THE BROWN & ROOT ASSESSMENT OF THE QUADREX DESIGN REVIEW OF THE SOUTH TEXAS PROJECT

APRIL, 1982

Brown & Root, Inc.

Engineers • Constructors

HOUSTON, TEXAS

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1.0 INTRODUCTION

This report contains Brown & Root, Inc.'s (Brown & Root) general assessment of the Quadrex Corporation (Quadrex) Report entitled Design Review of Brown & Root Engineering Work for the South Texas Project (Volumes I through III) dated May 1981 (the Quadrex Report), and Brown & Root's detailed responses to the major findings in the Quadrex Report.

Quadrex reported a substantial number of findings, which portray the South Texas Project (STP) design as one that might not meet applicable requirements set by the Nuclear Regulatory Commission for licensing commercial nuclear power plants. As shown in this report, the underlying data, and in many instances the individual assessments, do not support the Quadrex Report findings. Brown & Root has prepared this report to address each of the most significant Quadrex findings, evaluate them, and put them in proper perspective.

Evaluation of the Quadrex Findings

The Quadrex Report contains approximately 300 findings concerning the STP design, of which 135 were placed in "Most Serious" and "Serious" categories. Of those 135 findings, seventeen were "Generic" findings said to be applicable to most, if not all, the Brown & Root technical disciplines. The remainder are "Specific" findings directed at the various disciplines. The detailed responses set forth in this report demonstrate that all Generic findings, and the vast majority (all but 18) of the Specific ones, are erroneous. In the few cases in which Brown & Root agrees with a Quadrex finding, the matter is either insignificant, is outside Brown & Root's responsibility, or was known to Brown & Root and corrective action had been initiated or scheduled. See Table A at the end of this section.

Further, Brown & Root believes that Quadrex's characterizations of the significance of its findings are uniformly erroneous. The only potentially reportable design deficiency addressed in the Quadrex Report was in the HVAC systems, and was in fact identified to Quadrex by Brown & Root. Brown & Root filed a report to the NRC pursuant to 10 CFR 21 regarding this deficiency. The systems in question were undergoing a re-evaluation at the time of the Quadrex review. This re-evaluation resulted in design modifications that resolved the identified deficiencies. Indeed, none of the Quadrex findings has, at this point in the STP design, any safety significance; nor would any of them cause significant licensing delays.

Errors in the Quadrex Findings

As noted above, all the Generic Quadrex findings, and the vast majority of the Specific findings, are invalid. This is due to a number of reasons.

First, the findings are extremely broad generalizations of individual technical assessments, and in many instances are unsupported, or even contradicted, by the assessments.

Second, the underlying technical assessments are often based on a misunderstanding of the factual information conveyed to Quadrex by Brown & Root.

Third, many findings identify as shortcomings mere differences between Brown & Root and Quadrex with respect to the preferred design philosophy or method of analysis, or the type of documentation in which the design should be embodied. While Quadrex was entitled to express its professional opinion about the merits of Brown & Root's approach, considerations of fairness required Quadrex to indicate whether the design approach it criticized was consistent with NRC requirements and industry practices. All of the Brown & Root design approaches were consistent with NRC requirements and industry practices.

Fourth, in a number of instances Quadrex did not fully understand the STP design philosophy and found problems where no problems existed.

Fifth, Quadrex failed to recognize the ongoing nature of the STP design and described as design shortcomings matters still in the process of evaluation or design iteration by Brown & Root.

Sixth, the method used by Quadrex for categorizing the seriousness of the findings was arbitrary. In most instances, the gravity of the ranking was not warranted by the subject and nature of the finding. In several instances, there was no consistency between the assessment of the adequacy of the work of a technical discipline and the categorization of specific findings for that discipline.

Evaluation of the Quadrex Review Process

It is not surprising that the findings contained in the Quadrex Report are for the most part erroneous. The Quadrex review process was flawed from its inception in the manner it was conceived, its time schedule, its conduct, and as a result, in its assessments, findings and conclusions.

Quadrex was hired by the Houston Lighting & Power Co. (HL&P) to assist it in performing a technical review of Brown & Root's engineering design work for the STP. Having determined that an exhaustive review was "neither feasible nor desired," Quadrex was asked to "carefully devise a sampling program to determine the B&R engineering response to known unique nuclear industry issues and problem areas ... (to) provide sufficient insight regarding the adequacy of the technical work performed by that discipline." In fact, Quadrex's review was not a sampling program, nor was it capable of providing a sufficient insight into the adequacy of the STP design.

(a) Selectivity and Bias

HL&P personnel participated in the selection of the technical areas to be reviewed, and the areas selected apparently were those in which the HL&P personnel involved believed design problems may have existed. HL&P personnel also worked with Quadrex in the formulation of the questions to be posed to Brown & Root, and they reviewed and approved those questions. Under these circumstances, the Quadrex review could in no way constitute a valid sampling program for assessing the adequacy of Brown & Root's general design effort at the STP. The Quadrex review was a rather hurried investigation of selected, isolated areas of interest, from which it was erroneous to draw any general inferences.

In addition to dictating the way in which the review was to be conducted, HL&P personnel were deeply involved in all other phases of the review. Thus, HL&P personnel participated in the review meetings where Brown & Root provided information, and in the questioning of Brown & Root personnel at those meetings; HL&P personnel commented on the Brown & Root responses to questions, on the individual reviewers' assessments, and other aspects of the Report; and HL&P was briefed by Quadrex, and discussed with it the ongoing review. HL&P's pervasive participation may have compromised the independence of judgment of the Quadrex reviewers and the Quadrex personnel writing the Report.

(b) Lack of Time

Quadrex, in fact, was not allowed sufficient time to plan its investigation, to establish the key factors to be evaluated and the pertinent acceptance criteria, to obtain all the necessary design data from Brown & Root, to conduct its review, and to assimilate the information it had gathered, write findings, and issue its Report. Likewise, Brown & Root had inadequate time to provide all the technical information that may have been useful to Quadrex.

A total of 306 detailed technical questions, many of which required extensive file research, were submitted by Quadrex to Brown & Root in February, 1981. Responses to those questions were to be provided during design review meetings to be held in February and March, 1981. While responding to those questions (and to the follow-up questions posed at the review meetings) Brown & Root was also asked to continue its day-to-day engineering work in support of the STP construction effort. Also ongoing at the time were a series of important engineering activities relating to NRC public hearings and NRC inspections, and a major project cost and schedule re-estimate. Because of the time constraints of these ongoing activities, Brown & Root requested that HL&P reschedule the Quadrex review until a time when Brown & Root's technical personnel could give it more attention. HL&P declined to do so.

Quadrex was operating under an impossible schedule. To address the adequacy of a nuclear power plant design, it is necessary to conduct an in-depth review of thousands of pieces of documentation and interview key technical management personnel to determine whether their objectives are consistent with current licensing practices in their areas of expertise. Quadrex could not, and did not, accomplish this in the short time allowed. As a consequence, the review process suffered in all respects from the inadequate time allowed to it.

(c) Lack of Proper Approach

Quadrex's review was performed before Brown & Root's design had been finalized. When examining an ongoing design, the appropriate subject for investigation is the design basis, not the status of the design at the time of the review, because the design verification process at the completion of the design provides assurance that the design objectives will have been met. Quadrex erroneously focused on design status. Therefore, Quadrex was unable to assess objectively the overall design with respect to safety, for it failed to take into consideration that the design was not in its final stage. By the very nature of the process, refinement of the design continues until the plant is completed.

Coupled with its lack of recognition of the evolving status of the design at the time of the review, Quadrex had no overall design review plan that identified the key factors to be evaluated and the acceptance criteria to be used. These factors combined to produce erroneous and unrealistic assessments by Quadrex of the designs it examined.

(d) Lack of Proper Experience

Quadrex's experience in the nuclear power plant industry is as a consultant, mostly in connection with the design of the nuclear steam supply systems, that is, the "primary" side of a nuclear power plant. Quadrex is not an architect-engineer (A/E) and has had little, if any, experience in the plant design performed by A/Es such as Brown & Root. Therefore, Quadrex was not qualified to put in perspective the various features of Brown & Root's design and, in a number of instances, appears to have failed to comprehend the overall design approach. For example, Quadrex identified as "most serious problems" matters that are common A/E practice, such as performing the civil and structural design of the plant based on preliminary, yet conservative, environmental and load data.

Quadrex's lack of A/E experience also appears to have prevented it from exercising the degree of judgment that is required to determine

whether a design practice reasonably meets the intent of the NRC General Design Criteria and other pertinent regulations and industry standards. For instance, Quadrex criticizes Brown & Root's plan to verify the adequacy of the structural design after the structures have been erected. However, this is the accepted industry practice, and one that meets the intent of the applicable Codes and NRC regulatory requirements.

(e) Lack of Verification of Facts

The normal engineering review practice is to provide opportunity for comments at the end of the review so that misunderstandings can be identified and corrected, and agreements can be reached as to matters of fact. Such a process would have been particularly helpful in connection with the Quadrex review because, as noted above, the short period allowed did not permit Quadrex to gain an adequate understanding of many aspects of the STP design. However, Quadrex did not make use of this process. Had Quadrex done so, many of the mistakes in the Report might have been avoided.

Based on the answers provided by Brown & Root, the individual Quadrex reviewers responsible for the various technical disciplines wrote assessments of the adequacy of each response. These assessments include statements of Quadrex's questions and paraphrases of purported Brown & Root responses. Quadrex did not verify with Brown & Root the accuracy of the characterizations of Brown & Root's position. In fact, many of the responses attributed to Brown & Root do not accurately reflect what was said. Because of their attribution to Brown & Root, however, an uninformed reader would conclude that they do, in fact, reflect Brown & Root's position. As a result, the factual statements in the Quadrex Report are often misleading as well as mistaken.

(f) Exclusion of Key Technical Groups

Perhaps most egregious of all, Quadrex failed to include in its review key groups of Brown & Root's technical staff such as Licensing, System Design Assurance, and In-Service Inspection (ISI). Yet, Quadrex was critical of Brown & Root's licensing, design assurance and ISI programs. The absence of input from these groups left important gaps in Quadrex's understanding of the design and the procedures governing it, led to a substantial number of erroneous assessments and findings, and undercut the overall validity of the Report.

In view of these flaws, it is not surprising that, as indicated above, the Quadrex Report is replete with inaccurate factual statements, mischaracterizations of information conveyed by Brown & Root, and unsupported and erroneous generalizations about the adequacy of the STP design.

TABLE A

SUMMARY OF BROWN & ROOT, INC.'S

ASSESSMENT OF THE QUADREX REPORT

QUADREX FINDINGS AND IMPACT ASSESSMENTS	BROWN & ROOT'S POSITION			
	Agree With Finding	Agree With Impact Assessment	Disagree With Finding	Disagree With Impact Assessment
Generic Findings				
3.1(a)			X	X
3.1(b)			X	X
3.1(c)			X	X
3.1(d)			X	X
3.1(e)			X	X
3.1(f)			X	X
3.1(g)			X	X
3.1(h)			X	X
3.1(i)			X	X
3.1(j)			X	X
3.2(k)			X	X
3.2(l)			X	X
3.2(m)			X	X
3.2(n)			X	X
3.2(o)			X	X 1/
3.2(p)			X	X
3.2(q)			X	X
Specific Findings				
Civil/Structural				
4.1.2.1(a)			X	X
4.1.2.1(b)			X	X
4.1.2.1(c)			X	X
4.1.2.1(d)			X	X
4.1.2.1(e)			X	X
4.1.2.1(f)			X	X
4.1.2.1(g)			X	X
4.1.2.1(h)			X	X

1/ This finding covers an area which was not within Brown & Root's scope of work. Therefore, Brown & Root expresses no view as to the finding's impact on plant licensability or on the plant's ability to generate reliable power.

