NG	Structural Data Transfer
4.1.2.4(s)	22	4	6	R	NR	S	NG	Equipment Loading Values
4.1.2.4(v)	25	4	4	D	NR	S	G	Equipment Seismic Evaluation
4.2.2.4(g)	41	4	7	R	NR	S	NG	Computer Code Control
4.3.2.1(a)	48	1	6	R	NR	S	G	Design Assurance Group
4.3.2.1(b)	49	1	2	D	NR	S	G	Separation Requirements
4.2.2.1(b)	50	1	4	R	NR	S	G	Safety-Related Codes
4.3.2.1(c)	51	1	6	R	NR	S	G	TRD Planning/Design
4.3.2.1(f)	54	1	6	D	NR	S	G	Equipment Classifications
4.3.2.1(h)	57	1	6	R	NR	S	G	Support System Basis
4.3.2.1(i)	58	1	6	D	NR	S	NG	Document Operating Conditions
4.3.2.4(t)	70	4	7	R	NR	S	NG	Vendor Documentation Review
4.4.2.1(a)	81	1	1	D	R	S	G	HVAC Design Basis
4.4.2.4(i)	90	4	6	R	NR	S	NG	HVAC Design Inputs
4.4.2.4(j)	91	4	4	R	NR	S	NG	Basis for Ambient Conditions
4.4.2.4(m)	94	4	7	R	NR	S	NG	HVAC Design Criteria
4.4.2.4(n)	96	4	4	R	NR	S	NG	HVAC Design Basis
4.4.2.4(p)	98	4	6	R	NR	S	NG	Pressurizer Support Skirt Cooling
4.4.2.5(aa)	109	5	7	R	NR	S	NG	HVAC System Alarms
4.5.2.1(b)	112	1	7	R	NR	S	NG	EDS Design Review
4.5.2.3(f)	117	3	7	R	NR	NS	NG	Jet Impingement Loads
4.5.3.1(c)	132	1	7	R	NR	S	NG	Pipe Rupture Design
4.5.3.2(l)	141	2	4	R	NR	S	G	Maintenance Criteria
4.5.3.4(v)	151	4	5	R	NR	S	NG	Interaction Materials
4.5.5.1(c)	167	1	4	R	NR	S	G	Vendor Design Review

Quadrex Ranking - Most Serious Finding
3.1(g) Plant Design Basis (Continued)

Quadrex Section	Line Item	Quad Rank	BTF Cat	STP Status	NRC Evaluation R	S	G	Remarks
4.5.5.2(h)	172	2	6	R	NR	S	NG	Transient Categorization
4.6.2.1(b)	187	11	4	R	NR	S	NG	Environmental Analysis
4.6.2.1(c)	188	1	1	R	NR	S	NG	Nuclear Analysis Status
4.6.2.1(d)	189	1	4	R	NR	S	NG	Nuclear Analysis Calcs.
4.6.2.2(p)	203	2	7	R	NR	NS	NG	IVC and MAB High Energy Lines
4.6.2.4(t)	208	4	5	R	NR	S	NG	Westinghouse Data Review
4.7.2.3(g)	231	3	5	R	NR	NS	NG	Information Transmittal
4.7.3.2(l)	252	2	5	R	NR	S	NG	Design Margins
4.7.3.4(v)	254	2	4	R	NR	S	G	SSE SAM Displacements
4.7.3.4(w)	263	4	3	R	NR	S	NG	Stress Group Design Practice
4.8.2.1(b)	267	1	7	R	NR	NS	NG	ALARA Requirements
4.8.2.1(b)	268	1	6	D	NR	NS	NG	ALARA Requirements

Quadrex Ranking - Most Serious Finding
3.1(h) Equipment Reliability

Quadrex Section	Line Item	Quad Rank	BTF Cat	STP Status	NRC Evaluation R	S	G	Remarks
4.3.2.1(j)	60	1	7	R	NR	S	NG	Specification Revision
4.3.2.4(t)	70	4	7	R	NR	S	NG	Vendor Documentation Review
4.3.2.4(w)	73	4	7	R	NR	S	G	Separation Objectives

Quadrex Ranking - Most Serious Finding
3.1(i) Nuclear-Related Analysis

Quadrex Section	Line Item	Quad Rank	BTF Cat	STP Status	NRC Evaluation R	S	G	Remarks
4.1.2.1(f)	8	1	6	R	NR	S	G	EDS Pipe Rupture Loading
4.1.2.5(y)	28	5	7	R	NR	NS	NG	Finding not Supported
4.4.2.1(a)	81	1	1	D	R	S	G	HVAC Design Basis
4.4.2.4(r)	100	4	6	R	NR	S	NG	Reactor Cavity Cooling
4.4.2.4(s)	108	4	7	R	NR	NS	NG	Finding not Applicable
4.5.2.1(a)	111	1	5	R	NR	S	NG	Jet Surface Angle
4.5.3.1(a)	128	1	7	D	NR	S	NG	No Activity in Area
4.5.3.3(q)	146	3	4	D	NR	S	NG	Adequacy of Procured Equipment
4.5.5.4(m)	178	4	7	D	NR	S	NG	Stress Calculation
4.6.2.1(b)	187	1	4	P	NR	S	NG	Environmental Analysis
4.6.2.1(h)	197	1	6	R	NR	NS	NG	Opinion Finding
4.6.2.3(r)	206	3	4	R	NR	NS	NG	Cost/Schedule
4.6.2.4(v)	210	4	2	R	NR	S	NG	TS Limit
4.6.4.4(g)	219	4	2	R	NR	S	NG	Refer Line Item 210
4.7.2.1(d)	228	1	4	R	NR	S	NG	Pipe Support Stiffness Values
4.7.2.3(h)	232	3	7	R	NR	NS	NG	SSE SAM and Inertial Loads
4.7.3.1(h)	248	1	2	R	NR	S	G	SSE SAM Loads
4.7.3.1(i)	249	1	6	R	NR	S	NG	FW Hammer

Quadrex Ranking - Most Serious Finding
3.1(j) Final Design Verification

Quadrex Section	Line Item	Quad Rank	BTF Cat	STP Status	NRC Evaluation R	S	G	Remarks
4.1.2.1(h)	10	1	6	R	NR	S	NG	Load Verifications
4.4.2.1(g)	88	1	7	R	NR	S	NG	HVAC Design Verification
4.6.2.3(n)	206	3	4	R	NR	NS	NG	Cost/Schedule
4.6.4.3(d)	216	3	6	D	NR	NS	NG	Timing-BTF Agrees

Quadrex Ranking - Serious Finding
3.2(k) Plant Operation Criteria

Quadrex Section	Line Item	Quadrex Rank	BTF Cat	STP Status	NRC Evaluation R	S	G	Remarks
4.5.5.2(h)	172	2	6	R	NR	S	NG	Cost
4.5.5.4(p)	180	4	5	D	NR	S	NG	See 3.2(m)
4.5.5.4(r)	182	4	6	R	NR	S	NG	Transient Categorization
4.6.4.4(f)	218	4	5	R	NR	S	NG	Valve Performance Qualification

Quadrex Ranking - Serious Finding
3.2.(1) Use of Plant Symmetry

Quadrex Section	Line Item	Quad Rank	BTF Cat	STP Status	NRC Evaluation R	S	G	Remarks
4.9.2	No Related Findings							Only Reference to Item. BTF did not address para. 4.9 item in evaluation. This would not appear to be a serious problem.

Quadrex Ranking - Serious Findings
3.2(m) Valve Opening and Closing Rates

Quadrex Section	Line Item	Quad Rank	BTF Cat	STP Status	NRC Evaluation R	S	G	Remarks
4.5.4(p)	180	4	5	P	NR	S	NG	See 3.2(k) Valve Opening and Closing Rates.

Quadrex Ranking - Serious Finding
3.2(n) Access Provisions

Quadrex Section	Line Item	Quad Rank	BTF Cat	STP Status	NRC Evaluation R	S	G	Remarks
4.4.2.4(m)	95	4	5	R	NR	S	NG	Testing Requirements
4.5.3.2(l)	141	2	4	R	NR	S	G	Criteria Missing
4.5.3.4(t)	149	4	7	R	NR	NS	NG	Interference Resolution Slow
4.5.5.3(j)	174	3	6	R	NR	S	NG	Two Exceptions to ISI Access Access Limits
4.6.2.2(p)	203	2	7	R	NR	NS	NG	Cost Considerations
4.7.3.2(n)	254	2	4	R	NR	S	G	ISI & Maint Access
4.8.2.1(b)	268	1	6	D	NR	S	NG	ALARA Verification
4.8.2.1(e)	274	1	6	D	NR	S	NG	Shielding Design
4.8.2.4(ff)	304	4	5	D	NR	S	NG	Detector Replacement

Quadrex Ranking - Serious Finding
3.2(o) Test Provisions

Quadrex Section	Line Item	Quad Rank	BTF Cat	STP Status	NRC Evaluation R	S	G	Remarks
4.3.2.1(l)	62	1	6	R	NR	NS	NG	Observation
4.4.2.4(m)	95	4	5	R	NR	S	NG	See 3.2(n)

Quadrex Ranking - Serious Finding
3.2(p) Local Temperature During Maintenance

Quadrex Section	Line Item	Quad Rank	BTF Cat	STP Status	NRC Evaluation R	S	G	Remarks
4.4.2.1(a)	81	1	1	D	R	S	G	HVAC Design Bases
4.4.2.2(h)	89	1	6	R	NR	S	NG	HVAC Operating Conditions

Quadrex Ranking - Serious Finding
3.2(q) Pipe Support Requirements

Quadrex Section	Line Item	Quad Rank	STF Cat	STP Status	NRC Evaluation R	S	G	Remarks
4.5.5.3(k)	175	3	7	R	NR	NS	NG	Conservative - Cost Item
4.7.2.3(i)	233	3	7	R	NR	NS	NG	Valve Acceleration Criteria
4.7.3.2(m)	253	1	7	D	NR	S	NG	IVC Interface Supports and Restraints
4.7.3.3(p)	256	3	7	R	NR	S	NG	Valve Acceleration Limits