QUADREX FINDINGS AND IMPACT ASSESSMENTS	BROWN & ROOT'S POSITION			
	Agree With Finding	Agree With Impact Assessment	Disagree With Finding	Disagree With Impact Assessment
Computer Codes				
4.2.2.1(a)	X			X
4.2.2.1(b)			X	X
4.2.2.1(c)	X			X
4.2.2.1(d)	X			X
4.2.2.1(e)			X	X
4.2.2.1(f)			X	X
Electrical/I&C				
4.3.2.1(a)			X	X
4.3.2.1(b)			X	X
4.3.2.1(c)			X	X
4.3.2.1(d)			X	X
4.3.2.1(e)			X	X
4.3.2.1(f)			X	X
4.3.2.1(g)			X	X
4.3.2.1(h)			X	X
4.3.2.1(i)			X	X
4.3.2.1(j)			X	X
4.3.2.1(k)			X	X
4.3.2.1(l)			X	X */
4.3.2.1(m)			X	X
4.3.2.1(n)			X	X
4.3.2.1(o)			X	X
HVAC				
4.4.2.1(a)	X			X
4.4.2.1(b)	X			X
4.4.2.1(c)			X	X
4.4.2.1(d)			X	X
4.4.2.1(e)			X	X
4.4.2.1(f)	X			X
4.4.2.1(g)			X	X
4.4.2.2(h)			X	X
Pipe Rupture (EDS)				
4.5.2.1(a)			X	X
4.5.2.1(b)			X	X
4.5.2.1(c)			X	X
4.5.2.1(d)			X	X
4.5.2.2(e)			X	X

*/ See fn. 1 on page 1 of this Summary

QUADREX FINDINGS AND IMPACT ASSESSMENTS	BROWN & ROOT'S POSITION			
	Agree With Finding	Agree With Impact Assessment	Disagree With Finding	Disagree With Impact Assessment
Pipe Rupture (B&R)				
4.5.3.1(a)			X	X
4.5.3.1(b)			X	X
4.5.3.1(c)			X	X
4.5.3.1(d)			X	X
4.5.3.1(e)			X	X
4.5.3.1(f)			X	X
4.5.3.1(g)			X	X
4.5.3.1(h)			X	X
4.5.3.1(i)			X	X
4.5.3.1(j)			X	X
4.5.3.1(k)			X	X
4.5.3.2(l)			X	X
Mechanical				
4.5.5.1(a)			X	X
4.5.5.1(b)			X	X
4.5.5.1(c)			X	X
4.5.5.1(d)			X	X
4.5.5.1(e)			X	X
4.5.5.1(f)			X	X
4.5.5.1(g)	X			X
4.5.5.2(h)			X	X
4.5.5.2(i)	X			X */
Nuclear Analysis				
4.6.2.1(a)			X	X
4.6.2.1(b)			X	X
4.6.2.1(c)			X	X
4.6.2.1(d)			X	X
4.6.2.1(e)			X	X
4.6.2.1(f)			X	X
4.6.2.1(g)			X	X
4.6.2.1(h)			X	X
4.6.2.1(i)			X	X
4.6.2.1(j)			X	X
4.6.2.1(k)			X	X
4.6.2.1(l)			X	X
4.6.2.1(m)	X			X

*/ See fn. 1 on page 1 of this Summary

QUADREX FINDINGS AND IMPACT ASSESSMENTS	BROWN & ROOT'S POSITION			
	Agree With Finding	Agree With Impact Assessment	Disagree With Finding	Disagree With Impact Assessment
4.6.2.1(n)			X	X
4.6.2.1(o)			X	X
4.6.2.2(p)			X	X
Mechanical Analysis				
4.6.4.1(a)	X			X
4.6.4.1(b)	X			X
4.6.4.1(c)			X	X
Piping & Supports (Inside Containment)				
4.7.2.1(a)	X			X
4.7.2.1(b)			X	X
4.7.2.1(c)	X			X
4.7.2.1(d)			X	X
4.7.2.1(e)			X	X
4.7.2.1(f)	X			X
Piping & Supports (Outside Containment)				
4.7.3.1(a)			X	X
4.7.3.1(b)	X			X
4.7.3.1(c)			X	X
4.7.3.1(d)			X	X
4.7.3.1(e)	X			X
4.7.3.1(f)			X	X
4.7.3.1(g)	X			X
4.7.3.1(h)			X	X
4.7.3.1(i)			X	X
4.7.3.1(j)			X	X
4.7.3.1(k)			X	X
4.7.3.2(l)			X	X
4.7.3.2(m)			X	X
4.7.3.2(n)			X	X
4.7.3.2(o)			X	X

QUADREX FINDINGS AND IMPACT ASSESSMENT	BROWN & ROOT'S POSITION			
	Agree With Finding	Agree With Impact Assessment	Disagree With Finding	Disagree With Impact Assessment
Radiological				
4.8.2.1(a)			X	X
4.8.2.1(b)			X	X
4.8.2.1(c)	X			X */
4.8.2.1(d)			X	X
4.8.2.1(e)			X	X
4.8.2.1(f)			X	X
4.8.2.1(g)			X	X
4.8.2.2(h)			X	X
4.8.2.2(i)			X	X
4.8.2.2(j)			X	X
4.8.2.2(k)			X	X
4.8.2.2(l)			X	X
4.8.2.2(m)			X	X
4.8.2.2(n)			X	X
4.8.2.2(o)			X	X

*/ See fn. 1 on page 1 of this Summary

2.0 RESPONSES TO SPECIFIC DISCIPLINE FINDINGS

Contained in this section are the Brown & Root responses to each of the "Most Serious" and "Serious" findings 1/ for each discipline found in Section 4.0 of Volume I of the Quadrex Report. The remaining findings, classified by Quadrex as "Noteworthy", "Potential Problems", and "Other Findings", do not raise in Quadrex's view significant problems and therefore do not merit detailed discussion by Brown & Root. They are, however, subject to the same shortcomings discussed in detail in Section 1.0 of this report and herein.

These Brown & Root responses are presented for each discipline in the same order as the findings appear in Volume I of the Quadrex Report. Although the Brown & Root section numbers differ from those used by Quadrex, the responses to each finding identify the Quadrex finding number at the top of each response. Each Quadrex finding is reproduced verbatim, with Brown & Root's response directly following.

The following specific discipline findings and responses are contained in this section:

SECTION	DISCIPLINE
2.1	Civil/Structural
2.2	Computer Codes
2.3	Electrical/I&C
2.4	HVAC
2.5	Pipe Rupture
2.6	Mechanical
2.7	Nuclear Analysis
2.8	Mechanical Analysis
2.9	Piping and Supports
2.10	Radiological

1/ When reference is made to Quadrex "findings", "questions" and "assessments", "findings" means the evaluations contained in Volume I of the Quadrex Report; "questions" are the detailed technical questions asked by Quadrex during the review; and "assessments" refers to the assessments by individual Quadrex reviewers of Brown & Root's responses to the "questions". The "questions" and "assessments" are set forth in Volumes II and III of the Quadrex Report.

SECTION 2.1 - CIVIL/STRUCTURAL FINDINGS

Contained in this section are the Brown & Root responses to the Quadrex findings related to the Civil/Structural Discipline, which appear in Section 4.1.2 of Volume I of the Quadrex Report. For the Civil/Structural Discipline, Quadrex posed 46 questions from which Quadrex made eight "Most Serious" findings and no "Serious" findings. The following is a summary overview of the Quadrex findings and the Brown & Root responses thereto.

SECTION 2.1.1 - SUMMARY OVERVIEW

Of the eight Quadrex findings discussed in this section, five (5) relate to Brown & Root's use of input load data, specifically: the alleged failure of Brown & Root to question the reasonableness of input load data (see Quadrex Findings Nos. 4.1.2.1(a) and (b)), and the alleged inappropriateness of using preliminary input load data (see Quadrex Finding Nos. 4.1.2.1(f), (g) and (h)). As indicated in the Brown & Root responses to Quadrex Finding Nos. 4.1.2.1(a) and (b), the Civil/Structural Discipline can document not only that it reviewed the reasonableness and accuracy of input load data, but also that such data were carefully reviewed with Engineering Management.

Moreover, with regard to use of preliminary input load data, Brown & Root clearly demonstrates in its response to Quadrex Finding Nos. 4.1.2.1(f), (g), and (h) that there was nothing inappropriate about Brown & Root's use of such data because the data utilized were conservative and Brown & Root's design verification procedures require both documented control and final verification of those data when they become final. Indeed, these Brown & Root procedures are consistent with and satisfy all NRC requirements and are comparable to, and probably better than, the procedures used elsewhere in the industry.

Two of the Quadrex findings (see Quadrex Finding Nos. 4.1.2.1(d) and (e)) alleged design deficiencies for which there is no support. For example, Quadrex Finding No. 4.1.2.1(d) is based in part on an alleged deficiency in the allowable shear stress utilized by Brown & Root for load combinations. As Brown & Root indicates in its response to the finding, the structural design of STP satisfies both the AISC code and NRC acceptance criteria and requirements relating to allowable shear stress.

Finally, in Quadrex Finding No. 4.1.2.1(c), Quadrex disagrees with the methodology and approach taken by Brown & Root in analyzing the Turbine Generator Building. Brown & Root's methodology and design approach are consistent with sound engineering practices and have not been shown by Quadrex to be technically inadequate. That Quadrex design preferences may point in another direction does not detract from the validity of Brown & Root's approach.

In summary, the Quadrex findings related to the Civil/Structural Discipline identify no design deficiencies which would warrant corrective action or which could have any impact on plant licensability.

SECTION 2.1.2

RESPONSE TO CIVIL/STRUCTURAL FINDINGS

QUADREX FINDING NO. 4.1.2.1(a) - CIVIL/STRUCTURAL TECHNICAL ADEQUACY ASSESSMENT

For the Civil/Structural Discipline, the following findings are expected to seriously impact plant licensability:

(a) "B&R Structural Group does not appear to question the reasonableness of the 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 Question C-1, H-12 and N-3)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Contrary to Quadrex's allegation in the first sentence of the finding, the Structural Discipline does question the reasonableness and the acccuracy of its input data including margin. There have been many cases where the discipline has questioned data to the point of asking to review them with Engineering Management because of the effect that the use of the data could have on the design of a structure.

Quadrex seems to base the above finding upon its assessment of Brown & Root's response to Question C-4, where Quadrex criticized the Structural Discipline's alleged failure to review the input data used in the design of the secondary shield wall. Specifically, Quadrex questioned the conservative factor of 1.4 for design margin used by Brown & Root in the structural design of the wall. However, this factor is from the NRC Standard Review Plan; the Structural Discipline reviewed this number and found it reasonable. Similarly, Quadrex questioned the utilization of a 130 kip sizing load supplied by EDS for use in accounting for the effects of the rupture of lines 4" and smaller. Quadrex stated that this input value was unverified. This statement is incorrect. EDS, based on its experience, supplied this value as a preliminary sizing load to allow the design to continue and still appropriately account for pipe rupture effects. The discipline indeed reviewed this value, and established to its satisfaction that it was valid as a sizing load.

It is worthy of note that the Structural Discipline's judgment in accepting these input load factors has subsequently been re-evaluated using actual pipe rupture load data and the design has been shown to have adequately accounted for the loads under pipe rupture conditions.

The second sentence of the finding states that "some of the environmental information that affected the structural discipline has not become fixed even at this point in design". In fact, the environmental information used by the Structural Discipline was "fixed" early in the design cycle. However, in accordance with industry standards and practice, this information is continuously being refined and updated and incorporated into the plant design. This process of continuous refinement and updating of information throughout the design is a proper exercise of the role of an architect-engineer during the design of a major project.

To the extent that the second sentence in this finding also evidences a Quadrex concern that some of the design input loads have not been finalized even at a time when the majority of the structure has been designed and constructed, the concern is unjustified. As discussed in the Brown & Root response to Quadrex Finding No. 3.1(j), it is standard industry practice to have evolving design input loads throughout the construction process. The practice is acceptable so long as procedural controls are in place to assure that the input load assumptions (which are clearly identified as "preliminary" in the Brown & Root design) are tracked and finalized prior to plant operation. The Brown & Root design control system accomplishes this goal.

From the foregoing, it is clear that the above finding is erroneous and will not impact plant licensability.

QUADREX FINDING NO. 4...2.1(b) - CIVIL/STRUCTURAL TECHNICAL ADEQUACY ASSESSMENT

In the Civil/Structural Discipline, the following findings are expected to seriously impact plant licensability:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The first part of the finding alleges that the Civil/Structural Discipline did not question the reasonableness of postulated missiles. The criteria for internal missiles in effect at STP were originally issued in January, 1975 as report A369RD002, "Internal Missiles". This document was revised and reissued as TRD 1N209RQ013-A in September, 1975, and again in April, 1979. Each time the document was issued, it was reviewed by the Civil/Structural Discipline. In performing a formal review of the document, the Civil/Structural Discipline evaluated the criteria, including the reasonableness of postulated missiles.

Moreover, the reasonableness of postulated internal missiles is clearly demonstrated in the TRD and is based on design criteria requirements, as well as design philosophy. In the TRD, it is emphasized that, where possible, component and system design will preclude the generation of missiles. This is achieved by suitable choice of materials, consideration of normal and faulted stress levels, and definition of system and component characteristics that avoid missile-producing effects even under faulted conditions.

The TRD also gives the design requirements for internal missile protection. Potential missile sources and targets are to be determined after a review of the layout of safety related structures, systems, and components has been completed. This determination will be accomplished through the use of Safety System Hazard Analysis drawings, which will identify missile sources and unacceptable targets, as well as other hazards. Protection devices will be designed where damage evaluation confirms the need for them.

Prevention of pump impeller missiles is one example of the implementation of the TRD criteria. Motor driven pumps and compressors are driven by AC induction motors that cannot overspeed, thus decreasing the risk of generating a missile.

It should also be noted that Quadrex's assessment of the Brown & Root response to Question C-9, cited in the above finding, does not in fact support the finding. In that assessment, Quadrex stated:

> "It is evident that the Structural Discipline was handling the missile penetration problem in accordance with industry practice and the state-of-the-art. TRD 1N209RQ013-A was reviewed and found to contain comprehensive design criteria for determining and protecting against internally generated missiles."

Quadrex also alleges in the above finding that there was no evidence that the internal missile criteria had been implemented into the design. This part of the finding is also clearly unfounded. A careful review of the project design records would have disclosed that the internal missile criteria have been incorporated into various aspects of the STP design to minimize missile generation potential. Final incorporation of the missile criteria into the design would have been accomplished based on the Safety Systems Hazards Program. The timing of this activity is consistent with industry practice.

Given the above facts, it is clear that Brown & Root has adequately addressed the problem of postulated internal missiles. Accordingly, the above Quadrex finding is erroneous and will not impact plant licensability.

QUADREX FINDING NO. 4.1.2.1(c) - CIVIL/STRUCTURAL TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Contrary to Quadrex's assertion, there was no PSAR commitment that the STP Turbine Generator Building (TGB) would be analyzed for the Safe Shutdown Earthquake (SSE) condition. Rather, the TGB is classified as a Non-Category I structure and, accordingly, does not require an SSE analysis. Morever, neither the NRC nor HL&P have required that such an analysis be conducted.

The TGB must be designed, however, such that any failure of the building will not result in an unacceptable interaction with any safety-related structure, system, or component. In order to verify that the TGB has been appropriately designed, Brown & Root focused on the turbine generator pedestal located inside the building. This pedestal is separated from the remaining structures by a three inch gap. Because the TGB is a steel frame structure with concrete floors, a limited three inch movement would not cause a collapse of the building. If the TGB frame was deformed in excess of three inches during a postulated SSE, the pedestal would provide additional support for the building. In addition, Brown & Root designed the TGB to withstand tornado loadings and will install barriers in the building for missile protection. Brown & Root has determined in accordance with sound engineering judgment that the TGB will not collapse under SSE loadings in such a way as to interact with any safety-related structure, system or component.

The above Quadrex finding is, therefore, erroneous and will not impact plant licensability.

QUADREX FINDING NO. 4.1.2.1(d) - CIVIL/STRUCTURAL TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

This Quadrex finding is not only inaccurate but is also unsupported by the information generated by the questions cited in the finding. Quadrex Question C-5 relates to the maximum allowable shear stress used by Brown & Root for load combinations. The structural design at STP satisfies both the AISC Code and the NRC requirements and acceptance criteria relating to allowable shear stress. Indeed, the Quadrex assessment of Brown & Root's response to Question C-5 recognized that Brown & Root's response was adequate. On the other hand, Quadrex registered a concern regarding the possible lack of engineering judgment in cases where the NRC acceptance criteria may not be appropriately conservative. However, Quadrex did not cite any examples where this hypothetical situation might exist at STP. Moreover, it was and is Brown & Root's judgment that the AISC Code and the NRC acceptance criteria provided adequate margins in each case that they were used.

Quadrex also cites Question C-20, which relates to criteria used for decoupling major subsystems or equipment from the building model. Quadrex indicated in its assessment of Brown & Root's response to this question that the Brown & Root approach was consistent with industry norms and practices. However, Quadrex also theorized that Brown & Root may not have utilized these criteria in its evaluation of coupled and decoupled systems and thus may have failed to follow "exactly" an FSAR commitment. This speculative inference, however, is not supported by the facts. The Reactor Containment Building mathematical model was originally developed by EDS and was reviewed in detail by Brown & Root. All heavy equipment items, such as the reactor pressure vessel, steam generators, and reactor coolant pumps, were included in the model. Decoupling criteria were properly incorporated. In addition, Brown & Root conducted extensive studies to investigate the effects of frequency variation due to decoupling. Accordingly, Quadrex was in error when it indicated that there is failure to comply with the FSAR commitments on decoupling.

Finally, Quadrex cites in support of this finding Question C-43, which relates to the procedure and criteria used to compute the consequences of dropping heavy loads on safety-category floor slabs. Although Brown & Root had made calculations of the effects of heavy loads dropping on safety-category floor slabs, Brown & Root did not develop either a procedure or criteria for computing the consequences of dropping heavy loads, and there was no NRC regulation requiring Brown & Root to do so. Brown & Root was aware of NUREG-0612, which was issued in July, 1980, and which discusses the consequences of dropping heavy loads within safety-related structures. NUREG-0612 was primarily directed at existing operating plants built to earlier criteria. Indeed, a Brown & Root review of NUREG-0612 revealed that the majority of its recommendations had already been incorporated into the STP design by virtue of existing regulatory criteria and licensing commitments. At the time of the Quadrex review, Brown & Root was awaiting direction from HL&P on the extent to which NUREG-0612 should be addressed. HL&P was, in turn, awaiting promised implementation guidance from the NRC. On June 26, 1981, HL&P authorized and defined certain work to be done by Brown & Root in response to NRC questions relating to NUREG-0612.

Based on the above facts, there is no evidence supporting the Quadrex finding of significant Civil/Structural differences between the approved NRC criteria or methodology and FSAR commitments. Thus, the above Quadrex finding is erroneous and will not impact plant licensability.

QUADREX FINDING NO. 4.1.2.1(e) - CIVIL/STRUCTURAL TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

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

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The above finding is not only erroneous, but is also unsupported by the Questions listed in it.

With respect to Question C-3, this finding does not reflect the concern expressed by the Quadrex reviewer who wrote the assessment of Brown & Root's response to the question. The concern in the Question C-3 assessment was directed at the Mechanical Discipline, not the Civil/Structural Discipline. Therefore, the finding is totally misdirected.

Question C-3 deals with the design of the reactor containment building polar crane and of the crane supports. The Quadrex reviewer who examined Brown & Root's response to the question had no comments on the design of the crane supports, which was performed by the Civil/Structural Discipline. With respect to the crane itself, the reviewer concluded that the Brown & Root specification for the crane (written by the Mechanical Discipline) was adequate, but observed that "R.G. 1.104 or NUREG-0554, which present new NRC requirements, have not been reviewed for their potential impact on STP."

In fact, the Question C-3 assessment is totally erroneous. Brown & Root evaluated both R.G. 1.104 and its successor NUREG-0554 (which merely incorporates previous NRC Staff positions) for their potential impact on STP. These evaluations are well documented. See Brown & Root's response to Quadrex Generic Finding No. 3.1(d). With respect to the polar crane design, Brown & Root concluded that R.G. 1.104 would not be applicable to the STP polar crane. Thus, the assertions in Quadrex's assessment of Brown & Root's response to Question C-3 are erroneous and in no way support the above finding.

Question C-35, also cited in the above finding, does not support it either. That question asked whether NUREG-0577 had been taken into consideration for critical dynamically loaded structures. This NUREG is a draft document, which has not yet been issued for use by the NRC. It mostly concerns Westinghouse-supplied equipment, and in fact Quadrex's assessment of Brown & Root's response to Question C-35 states that:

> "there is, however, a potential exposure for the STP project in this area especially in the NSSS supports. It was not determined whether Westinghouse has this area covered." (Emphasis added)

Indeed, the Quadrex assessment did not indicate that Brown & Root had failed to respond to NUREG-0577. Thus, even if the assessment of Brown & Root's response to Question C-35 had been correct, it would not have supported the above finding. In reality, the Question C-35 assessment is erroneous. The part of NUREG-0577 which is relevant to this finding deals with the potential for cracking of bolting in steam generator supports. This portion of the NUREG was sent to all Licensees by the NRC as I&E Bulletin 80-36, dated 10/10/80. This Bulletin and the NUREG were reviewed by Brown & Root, and a response was sent to HL&P by letter ST-BR-HL-35382, dated 12/23/80.

Similarly, the NUREG was addressed by Westinghouse in detail with recommendations to HL&P by letter ST-WN-HL-1740. Brown & Root reviewed Westinghouse's recommendations and utilized them in the limited areas of the structural support design which were in Brown & Root's scope of work. Therefore, this NUREG has been adequately considered and responded to by Brown & Root.

With regard to Question C-38 (which refers to Question C-35), STP has evaluated the NUREG concern on lamellar tearing vs. ultrasonic testing in a conservative manner. In NUREG-0577, Part 2, Paragraph 6, the NRC advises as follows: "The Staff has concluded that actions by Licensees and Applicants regarding lamellar tearing may be deferred until the research program has been completed." Nevertheless, STP specifications to vendors conservatively require ultrasonic testing of weld locations on structural members before and after welding full penetration welds which contain loads in the through-thickness direction. These are the locations which cause the more severe through-thickness stresses.

Accordingly, the above finding is erroneous and will not impact plant licensability.

QUADREX FINDING NO. 4.1.2.1(f) - CIVIL/STRUCTURAL TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

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

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The first statement in the finding criticizes the adequacy of Brown & Root's use of input data supplied by EDS. This criticism is unfounded. The input data referred to is a 130 kip pipe rupture load figure utilized by Brown & Root in designing concrete and structural steel members inside containment. Because the figure was generated by EDS early in the STP design process, it was necessarily conservative (see Brown & Root's response to Quadrex Finding No. 4.5.2.1(b)). However, receiving this data at an early stage permitted Brown & Root to commence designing the members inside containment while EDS was in the process of generating the actual pipe rupture load data as a part of its pipe rupture analysis.

The 130 kip sizing load was initially used in the design of concrete slabs and walls to account for the then unknown routing of high energy piping. This sizing load was later also used in a re-evaluation of the design of structural steel members inside containment. When the routing of high energy lines was finalized, continued use of this sizing load became unnecessary. Upon receipt of the actual pipe rupture load data, Brown & Root reviewed the previously designed members inside containment to verify the adequacy of the original design. Those members which have been reviewed thus far have been shown to have been adequately designed.

Quadrex also appears to conclude in its assessment of Brown & Root's response to Question C-15 that a more cost effective design could have resulted if Brown & Root had reviewed the actual EDS loading values and locations. That conclusion is unfounded, because performing such a review would have resulted in additional costs far beyond those potentially incurred as a result of any possible overdesign.

Moreover, the approach taken by Brown & Root in utilizing conservative load figures is consistent with industry practice. It is an accepted design practice to have the design of the structural portion of a plant (whether nuclear or not) precede the design of the plant's other systems and components (see Brown & Root's response to Quadrex Finding No. 4.1.2.1(h)). In order for that structural design to commence, it was necessary to develop and design for conservative preliminary loads, including those loads resulting from assumed pipe ruptures.