APPENDIX C

CROSS-REFERENCE LIST

VOL. I QUADREX FINDINGS TO

VOL. II & III QUESTIONS

CROSS REFERENCE LIST - Quadrex Report

(Paragraph Sort)

Generic Findings (29)

3.1 (a)		H-6
3.1 (b)	(1)	C-1, H-1, H-3, H-27, M-28, N-3, N-9
	(2)	C-16, H-15, N-1, N-17
	(3)	M-41, M-49, M-51, M-52, N-1
	(5)	H-10, M-46
3.1 (c)	(3)	H-3, N-17
	(4)	H-3, H-14, N-8
	(5)	H-5
	(6)	M-3, M-5, N-1 and N-3
3.1 (d)	(1)	M-3, N-3, N-15, R-5
	(2)	N-23, N-25, R-7
	(3)	H-5
	(4)	C/M-3, C/M-8
	(5)	E-3, E-15, H-4, H-13, M-5, M-25, N-10, and R-6
	(6)	E-13, R-10
	(7)	H-18, H-23, M-3, M-10, M-50, P-20, and R-12
	(8)	C-3, C-5, C-6, C-35, H-6, P-16, R-1
3.1 (e)	(3)	R-6, E-15
	(4)	M-4, H-6, P-20, N-19, E-2
	(5)	H-6, P-20, N-19, E-4
3.1 (f)	(6)	M-30
(g)	(2)	N-1
(g)	(4)	E-5
(g)	(6)	C-12, H-8
(h)	(1)	E-7, E-8
(j)	(3)	C-16, H-17
3.2 (n)		M-26A, R-1, M-36, P-17
(o)		H-3, H-7, E-11, E-21
(p)		H-3

4.1 Civil/Structural Findings (31) (C-1 tnru C-46)

4.1.2.		C-4, C-18, C-16
4.1.2.1	(a)	C-1, C-4, H-12, N-3
	(b)	C-9
	(c)	C-40
	(d)	C-5, C-20, C-43
	(e)	C-3, C-35
	(f)	C-4, C-15
	(g)	C-7
	(h)	C-7, C-15

4.1.2.3	(i)	C-4
	(j)	C-7
	(k)	C-12, C-14
	(l)	C-4, C-18
	(m)	C-32, C-33, C-37, C-38
4.1.2.4	(n)	C-1
	(o)	C-6
	(p)	C-7
	(q)	C-12
	(r)	C-15
	(s)	C-17
	(t)	C-27
	(u)	C-28, C-31
	(v)	C-32, C-33
4.1.2.5	(w)	C-1, C-39
	(x)	C-2
	(y)	C-7, C-12, C-32
	(z)	C-26
	(aa)	C-29
	(bb)	C-36
	(cc)	C-11
	(dd)	C-39

4.2 Computer Codes Findings (12) (C/M 1 thru 16)

4.2.2.1	(a)	C/M-3
	(b)	C/M-8, R-7
	(c)	C/M-13
	(d)	C/M-1
	(e)	C/M-2
	(f)	C/M-8, C/M-9
4.2.2.4	(g)	C/M-1
	(h)	C/M-2, C/M-7
	(i)	C/M-8
	(j)	C/M-10
	(k)	C/M-15
4.2.2.5	(l)	C/M-4

4.3 Electrical/I&C Findings (29) (E-1 - E-22)

4.3.2.1	(a)	R-6, E-15
	(b)	E-1, E-15
	(c)	E-1, E-19
	(d)	E-1, E-8, E-19
	(e)	E-2, E-6
	(f)	E-3
	(g)	E-1, E-3, E-4, E-14, E-22
	(h)	E-3
	(i)	E-4, E-13
	(j)	E-8
	(k)	E-10, E-3
	(l)	E-11, E-16, E-21
	(m)	E-13
	(n)	E-14
	(o)	E-18
4.3.2.3	(p)	E-23
	(q)	E-5
4.3.2.4	(r)	E-2, E-16
	(s)	E-3, E-21, E-16
	(t)	E-3, E-5
	(u)	E-3
	(v)	E-5, E-9, E-21
	(w)	E-5, E-6, E-7
	(x)	E-8
	(y)	E-12
4.3.2.4	(z)	E-15
	(aa)	E-18
	(bb)	E-22
4.3.2.5	(cc)	E-2, E-17

4.4 HVAC (Heating, Ventilation & Air Conditioning) (29) (H-1 thru H-31)

4.4.2		H-3, H-5
4.4.2.1	(a)	H-3
	(b)	H-5
	(c)	H-3, H-27
	(d)	H-6, H-18
	(e)	H-23
	(f)	H-11
	(g)	H-17

4.4.2.2	(h)	H-3, H-10
4.4.2.4	(i)	H-1
	(j)	H-4
	(k)	H-5
	(l)	H-6
	(m)	H-7
	(n)	H-8
	(o)	H-10
	(p)	H-12
	(q)	H-13
	(r)	H-15
	(s)	H-16
	(t)	H-16
	(u)	H-18
	(v)	H-21
	(w)	H-22
	(x)	H-23
	(y)	H-24
	(z)	H-30
4.4.2.5	(aa)	H-31
	(bb)	H-2