Quadrex also criticizes Brown & Root in this finding for failing to generate pipe rupture loads outside containment. This criticism reflects a total misunderstanding on Quadrex's part of the philosophy of pipe rupture evaluations utilized by Brown & Root at STP. As indicated in the Brown & Root Response to Quadrex Finding No. 4.5.3.1(a), delaying pipe rupture evaluations for piping systems outside containment will have little, if any, impact because these piping systems are very few (3) in number; consequently, the analysis and design work required to mitigate the effects of ruptures in those piping systems is limited. Thus, Brown & Root could legitimately develop pipe rupture loads for these systems at the present time when more detailed information is available about the systems and the equipment that might be affected by a potential pipe rupture.

From the foregoing, it is evident that the above finding is erroneous and will have no impact on plant licensability.

QUADREX FINDING NO. 4.1.2.1(g) - CIVIL/STRUCTURAL TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

With regard to the MAB dead loads, Brown & Root utilized conservative preliminary values that are subject to final verification. In addition, in accordance with sound engineering judgment, Brown & Root has confirmed that the floor is of sufficient strength to accommodate any live loads that may be imposed.

With regard to the Quadrex concern that the amplification effects of vertical seismic loads may not have been properly considered, the final seismic spectra were not available when work commenced on the seismic calculations. However, when the final spectra were received, the floor design was evaluated in light of those spectra. That evaluation indicated that the effect of any vertical seismic load on the floor slab would be negligible because floors are thick and fundamental frequencies are high, so small amplifications would result. This determination would have been reconfirmed during the final verification.

Thus, the above Quadrex finding is erroneous and will not impact plant licensability.

QUADREX FINDING NO. 4.1.2.1(h) - CIVIL/STRUCTURAL TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

It is an accepted engineering practice to have the design of the structural portion of a plant precede the design of the mechanical/electrical systems and components. This practice is observed not only on nuclear plants, but on other types of industrial plants as well. During the initial structural design, structural loads are based upon estimates of forces produced by factors such as equipment weight, pipe loads, environmental loads, etc. These are referred to in the industry as "assumed" values. To minimize the effect of any design changes impacting on the calculation of such loads, the assumed values are conservative and in many cases are based on industry experience. However, during development, assumed loads are evaluated in accordance with sound engineering judgment, not only to preclude an excessive overdesign, but also to avoid compromising structural integrity. Utilization of such assumed values in the design of a plant's structures, as was done at STP, is an established industry practice.

In order to track and verify those assumed loads, Brown & Root developed a plan which identifies assumed values and provides for their final verification. This plan is in accordance with ANSI N45.2.11. The STP document governing the identification and verification of assumed values is Procedure STP-DC-015, "Engineering Procedure for Design Verification." The procedure requires that assumed values be identified with an asterisk in the design document and listed separately on a form which identifies all of the inputs to that document. Copies of these forms are retained in the Engineering Document Control Center. When the design of systems and components has matured to the point that loads can be identified as "final", engineering procedures require the structural designers to verify the accuracy of the assumed values. At the time the Quadrex review was conducted, the Structural Discipline was in the process of verifying the assumed values. This verification process confirmed that the

assumed loads were conservative.

For these reasons, the above finding is erroneous and will not impact plant licensability.

SECTION 2.2 - COMPUTER CODE FINDINGS

Contained in this section are the Brown & Root responses to the Quadrex findings relating to computer codes, which are contained in Section 4.2.2 of Volume I of the Quadrex Report. For the computer code area, Quadrex posed 16 questions from which Quadrex made six (6) "Most Serious" and no "Serious" findings. The following is a summary overview of the Quadrex findings in this area as well as the Brown & Root responses thereto.

SECTION 2.2.1 - SUMMARY OVERVIEW

Three of the Quadrex computer code findings relate to procedural deficiencies (mostly missing or inadequate computer program verification reports (CPVRs)) in the use of computer codes by the Nuclear Analysis Discipline. See Quadrex Finding Nos. 4.2.2.1(a), (c) and (e). As indicated in the Brown & Root responses to these findings, Brown & Root had identified these procedural deficiencies during an internal audit which took place prior to the Quadrex review. Indeed, it was Brown & Root which pointed the deficiencies out to Quadrex. These deficiencies can not, however, be regarded as atypical given the recent industry-wide increase in computer code documentation requirements and the increased emphasis that such documentation is receiving.

Subsequent to the Quadrex review, Brown & Root completed a project-wide investigation of computer code use and determined that the problem was limited to the Nuclear Analysis Discipline. A detailed review of major computer codes used by the Nuclear Analysis Discipline was conducted and resulted in no findings which appear to have a significant impact on the plant design.

Two of the findings criticize certain features of Brown & Root Engineering Procedure STP-DC-017-C, which contains the requirements for preparing CPVRs. See Quadrex Finding Nos. 4.2.2.1(b) and (f). It is clear from these findings, which are erroneous, that Quadrex does not understand how this Procedure operates. Moreover, as indicated in the Brown & Root responses to these findings, STP-DC-017-C is consistent with the industry practices and standards.

Finally, Quadrex Finding No. 4.2.2.1(d) points out a discrepancy between the computer codes listed in the FSAR and those listed in the Program Status Summary. This discrepancy has no design or licensing significance and would have been corrected, at the latest, during the "design freeze" review process.

In summary, the Quadrex findings related to computer codes will have no impact on plant licensability.

SECTION 2.2.2

RESPONSE TO COMPUTER CODE FINDINGS

QUADREX FINDING 4.2.2.1(a) - COMPUTER CODE TECHNICAL ADEQUACY ASSESSMENT

In the area of computer codes, the following findings are expected to seriously impact plant licensability:

(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)."

BROWN & ROOT RESPONSE

Brown & Root agrees with the above finding, but disagrees that it will have any impact on plant licensability.

In December 1980, an internal Brown & Root audit reported several deficiencies in the manner in which the Nuclear Analysis Discipline was verifying computer codes. This condition was reported to the NRC by HL&P in May 1981. Brown & Root communicated the existence of this problem to Quadrex during its review of the STP design. The following is a summary of the investigations and the corrective actions taken:

1. Since the deficiencies had been identified for only one discipline, a review was conducted of program use by other disciplines. Sixty-seven programs were reviewed and, although some minor documentation problems were discovered, it was found that a CPVR had either been prepared for each program, or the program was obtained from outside sources and verified by those sources. In either case, programs were not revised without verification and were used within the limits of their applicability. Thus, the deficiencies were found to be limited to the Nuclear Analysis Discipline.

2. A detailed review of 23 of the major programs used by the Nuclear Analysis Discipline has been completed, and there have been no findings which appear to have a significant impact on plant design.

Engineering procedures would have been revised to preclude recurrence of this condition, had the Brown & Root effort at STP continued.

For the above reasons, this finding will have no impact on plant licensability.

QUADREX FINDING NO. 4.2.2.1(b) - COMPUTER CODE TECHNICAL ADEQUACY ASSESSMENT

In the area of computer codes, the following findings are expected to seriously impact plant licensability:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The finding makes two allegations: 1) that Brown & Root's procedures may allow the use of non-safety-related (i.e., unverified) computer programs in safety-related calculations; and 2) that the basis utilized by Brown & Root for determining whether a calculation is safety-related is not sufficient and is not typical of industry practice. Both allegations are erroneous.

With regard to the first allegation, Engineering Procedure STP-DC-017 contains the requirements for obtaining Computer Program Verification Reports (CPVRs). Engineering Procedure STP-DC-008 sets forth the requirements for safety-related calculations and indicates that a computer program may be used in support of a safety-related calculation only if there is a CPVR for that program on file in the Engineering Document Control Center. As part of the design verification program for safety-related calculations, the design verifier must ensure that computer programs supporting that calculation have been adequately verified. Thus, Brown & Root procedures ensure that any computer program used in support of a safety-related calculation has been properly verified.

For its second allegation, Quadrex relies on its assessment of Brown & Root's response to Question R-7, where Brown & Root indicated that in-plant shielding calculations are not safety-related. The basis for

Brown & Root's conclusion is that NRC regulatory requirements and industry standards do not classify shielding calculations as safety-related, and that the industry does not consider shielding as a safety-related activity. Quadrex apparently disagrees with these widely held positions. Such disagreement at most denotes a philosophical difference between Quadrex and others in the industry, and does not bring into question the adequacy of the Brown & Root methods for making safety-related classifications. It should be noted that, although it is Brown & Root's position that shielding calculations are not safety-related, safety-related documentation and verification requirements were imposed on the initial shielding design basis analyses, with particular emphasis on critical plant areas such as the control room.

Given the foregoing, it is evident that the above finding is erroneous and will not impact plant licensability.

QUADREX FINDING NO. 4.2.2.1(c) - COMPUTER CODE TECHNICAL ADEQUACY ASSESSMENT

In the area of computer codes, the following findings are expected to seriously impact plant licensability:

* * * *

(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 B&R CPVR does not indicate which options of a particular code have been verified."

BROWN & ROOT RESPONSE

Brown & Root agrees with the above finding, but disagrees that it will have any impact on plant licensability.

Computer codes utilized at STP fall into two categories: standard codes developed by industry organizations and widely used by designers throughout the country, and codes developed by Brown & Root personnel for specific use at STP. As to the first category of codes, their developers (and users) have amply verified each option through day to day application, and the service bureaus supplying the codes have ensured that the verification runs include all program options. No changes to these codes are made without re-verification. With respect to the second category, a survey of computer programs used at STP did not reveal any instance, outside the Nuclear Analysis Discipline, where a code was not entirely verified by its developer, or where an option of a code was used that had not been previously verified. Quadrex did not identify any such instance either.

As noted in Brown & Root's response to Quadrex Finding No. 4.2.2.1(a), the Nuclear Analysis Discipline calculations are being reviewed. No deficiencies in the underlying design have been uncovered to date as a result of this review.

Based on the foregoing, the above Quadrex finding will not impact plant licensability.

QUADREX FINDING NO. 4.2.2.1(d) - COMPUTER CODE TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

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

BROWN & ROOT RESPONSE

Brown & Root agrees with the above finding, but disagrees that it will have any impact on plant licensability.

There was a discrepancy between the computer programs listed in the FSAR and those in actual use on STP at the time of the Quadrex review, which are for the most part identified in the Program Status Summary. However, the FSAR does not control work, but merely indicates its status; hence, the difference between the computer programs listed in these two documents does not reflect any deficiency in the design of the plant and has no licensing significance, although it indicates that the Engineering Procedures for updating the FSAR in a timely manner were not followed in this case. This administrative discrepancy would have been corrected, at the latest, during the "design freeze" review process.

Accordingly, the above Quadrex finding will have no impact on plant licensability.

QUADREX FINDING 4.2.2.1(e) - COMPUTER CODE TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees in part with the above finding and also disagrees that it will have any impact on plant licensability.

This finding is based on the information provided to Quadrex in response to Question C/M-2. The Quadrex reviewer noticed the inclusion of an incorrect version of a computer code output in a verification package. The Quadrex finding assumes that such an error would be avoided by instituting a procedure prohibiting the "use of a wrong verification problem to be subsequently signed off as verified." The Brown & Root design verification procedure encompasses the computer verification reports and requires that the results of verification runs be reviewed to ensure that the results obtained are applicable. Therefore, this procedural requirement is equivalent to the prohibition that Quadrex would impose.

As an additional way of preventing occurrence of the problem, the Quadrex assessment of Question C/M-2 suggests that in accordance with ANSI/ANS-10.5 1979, the program name and revision number, date of execution, and sequential page number should appear on every page of all computer output. Brown & Root agrees that including such information on each page of the output might reduce the potential of using an outdated version of a program in a verification run. However, the implementation of this suggestion on all programs at this point in the project would at best be difficult. A significant amount of analytical work has been completed thus far, using computer codes which have been correctly verified as accurate. Implementation of this new output format would require a retrofit of completed efforts to no measurable benefit. In addition, many of the computer codes used at STP are nationally recognized programs supplied and controlled by service bureaus and as such may be unsuitable for the specialized format requirements suggested by Quadrex. Since the particular computer

verification problems identified to Quadrex took place only in the Nuclear Analysis area, wholesale implementation of the new output format requirements is unnecessary. Moreover, there are measures in place within the overall design verification program to identify the computer code documentation problems discussed above. These measures have been re-emphasized to the discipline personnel responsible for computer code verification.

Finally, Brown & Root had reviewed, and where necessary would have modified, the output formats of many computer codes to incorporate the format changes suggested in ANSI/ANS-10.5 1979. This effort would have been mainly directed at the computer codes needed for future use. Codes previously used would have been reviewed to ensure that proper code documentation existed.

For the above reasons, this finding will not have an impact on plant licensability.

QUADREX FINDING NO. 4.2.2.1(f) - COMPUTER CODE TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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 re-verifications to only those deemed significant (see Questions C/M-8 and C/M-9)."

BROWN & RESPONSE

Brown & Root disagrees with the above finding.

Brown & Root has included a variety of options for verification of computer codes because no single verification method is optimum for all codes. For example, some codes can be verified against experimental data; others cannot, because they model theoretical approaches. The appropriate measure for verification for the latter type is another computer code in a similar generic category. Specifying five options allows for flexibility in meeting these different requirements. For that reason, the Verification Procedure allows for more reasonable application as necessary.

Quadrex also criticizes the limitation of re-verification only to those program changes deemed significant. Although Brown & Root believes that limited re-verification is adequate, it initiated a revision of its procedures subsequent to the Quadrex review to require re-verification regardless of the significance of the change. This change was being implemented because uniform re-verification facilitates auditing.

Given the foregoing, it is clear that the above finding will have no impact on plant licensability.

SECTION 2.3 - ELECTRICAL AND I&C DESIGN FINDINGS

Contained in this section are the Brown & Root responses to the Quadrex findings in Section 4.3.2 of Volume I of the Quadrex Report. Those findings represent Quadrex's combined assessment of the adequacy of the STP design by the Electrical, and Instrumentation and Control (I&C) disciplines. For these disciplines, Quadrex asked twenty-three (23) questions, most of which were directed at the Electrical Discipline design. Based on these questions, Quadrex posed fifteen (15) "Most Serious" findings and no "Serious" findings. The following is a summary overview of the Quadrex findings in the Electrical and I&C areas and Brown & Root's responses thereto.

SECTION 2.3.1 - SUMMARY OVERVIEW

Quadrex's findings in the Electrical and I&C areas are inconsistent with its overall assessment of the design in both areas. Quadrex's overall assessment was that the design will be adequate if the concerns identified are addressed and corrected; Quadrex went on to observe that "the impact of the stated findings is expected to be small." This favorable overall assessment, however, is followed by 15 "Most Serious" findings which in Quadrex's opinion "may have a serious impact on plant licensability."

In reality, only one of the findings could even conceivably have an impact on licensability. In Finding No. 4.3.2.1(a), Quadrex alleged that the design of the common instrument air line in the Exhaust Subsystem of the Fuel Handling Building does not meet the single failure criterion of 10 CFR 50. However, as indicated in Brown & Root's response to this finding, the NRC had agreed that a design such as that for the system in question would be acceptable if certain features were incorporated in it. Those features are indeed part of the design of this system, and Brown & Root believes that the system meets regulatory criteria. Moreover, the existing design could be modified with a minimum of cost to eliminate Quadrex's licensing concern, and such modification has been initiated. Therefore, this finding does not raise any obstacle to plant licensability.

Of the remaining fourteen findings, nine identified as deficiencies the lack of project-wide documents allegedly needed, including "key top-level TRDs" and plant-wide stipulations of: separation requirements, verification of single failure criterion, equipment classification requirements, support systems identification, plant operating and environmental conditions, assurance of feasibility of manual operations at remote panels, and circuit application of isolation devices. See Quadrex Finding Nos. 4.3.2.1(b), (c), (d), (e), (f), (h), (i), (m) and (n). The postulated top-level documents may have been deemed necessary by Quadrex to facilitate its understanding of the implementation of design criteria at STP. Indeed, as an outsider briefly looking in, this type of document would have eliminated the need to review a large number of design documents. However, there is no need for such documents within the

project itself. See Brown & Root response to Quadrex Generic Finding Nos. 3.1(c) and (g).

In fact, Quadrex identified no significant design deficiencies in the areas covered by the above nine findings, and Brown & Root had developed all documents necessary for the design in those areas, and has gathered the key design documents in these and the other areas of the plant design in a Design Manual. The appropriate codes, standards, and regulatory criteria have been applied in these documents to establish the requisite design requirements. Brown & Root's procedural requirements governing interdisciplinary review, design change control, SAR change control, and design verification assure the completeness, adequacy, and accuracy of the overall design effort, and the implementation of applicable regulatory requirements. These nine Quadrex findings are therefore without basis.

Three of the remaining findings allege that Brown & Root has failed to assure that FSAR commitments are implemented, that the requirements in NRC regulations and industry standards are specified to vendors, and that recent NRC requirements are introduced into the STP design. See Quadrex Finding Nos. 4.3.2.1(g), (j) and (k). The three findings are erroneous. All new or revised regulatory requirements are reviewed by Brown & Root and incorporated, where applicable and subject to the direction of HL&P, into the STP design. Consistency between the STP design and the FSAR is maintained in accordance with project procedures. With respect to incorporating regulatory requirements and industry standards into equipment specifications, this is done by either spelling out the requirement in the body of the specification or by referencing in the specification the regulatory or industry document containing the requirement. In either case, Brown & Root assures proper implementation by vendors of regulatory requirements, codes and standards. The Brown & Root program is consistent with industry practice.

Another finding (No. 4.3.2.1(o)), raises an alleged violation of the Brown & Root design verification procedure. However, the alleged violation did not take place; the practice said to be improper is in fact an accepted industry practice; and the Quadrex reviewer of Question E-18 (on which the finding is based) concluded that the calculation subject to the finding was done in a satisfactory manner and was thoroughly verified. Therefore, the finding is erroneous.

Finally, one finding (No. 4.3.2.1(l)) identifies problems with the interface between Brown & Root and HL&P in the area of pre-operational testing requirements and operating procedures. These activities are solely within the control of HL&P and, therefore, their inclusion in Quadrex's review of Brown & Root's design is inappropriate.

From the above discussion, it is evident that the Quadrex findings in the Electrical and I&C design areas will have no impact on plant licensability.

SECTION 2.3.2

RESPONSE TO ELECTRICAL AND I&C FINDINGS

QUADREX FINDING NO. 4.3.2.1(a) - ELECTRICAL/I&C TECHNICAL ADEQUACY ASSESSMENT

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:

(a) "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 CRF 50 (see Question E-15). 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 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."

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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 two other instruments connected in common to the other taps; only later did they discover that a blocked instrument line was causing the two common instruments to read erroneously.

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above findings.

The alleged "single failure criterion violation" cited in the finding refers to a common instrument air line which provides control air to dampers in the Fuel Handling Building (FHB) Exhaust Subsystem. In the event of a high radiation condition in the FHB, a radiation detector signal actuates a three-way solenoid valve in the air line. This action removes the control air supply to the dampers in the normal ventilation flow path and vents the control air line causing

these dampers to close. At the same time, the radiation detection signal causes other dampers to open and divert the ventilation flow through two redundant banks of HEPA-charcoal filters. These latter dampers are closed during normal operation and the filter banks are bypassed. The dampers in the normal flow path are held open by instrument air pressure and "fail closed" upon loss of air. Figure 9.4.2-2 of the FSAR provides a graphic representation of the instrument air line. This Figure indicates that some portion of the instrument air line is common to the redundant dampers.

The basis for the design of solenoid valves associated with control valves for damper actuators goes back to the initial filing of the PSAR. The NRC, in a second round Question Number 220.51, inquired as to the need for the instrument air system to be safety-related. Many telephone conversations were held with the NRC over this Question, resulting in a final NRC position that the instrument air system need not be safety-related and that a common mode or single failure of the line from a solenoid valve to its associated actuator need not be considered, provided the following design features were included:

1. All solenoids should be furnished with a filter regulator set.

2. The air supply line to the filter regulator set should be smaller than the line from the actuator to the vent port.

Based on the above NRC position, the FHB Exhaust Subsystem was designed so that it included the NRC-recommended features. It should be pointed out that the physical layout of the air line would differ from the functional schematic drawing in the FSAR Figure. As implemented, the line from the redundant solenoid valves to the redundant dampers would be a tee connection in the discharge of the second solenoid and then branch out to each of the actuators. The common discharge of the solenoid would have whatever physical protection was required based on the possible hazards in the area of installation.

From the discussions previously held with the NRC, Brown & Root believes that the above design meets regulatory criteria. However, Brown & Root acknowledged that, in a changing NRC environment, this is an area that could be subject to further clarification and that, with a minimum of cost, the design could be changed to eliminate any further licensing concerns. Therefore, Brown & Root decided to revise the design to show redundant sets of solenoids.

Brown & Root conducted a design review of the plant and found one other instance in which a similar concern existed. Appropriate design modifications were initiated in that case also.

Based on the foregoing facts, this finding will have no impact on plant licensability.

QUADREX FINDING NO. 4.3.2.1(b) - ELECTRICAL/I&C TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Brown & Root does not believe that it is necessary to create a TRD specifying STP plant-wide separation, and there is no NRC regulation requiring such a document. The requirements for electrical and mechanical separation are set forth in various regulatory documents and by industry standards. Examples of such regulatory documents are Regulatory Guides 1.46 and 1.75; Branch Technical Positions ASB (APCSB) 3-1 and 9.5.1; 10 CFR 50, Appendix A; and IEEE 279, 308, 379, and 384. Brown & Root has applied the requirements and guidelines of these documents to the STP design. Each discipline is aware of separation requirements and has incorporated, as applicable, these requirements in its design. Therefore, there is no need to have one project document that communicates these requirements "consistently to all disciplines." Also, to the extent that licensing documentation of separation requirements is needed, it is provided explicitly in the FSAR.

The two questions referenced by Quadrex in this finding do not support it. Quadrex stated in its assessment of the Brown & Root Response to Question E-1 that "the limited examples reviewed were satisfactory" indicating an adequate performance on Brown & Root's part with regard to STP plant-wide separation requirements. Quadrex, however, also stated in the assessment that Brown & Root has no documentation to verify adequate separation. This latter statement is incorrect. Verification of adequacy of separation is performed at the time the design documents are initially prepared and at any subsequent revisions, in accordance with the Engineering Procedure for design verification, STP-DC-015. Verification is formally documented. These reviews include consideration of all applicable regulatory requirements including separation.

With regard to Question E-15, Quadrex's assessment of the Brown & Root response to that question acknowledged that Brown & Root properly recommended to HL&P that certain devices (limit switches) in the turbine trip circuitry be procured as Class 1E devices. The purpose of such classification would be to require that the devices, which are to be installed in a non-Category 1 building (the Turbine Generator Building (TGB)), be installed according to the highest criteria attainable for physical installation in non-Category 1 structures. Quadrex complained, however, that Brown & Root's response did not state that proper separation would be observed in locating those switches and the cables connecting them to the Westinghouse RTS logic cabinets. Quadrex inferred from the non-inclusion of that statement in the response that Brown & Root "may be assuming that the responsibility for adequate separation belongs to others." Quadrex's inference is not warranted. Westinghouse will provide isolated interface terminals in the logic cabinets, and in doing so will observe the separation requirements for Class 1E equipment. Brown & Root will provide the cabling between these cabinets and the switches; the cabling will observe STP separation requirements in Category 1 structures, and will be placed in accordance with the highest criteria attainable for physical installation in the TGB.

The Brown & Root design for STP has, therefore, satisfactorily incorporated the appropriate separation requirements through implementation of the regulatory criteria. Accordingly, no specific "top level" document is necessary, and the NRC has certainly not required it. Therefore, the lack of such a document will have no impact on plant licensability.

QUADREX FINDING NO. 4.3.2.1(c) - ELECTRICAL/I&C TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(c) "There is ample evidence that B&R has not had an overall plant 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))."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The design criteria for STP are presented by Brown & Root in the Design Manual. This manual, which was given to Quadrex during the review, includes System Design Descriptions (SDDs) and Technical Reference Documents (TRDs), and is a project-wide controlled-issue document. The various SDDs and TRDs constitute what in Brown & Root's judgement are the "key" documents necessary for the design of STP. Therefore, contrary to Quadrex's finding, Brown & Root has identified and developed the top level design documents needed for STP, and included them in the Design Manual. Additional design documents are developed as the need for them is identified. Brown & Root's program for the development and use of "key" design documents is consistent with 10 CFR 50, Appendix B, Criteria III, IV, and VI, and with industry practice.