4.5 Mechanical (64) (M-1 thru M-52)
Inside Containment (EDS)

4.5.2.1	(a)	M-4
	(b)	C-4, M-8
	(c)	M-19, M-26
	(d)	M-9
4.5.2.2	(e)	M-26A, P-17
4.5.2.3	(f)	M-4
	(g)	M-6, M-7, M-11, M-15
	(h)	M-16
	(i)	M-12
4.5.2.4	(j)	M-7
	(k)	M-10
	(l)	M-19
	(m)	M-23

4.5.2.5	(n)	M-26B
	(o)	M-26C
	(p)	-
	Outside Containment (B&R)	
4.5.3		M-2
4.5.3.1	(a)	M-3, M-4, M-5, M-10, M-12, M-25
	(b)	M-4
	(c)	M-1, M-2
	(d)	M-3, M-4, M-5, M-10, M-26
	(e)	M-4
	(f)	M-6
	(g)	M-7, M-8
	(h)	M-9
4.5.3.1	(i)	M-10
	(j)	M-18
	(k)	M-26
4.5.3.2	(l)	M-26A
4.5.3.3	(m)	M-2
	(n)	M-4
	(o)	M-4
	(p)	M-7
	(q)	M-4, M-25
	(r)	M-26C
	(s)	M-7
4.5.3.4	(t)	M-26A
	(u)	M-1
	(v)	M-3
	(w)	M-4
	(x)	M-5
	(y)	M-6, M-8
	(z)	M-10
	(aa)	M-12
	(bb)	M-13
	(cc)	M-16
	(dd)	M-18
	(ee)	M-19
	(ff)	M-24
	(gg)	M-24
	(hh)	M-26A, M-26B

4.5.5.1	(a)	M-50, M-51, M-52
	(b)	M-29
	(c)	M-30, M-41, M-49, M-50, M-51, M-41
	(d)	M-47
	(e)	M-49, M-51
	(f)	M-50
	(g)	M-30, M-39
4.5.5.2	(h)	M-28
	(i)	M-31
4.5.5.3	(j)	M-36
	(h)	M-49, M-51
4.5.5.4	(l)	M-33
	(m)	M-35
	(n)	M-30
	(o)	M-41
	(p)	M-48
	(q)	M-30
	(r)	M-31, M-48
	(s)	M-50
4.5.5.5	(t)	M-35

4.6 Nuclear Analysis (34) (N-1 thru N-33) (Nuclear Analysis Group)

4.6.2		N-15, N-17, M-31, M-33, M-47
4.6.2.1	(a)	N-15, N-1
	(b)	N-13, N-1, N-2, N-3, N-8, N-10, N-11, N-12, N-15, N-17, N-25
	(c)	-
	(d)	N-1
	(e)	N-2
	(f)	N-8
	(g)	N-10
	(h)	N-11
	(i)	N-12
	(j)	N-13
	(k)	N-13
	(l)	N-15
	(m)	N-17
	(n)	N-17
	(o)	N-25
4.6.2.2	(p)	N-3
	(q)	N-2
	(r)	N-3, N-4, N-5, N-14
	(s)	N-25, N-27

4.6.2.4 (t)	N-4, N-9, N-12, N-18
4.6.4	N-22, N-24, N-26, N-27 N-28, N-29, N-30, N-31, N-32
4.6.4.1 (a)	N-16, N-19, N-20, N-21
(b)	N-23
(c)	N-19
4.6.4.3 (d)	N-26, N-28, N-31
4.6.4.4 (e)	N-19
(f)	N-12
(g)	N-17
(h)	M-33
(i)	N-28
(j)	N-31
4.6.4.5 (k)	N-16, N-17, N-20
(l)	N-20, N-22, N-28

4.7 Piping and Support (42) (P-1 thru P-38)

4.7.2.1 (a)	P-7
(b)	P-7
(c)	P-9
(d)	P-12
(e)	P-16
(f)	P-24
4.7.2.3 (g)	P-4
(h)	P-7, P-18
(i)	P-8
(j)	P-20
(k)	P-30
4.7.2.4 (l)	P-12
(m)	P-32
(n)	P-36
(o)	P-20
4.7.2.5 (p)	P-33
4.7.3	P-5, P-7, P-8, P-12, P-13, P-15, P-18, P-19, P-20 P-24, P-25, P-27, P-28, P-30, P-32, P-34, P-35, P-36, P-38
4.7.3.1 (a)	P-20
(b)	P-1
(c)	P-1
(d)	P-1, P-3
(e)	P-3
(f)	P-16

4.7.3.1	(g)	P-7
	(h)	P-7
	(i)	P-21
	(j)	P-26
	(k)	P-29
4.7.3.2	(l)	P-2
	(m)	P-6
	(n)	P-17, M-10, M-12
	(o)	P-29
4.7.3.3	(p)	P-8
	(q)	P-22
4.7.3.4	(r)	P-6
	(s)	P-6
	(t)	P-7
	(u)	P-12
	(v)	P-7, P-18
	(w)	P-19
	(x)	P-32
	(y)	P-36

4.8 Radiological Control (39) (R-1 thru (R-32)

4.8.2		R-1, R-2, R-5, R-7, R-9, R-10, R-11, R-12, R-13, R-20, R-22
4.8.2.1	(a)	R-6
	(b)	R-1
	(c)	R-5, R-29
	(d)	R-7, R-11, R-12, R-14
	(e)	R-10
	(f)	R-30
	(g)	R-11
4.8.2.2	(h)	-
	(i)	R-1, R-2
	(j)	R-2, R-9
	(k)	R-9
	(l)	R-11
	(m)	R-10, R-12
	(n)	R-7, R-13
	(o)	R-15

4.8.2.3	(p)	R-19
4.8.2.4	(q)	R-3
	(r)	R-3
	(s)	R-4, R-10
	(t)	R-5
	(u)	R-5
	(v)	R-6
	(w)	R-8
4.8.2.4	(x)	R-10
	(y)	R-11
	(z)	R-12
	(aa)	R-12, R-14
	(bb)	R-17
	(cc)	R-19
	(dd)	R-20
	(ee)	R-22, R-27
	(ff)	R-23
	(gg)	R-25
	(hh)	R-28
	(ii)	R-30
	(jj)	R-26
	(kk)	R-21
	(ll)	R-24

Geotechnic (O) G-1 thru G-6 (Included in Civil/Structural)

CROSS REFERENCE LIST - QUADREX REPORT

(Question Sort)

Civil/Structural Findings (31) (C-1 thru C-46)

C-01
3.1(b)(1)
4.1.2.1(a)
4.1.2.4(n)
4.1.2.5(w)

C-02
4.1.2.5(x)

C-03
3.1(d)(8)
4.1.2.1(e)

C-04
4.1.2
4.1.2.1(a)
4.1.2.1(f)
4.1.2.3(i)
4.1.2.3(l)
4.5.2.1(b)

C-05
3.1(d)(8)
4.1.2.1(d)

C-06
3.1(d)(8)
4.1.2.4(o)

C-07
4.1.2.1(g)
4.1.2.1(h)
4.1.2.3(j)
4.1.2.4(p)
4.1.2.5(y)

C-08
None

C-09
4.1.2.1(b)

C-10
None

C-11
4.1.2.5(cc)

C-12
3.1(g)(6)
4.1.2.3(k)
4.1.2.4(q)
4.1.2.5(y)

C-13
None

C-14
4.1.2.3(k)

C-15
4.1.2.1(f)
4.1.2.1(h)
4.1.2.4(r)

C-16
3.1(b)(2)
3.1(j)(3)
4.1.2

C-17
4.1.2.4(s)

C-18
4.1.2
4.1.2.1(l)

C-19
None

C-20
4.1.2.1(d)

C-21 thru 25
None

C-26
4.1.2 (z)

C-27
4.1.2.4(t)

C-28
4.1.2.4(u)

C-29
4.1.2.5 (aa)

C-30
None

C-31
4.1.2.4(u)

C-32
4.1.2.3(m)
4.1.2.4(v)
4.1.2.5(y)

C-33
4.1.2.3(m)

C-34
None

C-35
3.1(d)(8)
4.1.2.1(e)

C-36
4.1.2.5(bb)

C-37
4.1.2.3(m)

C-38
None

C-39
4.1.2.3(m)
4.1.2.5(w)
4.1.2.5(dd)

C-40
4.1.2.1(c)

C-41 to 42
None

C-43
4.1.2.1(d)

C-44 to 46
None

4.2 Computer Codes Findings (12) (CM-1 thru 16)

CM-01
4.2.2.1(d)
4.2.2.4(g)

CM-02
4.2.2.1(e)
4.2.2.4(h)

CM-03
3.1(d)(4)
4.2.2.1(a)

CM-04
4.2.2.5(l)

CM-05 to 06
None

CM-07
4.2.2.4(h)

CM-08
3.1(d)(4)
4.2.2.1(b)
4.2.2.1(f)
4.2.2.4(i)

CM-09
4.2.2.1(f)

CM-10
4.2.2.4(j)

CM-11 to 12
None

CM-13
4.2.2.1(c)

CM-14
None

CM-15
4.2.2.4(k)

CM-16
None

Electrical/i&C Findings (29) (E1 thru 22)

E-01
4.3.2.1(b)
4.3.2.1(c)
4.3.2.1(d)
4.3.2.1(g)

E-02
3.1(e)(4)
4.3.2.1(e)
4.3.2.4(r)
4.3.2.5(cc)

E-03
3.1(d)(5)
4.3.2.1(f)
4.3.2.1(g)
4.3.2.1(h)
4.3.2.1(k)
4.3.2.4(s)
4.3.2.4(t)
4.3.2.4(u)

E-04
3.1(e)(5)
4.3.2.1(g)
4.3.2.1(i)

E-05
3.1(g)(4)
4.3.2.3(q)
4.3.2.4(t)
4.3.2.4(v)
4.3.2.4(w)