The allegation in the first part of the above finding that Brown & Root lacked an overall plan to develop "key" top level TRDs appears to be based entirely on Quadrex's assessment of Question E-1. However, that assessment does not support the finding, for the assessment deals with only one specific TRD, EQ006, and therefore can hardly be viewed as providing "ample evidence" to support a plant-wide conclusion. Furthermore, the Quadrex assessment of Question E-1 found no fault with the TRD in question, but merely expressed the opinion that:

> "...it is our feeling that a top level separation requirements document is required..."

Not only was the assessment by the Quadrex reviewer of Question E-1 a mere expression of opinion, but the opinion was based on inadequate information. The reviewer wrote:

> "To the best of our knowledge, the STP Design Manual mentioned by Brown & Root does not exist."

In fact, TRD EQ006, which provides the basis for the Quadrex reviewer's assessment of Question E-1 (as well as for the above finding), is part of the STP Design Manual.

In the second part of this finding, Quadrex states that documentation does not exist for some basic design decisions. This finding is based on Quadrex's assessment of Brown & Root's response to Question E-19; that assessment, again, does not support the finding. Question E-19 is concerned with the use of direct versus derived signals. Brown & Root made available to Quadrex TRD ZQ002 which describes how certain process signals are used in plant operation. Quadrex found the Brown & Root design philosophy as presented in TRD ZQ002 to be adequate in that Brown & Root used direct signals. However, the reviewer noted that there was no document that described the origin of this design philosophy. This observation is irrelevant, because a design is to be reviewed for its adequacy and not in terms of how it was achieved.

The Quadrex assessment of Question E-19 also alleges that Brown & Root did not discuss possible failure modes and their consequences in the information it provided with respect to the presentation of process and safety information to the operator. However, failure modes and their consequences were discussed with Quadrex during the review.

For these reasons, it is evident that the above finding is erroneous and will not impact plant licensability.

QUADREX FINDING NO. 4.3.2.1(d) - ELECTRICAL/I&C TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

All safety-related structures, systems, and components designed by Brown & Root are formally verified for complete and accurate incorporation of regulatory requirements such as redundancy, separation, and single failure criterion as applicable. The requirements for documentation of this verification process are set forth in the Brown & Root Procedure for design verification, STP-DC-015. Among other elements of the design, all design basis inputs must be verified. The design basis inputs include failure analysis, redundancy, separation, and regulatory commitments. See Table II of STP-DC-015. The Quadrex finding is, therefore, erroneous. (Related information is contained in Brown & Root's response to Quadrex Finding No. 4.3.2.1(b)).

Given the foregoing, it is clear that the above Quadrex finding will have no impact on plant licensability.

QUADREX FINDING NO. 4.3.2.1(e) - ELECTRICAL/I&C TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The STP design, with certain minor exceptions, is committed to complying with the requirements of Regulatory Guide (R.G.) 1.75, which endorses IEEE 384-1974. This commitment is consistently documented in Brown & Root design documents. Brown & Root believes that IEEE 384-1974, as supplemented by other Brown & Root design documents, provides adequate definition of separation criteria needed to meet electrical independence requirements. Each vendor's design must meet these separation criteria, and each vendor's design is reviewed by Brown & Root for compliance with separation requirements. In no instance did Quadrex find a design (whether by Brown & Root or a vendor) for which inadequate separation had been provided. This is evidenced by Quadrex's assessment of the Brown & Root responses to Questions E-2 and E-6. Indeed, the one example cited by Quadrex (the main control board design) was expressly found by Quadrex to have satisfactory electrical separation.

As a final point, a multi-disciplinary Task Force under the direction of the Systems Engineering Group was to provide a project overview of hazards to safety systems. This multi-disciplinary effort would have included separation barrier requirements for hazards such as fire, jets, pipe whip, missiles, etc., and would have verified that there existed an integrated approach to separation barriers.

Accordingly, the above Quadrex finding is erroneous and will have no impact on plant licensability.

QUADREX FINDING NO. 4.3.2.1(f) - ELECTRICAL/I&C TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

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

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Brown & Root does not believe that it is necessary to create a TRD specifying plant-wide equipment classification requirements, and there is no NRC regulation requiring such a document. Under Engineering Procedure STP-DC-010, systems, structures, and components of STP have been classified by Brown & Root in accordance with their importance to safety in a manner consistent with regulatory requirements. Regulatory Guide (R.G.) 1.26 and ANSI N18.2 have been used to define safety classes of equipment. The regulatory positions of R.G. 1.29 have also been followed for seismic classification of equipment. Classification of electrical equipment additionally reflects the provisions of IEEE 308-1974, i.e., Class 1E designation. All of these requirements are properly reflected in the plant design.

In accordance with Engineering Procedure STP-DC-010, the safety classification for equipment is part of the Total Plant Numbering System under which all design documents are designated. A consolidated listing of equipment classifications is contained in Table 3.2 of the FSAR.

Subsequent to the Show Cause Order in 1980, HL&P asked Brown & Root to issue this table as a TRD to facilitate its use by field personnel. A draft of this TRD was issued for review in 1980 but, because of higher priority work, was never issued for use. In late 1981, this TRD, numbered TRD A470GQ006, "Classification of Systems, Structures and Components," was reissued for review. The removal of Brown & Root from STP precluded final issuance of this TRD, which was prepared solely as a convenience.

Quadrex's assessment of Brown & Root's response to Question E-3, cited in the above finding, acknowledges that Brown & Root understands the difference between active and passive components (equipment operability versus structural integrity). This difference is described in R.G. 1.48. No instances were cited by Quadrex where equipment was improperly classified.

Given the foregoing, it is evident that the above Quadrex finding will have no impact on plant licensability.

QUADREX FINDING NO. 4.3.2.1(g) - ELECTRICAL/I&C TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

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

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The finding is based primarily on Quadrex's assessment of Brown & Root's responses to Questions E-1 and E-3 (Questions E-4 and E-14 do not refer to FSAR commitments and do not support the finding.) In its Question E-1 assessment, Quadrex stated that Brown & Root had not answered the question whether design inputs and criteria were verified for compliance with FSAR commitments. In fact, both the question and the Quadrex assessment denote Quadrex's lack of understanding of STP procedural requirements and the design/licensing process. The design process is the lead activity, and the FSAR is a licensing document which presents a plant design to the NRC. The FSAR describes how the design incorporates codes, standards and NRC regulatory guidance documents, thereby accounting for fundamental safety criteria and demonstrating compliance with regulatory requirements. However, the engineers and designers are cognizant of FSAR commitments and are required by Engineering Procedures to evaluate all design changes to determine their effect, if any, on FSAR commitments.

In certain cases, such as FSAR Sections 3.10 (Seismic Qualification) and 3.11 (Environmental Qualification), the FSAR contains a convenient consolidated listing of information relevant to Quadrex's questions. These listings are compilations of related data from numerous design documents. Brown & Root referred Quadrex to FSAR Sections 3.10 and 3.11 in its response to Question E-3 to simplify identification of equipment subject to seismic and environmental qualification programs. Quadrex erroneously assumed from Brown & Root's response that the FSAR somehow was establishing design. In fact, Brown & Root developed the design documents and numerous equipment specifications upon which FSAR Sections 3.10 and 3.11 are based prior to the issuance of those two FSAR sections. These design documents and equipment specifications were developed in accordance with relevant standards and NRC guidelines.

Quadrex also indicates in this finding that a Westinghouse design change to a lower boric acid concentration may require further review by the NRC for acceptance. It appears that Quadrex is referring to the deletion of the Emergency Boration System. This deletion has already been made on the Comanche Peak plant and in the RESAR 414 applications. In both cases, NRC acceptability has not been a problem. Thus, Brown & Root is confident that the NRC will likewise accept the deletion for STP. In any event, NRC acceptance of STP NSSS changes is the responsibility of the NSSS vendor (Westinghouse) and not of Brown & Root.

In sum, the above Quadrex finding is not only factually inaccurate, but also demonstrates a fundamental lack of understanding on Quadrex's part as to the relationship between design and FSAR commitments. Accordingly, this finding will have no impact on plant licensability.

QUADREX FINDING NO. 4.3.2.1(h) - ELECTRICAL/I&C TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability, or deserve licensing attention:

* * * *

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

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

In its response to Question E-3, Brown & Root stated:

> "The support systems for safety-related systems are determined by reviewing each safety system or group of components. In each case, where the successful operation of a safety item depends on the functioning of another device or system, such as air conditioning, that system is identified as a support system. That support system must then be provided with appropriate redundancy and qualified, or the primary safety system must be qualified to conditions assuming the failure of the support system."

Brown & Root believes its response to the Quadrex question regarding identification of support systems needed to assure safety system performance was clear, concise, and complete. Brown & Root does not understand what other or further "basis or procedures" were sought by Quadrex, nor what other or further basis or procedures Quadrex anticipates the NRC will use in reviewing the STP design. Therefore, it is clear that the above Quadrex finding will have no impact on plant licensability.

QUADREX FINDING NO. 4.3.2.1(i) - ELECTRICAL/I&C TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The environmental conditions (temperature, pressure, humidity, and radiation) in all safety-related plant areas during normal and accident conditions are clearly presented in TRD EQ004. TRD EQ004 is included in the STP Design Manual, which is a project-wide controlled-issue document. The TRD was given to Quadrex during the design review. Quadrex expected, however, a document much broader in format and more specific in content. (See Brown & Root response to Quadrex Generic Finding No. 3.1(c)). Nonetheless, no technical inadequacy in the TRD EQ004 definition of plant environmental conditions was identified by Quadrex. The Quadrex finding, therefore, merely denotes a format preference and is factually inaccurate.

Quadrex acknowledged that operating and environmental conditions had been considered in all the designs it reviewed. The Quadrex finding, however, suggests an expectation that the designs not reviewed by Quadrex are inadequate. Such an implication is without technical basis and is indicative of an unsound approach to the review of the Brown & Root design.

Given the foregoing, it is evident that the above Quadrex finding is erroneous and will not impact plant licensability.

QUADREX FINDING NO. 4.3.2.1(j) - ELECTRICAL/I&C TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(j) "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. 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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Regulatory requirements and industry standards are incorporated into equipment specifications by Brown & Root in one of two ways. The specific requirements to be met can be expressly stipulated in the body of the specification. Alternatively, the applicable regulatory document (e.g., Regulatory Guide, Branch Technical Position), code or standard can be referenced in the specification for compliance by the vendor. Under the second approach, the vendor has, or develops, a program to comply with the referenced requirements and must submit this program to Brown & Root for review and approval. This practice is common in the nuclear industry and, to the best of Brown & Root's knowledge, has never been considered "marginal." In fact, each vendor includes detailed data on the performance of its equipment within its compliance program. Therefore, when Brown & Root reviews the vendor's compliance program for plantwide acceptance, it can verify that the vendor is indeed complying with regulatory requirements.

In its assessment of Brown & Root's response to Question E-8, Quadrex stated that Brown & Root had not specified acceptance criteria for Essential Safety Features (ESF) Sequencer reliability. Yet, Quadrex found no technical inadequacy in the design of the ESF Sequencer. In any event, there is no requirement to specify acceptance criteria for the reliability of equipment. Reliability is assured in nuclear-grade components/systems through compliance with stringent regulatory requirements such as 10 CFR 50, Appendix B; Regulatory Guides and

Branch Technical Positions; pre-operational and in-service test and inspection programs; plant technical specifications; and applicable codes and standards. These requirements encompass not only pre-operational processes such as design, manufacture, and installation, but also the periodic test and inspection functions that provide continued assurance throughout the operational life of the plant that components and systems will perform their intended safety function upon demand. No further reliability acceptance criteria are specified by the NRC. Notwithstanding this absence of requirements, the specification for the ESF Sequencer required the vendor to perform a reliability analysis in accordance with IEEE 352-1975.

Given the foregoing, it is evident that Brown & Root's procedures for ensuring vendor compliance with regulatory requirements are both adequate and consistent with industry practice. Accordingly, the above Quadrex finding will have no impact on plant licensability.