E-06
4.3.2.1(e)
4.3.2.4(w)

E-07
3.1(h)(1)
4.3.2.4(w)

E-08
3.1(h)(1)
4.3.2.1(d)
4.3.2.1(j)
4.3.2.4(x)

E-09
4.3.2.4(v)

E-10
4.3.2.1(k)

E-11
3.2(c)
4.3.2.1(l)

E-12
4.3.2.4(y)

E-13
3.1(d)(6)
4.3.2.1(i)
4.3.2.1(m)

E-14
4.3.2.1(g)
4.3.2.1(n)

E-15
3.1(d)(5)
3.1(e)(3)
4.3.2.1(a)
4.3.2.1(b)
4.3.2.4(z)

E-16
4.3.2.1(l)
4.3.2.4(r)
4.3.2.4(s)

E-17
4.3.2.5(cc)

E-18
4.3.2.1(o)
4.3.2.4(aa)

E-19
4.3.2.1(c)
4.3.2.1(d)

E-20
None

E-21
3.2(o)
4.3.2.1(l)
4.3.2.4(s)
4.3.2.4(v)

E-22
4.3.2.1(g)
4.3.2.4(bb)

E-23
4.3.2.3(p)

HVAC Findings (29) (H1 thru 31)

H-01
3.1(b)(1)
4.4.2.4(i)

H-02
4.4.2.5(bb)

H-03
3.1(b)(1)
3.1(c)(3)
3.1(c)(4)
3.2(o)
3.2(p)
4.4.2
4.4.2.1(a)
4.4.2.1(c)
4.4.2.2(h)

H-04
3.1(d)(5)
4.4.2.4(j)

H-05
3.1(c)(5)
3.1(d)(3)
4.4.2
4.4.2.1(b)
4.4.2.4(k)

H-06
3.1(a)
3.1(d)(8)
3.1(e)(4)
3.1(e)(5)
4.4.2.1(d)
4.4.2.4(l)

H-07
3.2(o)
4.4.2.4(m)

H-08
3.1(g)(6)
4.4.2.4(n)

H-09
None

H-10
3.1(b)(5)
4.4.2.2(h)
4.4.2.4(o)

H-11
4.4.2.1(f)

H-12
4.1.2.1(a)
4.4.2.4(p)

H-13
3.1(d)(5)
4.4.2.4(q)

H-14
3.1(c)(4)

H-15
3.1(b)(2)
4.4.2.4(r)

H-16
4.4.2.4(s)
4.4.2.4(t)

H-17
3.1(j)(3)
4.4.2.1(g)

H-18
3.1(d)(7)
4.4.2.1(d)
4.4.2.4(u)

H-19 & 20
None

H-21
4.4.2.4(v)

H-22
4.4.2.4(w)

H-23
3.1(d)(7)
4.4.2.1(e)
4.4.2.4(x)

H-24
4.4.2.4(y)

H-25 & 26
None

H-27
3.1(b)(1)
4.4.2.1(c)

H-28 & 29
None

H-30
4.4.2.4(z)

H-31
4.4.2.5(aa)

Mechanical Findings (64) (M1 thru 52)

M-01
4.5.3.1(c)
4.5.3.4(u)

M-02
4.5.3
4.5.3.1(c)
4.5.3.3(m)

M-03
3.1(c)(6)
3.1(d)(1)
3.1(d)(7)
4.5.3.1(a)
4.5.3.1(d)
4.5.3.4(v)

M-04
3.1(e)(4)
4.5.2.1(a)
4.5.2.3(f)
4.5.3.1(a)
4.5.3.1(b)
4.5.3.1(c)
4.5.3.1(d)
4.5.3.1(n)
4.5.3.3(o)
4.5.3.3(q)
4.5.3.4(w)

M-05
3.1(c)(6)
3.1(d)(5)
4.5.3.1(a)
4.5.3.1(d)
4.5.3.4(x)

M-06
4.5.2.3(g)
4.5.3.1(f)
4.5.3.4(y)

M-07
4.5.2.3(g)
4.5.2.4(j)
4.5.3.1(g)
4.5.3.3(p)
4.5.3.3(s)

M-08
3.1(d)(4)
4.2.2.1(b)
4.2.2.1(f)
4.2.2.4(i)
4.5.2.1(b)
4.5.3.1(g)
4.5.3.4(y)

M-09
4.5.2.1(d)
4.5.3.1(h)

M-10
3.1(d)(7)
4.2.2.4(j)
4.5.2.4(k)
4.5.3.1(a)
4.5.3.1(d)
4.5.3.1(i)
4.5.3.4(z)
4.7.3.2(n)

M-11
4.5.2.3(g)

M-12
4.5.2.3(i)
4.5.3.1(a)
4.5.3.4(aa)
4.7.3.2(n)

M-13
4.5.3.4(bb)

M-14
None

M-15
4.5.2.3(g)

M-16
4.5.2.3(h)
4.5.3.4(cc)

M-17
None

M-18
4.5.3.1(j)
4.5.3.4(dd)