QUADREX FINDING NO. 4.3.2.1(k) - ELECTRICAL/I&C TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The first statement in the finding is not supported by the specific Question cited in the finding. According to its assessment of Brown & Root's response to Question E-10, Quadrex was unable to determine if the "requirements" of NRC I&E Circular 79-12 have been incorporated into the STP design. Actually, Circular 79-12 did not impose any requirements, but merely described an NRC concern with General Motors diesel engines, providing certain recommendations to owners of those specific engines. Brown & Root reviewed Circular 79-12 and found it to be inapplicable to STP since the STP standby diesel-generators have been manufactured by Cooper Energy Systems. The Brown & Root review is well-documented.

The second statement in the finding alleges that Brown & Root is using superseded industry standards and NRC regulations. With reference to Question E-3, the basis for the Quadrex allegation is an apparent STP design requirement to meet IEEE 344-1971 when, according to Quadrex, the FSAR commitment refers to IEEE 344-1975. Quadrex is wrong on both counts. The STP commitment for seismic qualification of electrical components requires compliance with the requirements of IEEE 344-1971 as supplemented by NRC Branch Technical Position EICSB-10. These two documents together are essentially equivalent to the requirements of IEEE 344-1975; however, STP has not specifically committed to the 1975 issue of the standard. The equivalence between the two sets of standards is spelled out in Brown & Root TRD EQ004-A, which states that the reference standard to use for seismic design is:

> IEEE Standard 344-1971, Guide for Seismic Qualification of Class IE Electrical Equipment, with Branch Technical Positions EICSB-10 (11/4/75), or IEEE 344-1975, Guide for Seismic Qualifications of Class IE Electric Equipment.

Thus, the TRD does reflect knowledge by Brown & Root of the more recent industry standard.

In a more general sense, Brown & Root has endeavored to ensure that all equipment designed and/or procured meets the applicable codes, standards, and regulations as stipulated by the NRC and as committed to in the FSAR. While more recent issues of codes, standards, and regulatory requirements than those actually used by Brown & Root may exist, implementation criteria as mandated by the NRC have been properly followed in all cases. This is a common industry practice.

For these reasons, the above finding is erroneous and will have no impact on plant licensability.

QUADREX FINDING NO. 4.3.2.1(I) - ELECTRICAL/I&C TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(I) "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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Neither pre-operational testing nor operating procedure development are within Brown & Root's scope of work. Therefore, development of any "interfaces" between Brown & Root and HL&P in these areas is the sole responsibility of HL&P. On the other hand, Brown & Root has assisted HL&P in its pre-operational activities to the extent that HL&P has so requested.

In Questions E-11, E-16, and E-21, Quadrex acknowledges that the pre-operational and startup testing were consistently identified by Brown & Root as out-of-scope activities. This is in accordance with FSAR Section 14.1 which states that HL&P is responsible for preparation of pre-operation and startup test procedures. In addition, in accordance with R.G. 1.68, the initial test program was also to be developed by HL&P. Accordingly, HL&P has overall responsibility for the initial test program, as well as for developing an appropriate interface with Brown & Root on this subject. Brown & Root, on the other hand, was responsible for normal construction activities prior to equipment and system release to the plant startup test organization.

It is not within Brown & Root's scope of responsibility to resolve the problems alleged by Quadrex to exist in these areas. Brown & Root expresses no opinion regarding the impact that such problems, if existing, will have on plant licensability.

QUADREX FINDING NO. 4.3.2.1(m) - ELECTRICAL/I&C TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The design and layout of local panels for the control of equipment at STP were performed by Brown & Root personnel with plant startup and operating experience. This experience, in conjunction with defined environmental parameters for safety-related plant areas, were applied to factor considerations of equipment testability, accessibility, maintainability, and operability into the design. These design and layout functions were performed before the TMI accident and are in accordance with the pre-TMI regulatory requirements.

Additional regulatory emphasis has been placed on accessibility of remote panels as the direct result of the accident at TMI. Activity in this area is included in Brown & Root's TMI work plans, which are still in progress. However, Quadrex chose to assess Brown & Root's response to Question E-13 against the post-TMI regulatory environment. Quadrex had agreed to exclude post-TMI considerations from its review. Quadrex's assessment is, therefore, inappropriate.

Brown & Root's response to Question E-13 shows that the design of local panels was adequate in light of pre-TMI considerations. Post-TMI requirements were being analyzed by Brown & Root at the time of the Quadrex review.

Given the foregoing, the above Quadrex finding is erroneous and will have no impact on plant licensability.

QUADREX FINDING NO. 4.3.2.1(n) - ELECTRICAL/I&C TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

As required by Regulatory Guide 1.75 and IEEE-383, the Brown & Root design of STP includes electrical and control circuit isolation devices in applicable locations. Electrical design drawings as presented to Quadrex symbolically depict the isolation devices in the circuits. Morever, the specification to be used for procuring isolation devices was discussed with Quadrex during the review, and covers approximately 98% of the devices needed at STP. Brown & Root does not believe an additional document on isolation device application is necessary for the few remaining devices.

Brown & Root also notes that, in the assessment of Brown & Root's response to Question E-14, Quadrex states that Brown & Root is delinquent in procuring isolation devices relative to the construction schedule and issuance dates of the applicable industry standards. This statement is erroneous. First of all, final design and layout of the isolation devices is dependent upon the completion of electrical and control circuit design. Since the design of the control circuits is not yet completed, specification and procurement of isolation devices at this time would be premature. Further, procurement of isolation devices after completion of the circuit design will allow the isolation devices to be located and grouped more efficiently in space reserved for isolation cabinets. Finally, and most importantly, fully qualified isolation devices are available in the market with little lead time and with no impact on construction schedule.

Given the foregoing, it is evident that the above Quadrex finding is erroneous and will have no impact on plant licensability.

QUADREX FINDING NO. 4.3.2.1(o) - ELECTRICAL/I&C TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Section 2.3.2.1 of Engineering Procedure STP-DC-015, "Design Verification", states that checking and verification of a calculation may be conducted by the same individual provided the requirements of independence are maintained. This is consistent with ANSI N45.2.11 and is a common industry practice. Moreover, Quadrex noted in its assessment of Brown & Root's response to Question E-18 that the particular calculation referred to in the above finding was done in a satisfactory manner, its verification was thorough, and the resultant design is conservative and meets applicable IEEE criteria. The above Quadrex finding has, therefore, no basis since the calculation cited was completed, checked, and verified in a conservative and accurate manner in accordance with Brown & Root procedural requirements.

Accordingly, the above finding is erroneous and will have no impact on plant licensability.

SECTION 2.4 - HVAC DESIGN FINDINGS

Contained in this section are the Brown & Root responses to the Quadrex findings in Section 4.4.2 of Volume I of the Quadrex Report, which address the technical adequacy of the design of heating, ventilation and air conditioning (HVAC) systems at STP. For the HVAC technical adequacy assessment, Quadrex posed thirty-one (31) questions, which resulted in seven (7) "Most Serious" findings and one (1) "Serious" finding. The following is a summary overview of the Quadrex findings in the HVAC area and Brown & Root's responses thereto.

SECTION 2.4.1 - SUMMARY OVERVIEW

Quadrex's overall assessment of the HVAC design at STP is that it is adequate provided Quadrex's identified concerns are addressed and corrected. Those concerns appear to lie generally in the areas of safety classifications, design bases, design verification, off-normal operating conditions, protection against common mode failures, and criteria for system design in radioactive areas. As will be seen, of the eight "Most Serious" and "Serious" findings expressing these concerns, five are erroneous, one is correct but deals with a minor administrative concern, and the remaining two address problems which were under investigation by Brown & Root at the time of the Quadrex review and have been subsequently resolved.

Brown & Root's design bases and safety classifications of equipment are questioned in three "Most Serious" findings; see Quadrex Finding Nos. 4.4.2.1(a), (b) and (e). As explained in the response to Finding No. 4.4.2.1(a), Brown & Root's design bases for HVAC systems at STP are satisfactory, meet all applicable NRC criteria, and are consistent with industry practices. Moreover, the plant operating modes and off-normal operating conditions (including analysis of plant transient and accident conditions) are also adequately addressed by Brown & Root in the current HVAC design. Likewise, as discussed in Brown & Root's response to Quadrex Finding No. 4.4.2.1(b), the determination of safety classification of HVAC equipment is based on NRC guidelines, such as R.G. 1.26; these classifications conform with industry codes and standards and are traceable to the "user" systems. It is acknowledged, however, that prior to the Quadrex review, questions had been raised as to the ability of the safety-grade HVAC Systems at STP to provide cooling for certain safety-related systems and equipment required to achieve the safe shutdown of the plant. An HVAC design re-evaluation program was initiated by Brown & Root prior to the Quadrex review; Quadrex was informed of the status of the program and its preliminary findings. The re-evaluation program identified certain areas of the plant as requiring additional safety-related HVAC equipment. Accordingly, coincident with the Quadrex review, Brown & Root informed HL&P and the NRC (under 10 CFR 21) of the existence of a reportable deficiency in the safety-related HVAC systems at STP. This HVAC re-evaluation also determined that certain preliminary thermal loads utilized to define the initial design bases for the HVAC systems were non-conservative. Both problems have been resolved by making appropriate design modifications.

Quadrex Finding No. 4.4.2.1(e) alleges that an improper safety classification was given to the floor drainage system on account of the insufficient number of leak detection devices provided. However, Quadrex's contention is erroneous and is apparently based on a misunderstanding by Quadrex of the leak detection systems in place at STP.

Protection against common mode failures is raised in Quadrex Finding No. 4.4.2.1(d), which alleges that separation criteria for protection against such failures have not been identified. As noted in Brown & Root's response to that finding, adequate separation criteria have been implemented at STP based on NRC Regulatory Guides, Branch Technical Positions and industry codes. Moreover, the System Design Assurance Group had among its functions that of reviewing plantwide implementation of separation requirements to protect against common mode failures. Therefore, this Quadrex finding is erroneous.

Brown & Root's system design in radiation areas is questioned in Quadrex Finding No. 4.4.2.2 (h). Quadrex alleges that Brown & Root did not take into consideration actual plant operating conditions when designing HVAC systems for those areas. In fact, the conditions postulated by Quadrex are not "actual", and do not represent the anticipated operation of the plant. The Brown & Root design is appropriately based on anticipated operating conditions, and is consistent with industry practice.

Another Quadrex finding, No. 4.4.2.1 (c), contends that the Brown & Root analysis of hydrogen concentration in the battery room and in the Containment Building is insufficient. Brown & Root's response demonstrates that the design of HVAC systems for the Containment Building and battery room precludes significant hydrogen accumulation.

Quadrex Finding No. 4.4.2.1(g) alleges that Brown & Root's HVAC design verification program needs to be reexamined. However, Brown & Root's design verification program is comprehensive and well documented, and is consistent with (and in some respects, exceeds) industry practice.

Finally, Quadrex identifies as a "Most Serious Finding", the alleged existence of inconsistencies between the FSAR and the HVAC design documents. (See Quadrex Finding No. 4.4.2.1(f)). In fact, there are licensing procedures in place to resolve any inconsistencies between the FSAR and design documents. While limited instances of failure to follow these procedural requirements have occurred, no technical inadequacy or adverse licensing impact would result from such an administrative discrepancy because the FSAR is not a design document, but only a document that evidences the design's compliance with regulatory requirements. In any event, Brown & Root's System Design Assurance Group had scheduled a second level review that would have identified and resolved all FSAR discrepancies.

From the above discussion, it is clear that the Quadrex findings in the HVAC area will present no obstacles to plant licensability or reliable plant operation.

SECTION 2.4.2

RESPONSE TO HVAC FINDINGS

QUADREX FINDING NO. 4.4.2.1(a) - HVAC TECHNICAL ADEQUACY ASSESSMENT

For the HVAC discipline, the following findings are expected to seriously impact plant licensability:

(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)."

BROWN & ROOT RESPONSE

Brown & Root agrees with the above finding, but disagrees that it will have any impact on plant licensability.