M-19
4.5.2.1(c)
4.5.2.4(l)
4.5.3.4(ee)

M-20-22
None

M-23
4.5.2.4(m)

M-24
4.5.3.4(ff)
4.5.3.4(gg)

M-25
3.1(d)(5)
4.5.3.1(a)
4.5.3.3(q)

M-26
3.2(n)
4.5.2.1(c)
4.5.2.2(e)
4.5.2.5( )
4.5.2.5(u)
4.5.3.1(d)
4.5.3.1(k)
4.5.3.2(l)
4.5.3.3(r)
4.5.3.4(t)
4.5.3.4(hh)

M-27
None

M-28
3.1(b)(1)
4.5.5.2(h)

M-29
4.5.5.1(b)

M-30
3.1(f)(6)
4.5.5.1(c)
4.5.5.1(g)
4.5.5.4(g)

M-31
4.5.5.2(i)
4.5.5.4(r)
4.6.2

M-32
None

M-33
4.5.5.4(l)
4.6.2
4.6.4.4(h)

M-34
None

M-35
4.5.5.4(m)

M-36
3.2(n)
4.5.5.3(j)

M-37 to 38
None

M-39
4.5.5.1(g)

M-40
None

M-41
3.1(b)(3)
4.5.5.1(c)
4.5.5.4(o)

M-42 to 45
None

M-46
3.1(b)(5)

M-47
4.5.5.1(d)
4.6.2

M-48
4.5.5.4(p)

M-49
3.1(b)(3)
4.5.5.1(c)
4.5.5.1(e)
4.5.5.3(k)

M-50
3.1(d)(7)
4.5.5.1(a)
4.5.5.1(c)
4.5.5.1(f)

M-51
3.1(b)(3)
4.5.5.1(a)
4.5.5.1(c)
4.5.5.1(e)
4.5.5.3(k)

M-52
3.1(b)(3)
4.5.5.1(a)

4.6 Nuclear Analysis Findings (34) (N1 thru 33)

N-01
3.1(b)(2)
3.1(b)(3)
3.1(c)(6)
3.1(g)(2)
4.6.2.1(a)
4.6.2.1(b)
4.6.2.1(d)

N-02
4.6.2.1(b)
4.6.2.1(e)
4.6.2.3(q)

N-03
3.1(b)(1)
3.1(c)(6)
3.1(d)(1)
4.6.2.1(a)
4.6.2.1(b)
4.6.2.2(p)
4.6.2.3(r)

N-04
4.6.2.3(r)
4.6.2.4(t)

N-05
4.6.2.3(r)

N-06 to 07
None

N-08
3.1(c)(4)
4.6.2.1(b)
4.6.2.1(f)

N-09
3.1(b)(1)
4.6.2.4(t)

N-10
3.1(d)(5)
4.6.2.1(b)
4.6.2.1(g)

N-11
4.6.2.1(b)
4.6.2.1(h)

N-12
4.6.2.1(b)
4.6.2.1(i)
4.6.2.4(t)
4.6.4.4(e)

N-13
4.6.2.1(b)
4.6.2.1(j)
4.6.2.1(k)

N-14
4.6.2.3(r)

N-15
3.1(d)(
4.6.2
4.6.2.1(a)
4.6.2.1(b)
4.6.2.1(l)

N-16
4.6.4.1(a)
4.6.4.5(k)

N-17
3.1(b)(2)
3.1(c)(3)
4.6.2
4.6.2.1(b)
4.6.2.1(m)
4.6.2.1(n)
4.6.4.4(g)
4.6.4.5(k)

N-18
4.6.2.4(t)

N-19
3.1(e)(4)
3.1(e)(5)
4.6.4.1(a)
4.6.4.1(c)

N-20
4.6.4.1(a)
4.6.4.5(k)
4.6.4.5(l)

N-21
4.6.4.1(a)

N-22
4.6.4
4.6.4.5(l)

N-23
3.1(d)(2)
4.6.4.1(b)

N-24
4.6.4

N-25
3.1(d)(2)
4.6.2.1(b)
4.6.2.1(o)
4.6.2.3(s)

N-26
4.6.4
4.6.4.3(d)

N-27
4.6.2.3(s)
4.6.4

N-28
4.6.4
4.6.4.3(d)
4.6.4.3(i)
4.6.4.5(l)

N-29
4.6.4

N-30
4.6.4

N-31
4.6.4
4.6.4.3(d)
4.6.4.4(j)

N-32
4.6.4

N-33
None

4.7 Piping and Supports Findings (42) (P01 thru P38)

P-01
4.7.3.1(b)
4.7.3.1(c)
4.7.3.1(d)

P-02
4.7.3.2(l)

P-03
4.7.3.1(d)
4.7.3.1(e)

P-04
4.7.2.3(g)

P-05
4.7.3

P-06
4.7.3.2(m)
4.7.3.4(r)
4.7.3.4(s)

P-07
4.7.2.1(a)
4.7.2.1(b)
4.7.2.3(h)
4.7.3
4.7.3.1(g)
4.7.3.1(h)
4.7.3.4(t)
4.7.3.4(v)

P-08
4.7.2.3(i)
4.7.3
4.7.3.3(p)

P-09
4.7.2.1(c)

P-10 to 11
None

P-12
4.7.2.1(d)
4.7.2.4(l)
4.7.3
4.7.3.4(u)

P-13
4.7.3

P-14
None

P-15
4.7.3.

P-16
3.1(d)(8)
4.7.2.1(e)
4.7.3.1(f)

P-17
3.2(n)
4.5.2.2(e)
4.7.3.2(n)

P-18
4.7.2.3(h)
4.7.3
4.7.3.4(v)

P-19
4.7.3
4.7.3.4(w)

P-20
3.1(d)(7)
3.1(e)(4)
3.1(e)(5)
4.7.2.3(j)
4.7.2.4(o)
4.7.3
4.7.3.1(a)

P-21
4.7.3.1(i)

P-22
4.7.3.3(q)

P-23
None

P-24
4.7.2.1(f)
4.7.3

P-25
4.7.3

P-26
4.7.3.1(j)

P-27
4.7.3

P-28
4.7.3

P-29
4.7.3.2(o)
4.7.3.1(k)

P-30
4.7.2.3(k)
4.7.3

P-31
None

P-32
4.7.2.4(m)
4.7.3
4.7.3.4(x)

P-33
4.7.2.5(p)

P-34
4.7.3

P-35
4.7.3

P-36
4.7.2.4(n)
4.7.3
4.7.3.4(y)

P-37
None

P-38
4.7.3

4.8 Radiological Controls Findings (39) R-01 - R-32

R-01
3.1(d)(8)
3.2(n)
4.8.2
4.8.2.1(b)
4.8.2.2(i)

R-02
4.8.2
4.8.2.2(i)
4.8.2.2(j)

R-03
4.8.2.4(q)
4.8.2.4(r)

P-04
4.8.2.4(s)

P-05
3.1(d)(1)
4.8.2
4.8.2.1(c)
4.8.2.4(t)
4.8.2.4(u)

R-06
3.1(d)(5)
3.1(e)(3)
4.3.2.1(a)
4.8.2.1(a)
4.8.2.4(v)

R-07
3.1(d)(2)
4.2.2.1(b)
4.8.2
4.8.2.1(d)
4.8.2.2(n)

R-08
4.8.2.4(w)

R-09
4.8.2
4.8.2.2(j)
4.8.2.2(k)

R-10
3.1(d)(5)
4.8.2
4.8.2.1(e)
4.8.2.2(m)
4.8.2.4(s)
4.8.2.4(x)

R-11
4.8.2
4.8.2.1(d)
4.8.2.1(g)
4.8.2.2(l)
4.8.2.4(y)

R-12
3.1(d)(7)
4.8.2
4.8.2.1(d)
4.8.2.2(m)
4.8.2.4(aa)
4.8.2.4(z)

R-13
4.8.2
4.8.2.2(n)

R-14
4.8.2.1(d)
4.8.2.4(aa)

R-15
4.8.2.2(o)

R-16
None

R-17
4.8.2.4(bb)

R-18
None

R-19
4.8.2.3(p)
4.8.2.4(cc)

R-20
4.8.2
4.8.2.4(dd)

R-21
4.8.2.4(kk)

R-22
4.8.2
4.8.2.4(ee)

R-23
4.8.2.4(ff)

R-24
4.8.2.4(ll)

R-25
4.8.2.4(gg)

R-26
4.8.2.4(jj)

R-27
4.8.2.4(ee)

R-28
4.8.2.4(hh)

R-29
4.8.2.1(c)

R-30
4.8.2.1(f)
4.82.4(ii)

R-31 & 32
None

Geotechnic Findings (0) (G01 thru G6)
G1 through G-6 (Included in Civil/Structural)

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16. ABSTRACT *(200 words or less)* This report is the NRC staff's review of the South Texas Project's "Quadrex Report." The Quadrex Report contained a limited assessment of the Brown & Root engineering design efforts for STP. This design review was conducted during January-May 1981 by the Quadrex Corporation at the request of Houston Lighting & Power Company. Subsequently, the Quadrex Report will become the subject of a public hearing to be held by the ASLB at a later date. In November 1981, HL&P announced that Bechtel Power Corporation would replace B&R as the AE. As a result, Bechtel was assigned the task of resolving the Quadrex findings. Their report, EN-619 (Quadrex Work Package) was completed in September 1982. In February 1982, Region IV requested HL&P to provide information on their transition program pursuant to 10 CFR 50.54(f). Information on the Quadrex Report resolution was specifically requested. A NRC team composed of personnel from OIE, NRR, and Region IV conducted the staff review, principally in the Bechtel offices in Houston, Texas. This report details the results of the review of approximately 351 separate Quadrex findings. Each finding was reviewed for reportability under 10 CFR 50.55(e), safety significance and generic implications, and adequacy of resolution. Assessments and conclusions are given in the report along with the individual inspection findings.

17. KEY WORDS AND DOCUMENT ANALYSIS

17a. DESCRIPTORS

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SOUTH TEXAS PROJECT
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HL&P
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