The conceptual design of nuclear HVAC systems is normally undertaken at the initial development of the plant design when only preliminary information is available on the actual thermal loads which will exist. Regulatory Guides (e.g., R.G. 1.52) and design experience play an important role in establishing the conservative initial HVAC design bases. These initial design bases include bounding thermal loads calculated using regulatory requirements, recommended ASHRAE environmental conditions, and other appropriate design bases that take into consideration full power operation and accident conditions. In addition, initial HVAC design bases generally assume diversity factors for equipment expected to operate only part-time, and incorporate heat gain factors into the design of those systems which are expected to function under loss of off-site power and accident conditions. As more refined thermal data become available (generally after major components have been purchased and large bore piping and high voltage conduits have been routed), and as major components are located, additional analyses are performed to confirm the appropriateness of the initial assumptions.

At STP, Brown & Root developed the HVAC design bases consistently with the industry practice outlined above. Preliminary thermal loads were utilized to define the initial design bases for the HVAC systems and equipment. Since the design bases were established early in the project, they were scheduled for review and updating as HVAC system requirements

became finalized. This review and updating process was underway prior to the time of the Quadrex review.

As final thermal loads started to become available, it was determined that in certain areas the actual loads were larger than the preliminary loads assumed. It was also determined that the HVAC duct work was conservatively sized so that, if necessary, it could accommodate the increase in air flow required to meet the larger system capacity; therefore, any design modification that resulted could be implemented without a significant impact on construction activities. The awareness of a potential underestimation of the HVAC requirements in certain areas of the plant led Brown & Root to initiate a detailed review of the heat-generating fluid systems and components so that HVAC requirements could be finalized and any additional cooling needs could be identified at the earliest possible time.

During the Quadrex review, Brown & Root apprised Quadrex of the status of the HVAC re-evaluation effort and informed Quadrex that supplementary safety-grade HVAC systems might be added in some areas of the plant. Quadrex failed to acknowledge that this effort was under implementation and that appropriate action was being taken to resolve any HVAC deficiency.

The HVAC re-evaluation has now been completed and has resulted in the identification of certain additional safety-grade cooling requirements. Design modifications have been incorporated to accommodate these additional requirements. As modified, the HVAC systems at STP are capable of meeting the heat loads produced during normal, off-normal and accident conditions.

With regard to the concern about airborne contaminants raised in the Quadrex assessment of Brown & Root's response to Question H-3 (cited in the above finding), control of contaminants was a design consideration for HVAC systems which were to operate in potentially contaminated areas. Outlined below are examples of several of the methods employed by STP HVAC designers to control airborne radioactive material and thereby reduce in-plant exposures:

- Individual hoods and a supplemental exhaust charcoal filtration subsystems have been used for the radioactive chemical laboratory and sample room.

- Normal and supplementary containment purge systems have been designed for the Reactor Containment Building and fuel pool.

- An air exhaust system with charcoal filtration has been provided for the fuel pool to control airborne contamination in the Fuel Handling Building (FHB).

Radioactive areas of the plant have also been enclosed and are maintained under negative pressure to prevent transfer of contamination to clean areas. Access to such areas is through doors which, under normal circum-

stances, are kept closed and are under administrative control. Hatches have been provided for maintenance and equipment removal, and will be utilized only for limited periods of time. Where necessary, these hatches have been closed to limit migration of contaminated air to other areas of the plant. Should the need arise to augment individual HVAC systems to facilitate maintenance in a particular area, common industry practice is to use portable fans and, if necessary, temporary ducting to the affected area with appropriate filtration for contamination control.

Ventilation and air cleanup rates for each particular area of the plant were based primarily on thermal cooling requirements, potential radiation hazards, and the potential combustion hazard of that area. In determining the radiation hazard and consequent air cleanup requirements for areas such as the Control Room and the FHB, Brown & Root considered and analyzed the worst conceivable accident and its resulting effluents.

The HVAC systems for the radioactive areas of the plant are designed and balanced for "normal" operating conditions which assume that doors and hatches are closed. As stated in the FSAR and SDD, pressure in all contaminated areas will be maintained at a level less than that maintained in clean areas of the plant. At the time of balancing, minimum air velocities at the entry point are established with the doors and hatches closed. When the doors/hatches are opened, the air velocity decreases, but the air flow is still from the clean area to contaminated areas, preventing migration of contaminated air to clean areas of the plant. If a ventilation system were designed and balanced assuming open doors/hatches, a relatively large system would result. Such an overdesigned ventilation system would not only be expensive to build, operate, and maintain, but could cause increased differential pressure across doors/hatches under normal conditions, making them difficult to open.

Thus, the design bases for safety-related HVAC systems at STP are currently satisfactory. The adequacy of those bases was under re-evaluation by Brown & Root prior to the Quadrex review, and appropriate modifications have been incorporated into the HVAC design as a result of this re-evaluation. Plant operating modes and off-normal operating conditions of HVAC systems and of systems supported by HVAC (including analysis of plant transients and accident conditions) have been addressed and are properly accounted for in the design.

For these reasons, the above finding will have no impact on plant licensability.

QUADREX FINDING NO. 4.4.2.1(b) - HVAC TECHNICAL ADEQUACY ASSESSMENT

For the HVAC discipline, the following findings are expected to seriously impact plant licensability:

* * * *

(b) "The safety classification of HVAC systems is not traceable to user systems (see Question H-5)."

BROWN & ROOT RESPONSE

Brown & Root agrees with the above finding, but disagrees that it will have any impact on plant licensability.

As an initial matter, it should be noted that the systems, structures, and components designed by Brown & Root and their associated design documents such as calculations are classified as safety-related or non-safety-related. The determination of the appropriate classification is made in accordance with the importance to plant safety provided by the function(s) of the system, structure, or component. Safety functions are defined in industry codes and standards such as ASME, IEEE, ANSI, and NRC Regulatory Guides (R.G.). NRC regulations specify that these documents should be utilized in the design, manufacture, fabrication, erection, construction, testing, and inspection of nuclear components commensurate with the importance of the safety function to be performed by such components. These documents are used throughout the nuclear industry for the determination of safety classification and application of design requirements and were utilized in the design of STP.

Once an HVAC system design is developed by Brown & Root, it is subjected to review for accuracy and adequacy in the form of System Design Descriptions and Piping & Instrumentation Diagrams. These documents are submitted to all disciplines responsible for "user" systems. During this review process the safety classification of the HVAC system is re-evaluated and confirmed in light of the requirements of the "user" systems. The scope of the review performed on non-safety and safety-related HVAC designs is similar, except that in the latter case, more rigid requirements for documentation and independence of the review process are applied to demonstrate compliance with regulatory requirements as set forth in 10 CFR 50, Appendix B, R.G. 1.64 and ANSI N45.2.11. However, in all cases a review and verification is still completed.

BROWN & ROOT RESPONSE 4.4.2.1(b) - CONT.

During the course of the HVAC design review, and as final thermal load data became available, questions were raised about the absence of safety-grade HVAC systems to provide cooling for the hot shutdown panel and the hydrogen monitors. These concerns resulted in an accelerated Brown & Root program, identified as "Special Problem 16," to determine whether the safety-grade HVAC systems were adequate to provide cooling for all systems and equipment required to achieve the safe shutdown of the plant. This re-evaluation program was initiated prior to the Quadrex review, and Quadrex was informed of its status and preliminary results. As the HVAC re-evaluation was completed, Brown & Root identified certain areas of the plant as requiring additional safety-grade HVAC equipment. Accordingly, coincident with the Quadrex review, Brown & Root informed HL&P and the NRC (under 10 CFR 21) of the existence of a reportable deficiency in the safety-related HVAC systems at STP. The results of the HVAC re-evaluation program are discussed in Brown & Root's response to Quadrex Finding No. 4.4.2.1(a).

As indicated above, Brown & Root had appropriate programs in place prior to the Quadrex review to identify and resolve any inconsistencies in the classification of HVAC systems in relation to "user" systems. Quadrex failed to recognize these programs and the ongoing efforts to resolve identified concerns.

Given the foregoing facts, it is clear that the current safety classification of HVAC systems is appropriately traceable to "user systems". Accordingly, the above Quadrex finding will have no effect on plant licensability.

QUADREX FINDING NO. 4.4.2.1(c) - HVAC TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Initially, it should be realized that the potential for hydrogen accumulation inside containment after an accident has been given great attention by the NRC and the industry as a result of the TMI accident. The new regulatory posture seems to be that all calculations documenting sufficient mixing of hydrogen inside containment are questionable, no matter the amount of redundancy or conservatism provided in the design. This regulatory position has led many facilities to consider additional means of protecting against hydrogen pocketing within containment. Brown & Root was aware of these developments and was studying the use of "glow plugs" (igniters) as a means of preventing increased hydrogen concentrations. Given these circumstances, Quadrex's suggestion in the above finding that Brown & Root's hydrogen mixing calculations should be reexamined is irrelevant.

In any event, Quadrex's criticism of Brown & Root's treatment of hydrogen accumulation inside containment has no basis in fact. The Reactor Containment Building HVAC system has been designed to ensure against hydrogen accumulation and provides for uniform mixing during both normal and accident conditions. The mixing of hydrogen is accomplished by the forced ventilation of containment air by the Reactor Containment Fan Cooler System. This system consists of 6 fan coolers which receive warm air from the upper portion of the containment and, through coolers, deliver cool air to the lower portion. One of the criteria utilized by Brown & Root for laying out the ductwork and locating air supply and return diffusers was to provide uniform mixing based on discharge velocities and flow at each supply or return, and natural convective air flow paths. This was done not only to provide uniform mixing for hydrogen but also to prevent pocket accumulations of hydrogen inside containment as a result of stagnant air. This is a standard design practice in the industry.

BROWN & ROOT RESPONSE 4.4.2.1(c) - CONT.

The above finding also states that there was an inconsistency in specifying the hydrogen concentration limit for the battery room. No such inconsistency exists. In July, 1974, Brown & Root issued a safety-related, design verified calculation that assumed a hydrogen concentration below the limit recommended by the battery manufacturer (3%). The results of this calculation indicated that, in order to maintain hydrogen concentration below 3%, an air flow rate of 2.2 cubic feet per minute (CFM) was necessary. As implemented in the design, the air flow rate is 2000 CFM, almost a thousand times that required to maintain the 3% level. This vast margin assures that the hydrogen concentration in that room will be kept well below the recommended limit.

It was later identified, in response to an NRC question, that hydrogen concentration in the battery room should be limited to 2%. The Nuclear Analysis discipline submitted a calculation that employed a 2% limit and established that the air flow rate provided in the design was more than sufficient to keep the hydrogen concentration under a 2% limit. The Nuclear Analysis Discipline calculation was not classified as safety-related since it was not part of the design basis. See Brown & Root responses to Quadrex Finding Nos. 4.6.2.1(b) and 4.6.2.1(o).

Subsequent to the Quadrex review and as part of the HVAC design re-evaluation, a safety-related, design verified calculation was re-performed, and it was again established that the HVAC system design is more than adequate to keep hydrogen concentration in the battery room well below 2%.

Given the above facts, it is evident that the above finding is erroneous and will have no impact on plant licensability.

QUADREX FINDING NO. 4.4.2.1(d) - HVAC TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(d) "Separation requirements to protect against common mode failures such as fire and jet impingement are not identified (see Question H-6). B&R has not reviewed the impact of non-safety HVAC ductwork on safety-related equipment (see Question H-18)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Quadrex criticizes Brown & Root for not identifying separation requirements to protect against common mode failures. This criticism is without basis. During the initial design, various regulatory guides, technical positions, and codes, as committed in the PSAR, constituted the guidelines for separation criteria. These sources are appropriately accounted for in the discipline design documents. In addition, each discipline's design documents were reviewed by the other disciplines in accordance with project procedures.

As the design progressed, the Systems Design Assurance Group (DAG), the Safety Systems Hazards Analysis Program (SSHAP), and the Fire Hazard Analysis (FHA) Group were established to ensure total project compliance with separation requirements to protect against common mode failures which may be caused by fire, jet impingement, or other hazards.

Brown & Root had previously issued a separation criteria TRD. This TRD and the activity of the DAG to implement the on-going SSHAP ensures separation requirements have been met for all disciplines. Fire and jet impingement are only two of several hazards investigated by this multi-discipline group. The FHA presently being performed by NUS is coordinated by SSHAP and the results of the FHA are factored into the program, as are the jet impingement results.

To the extent that the last sentence in this finding refers to the operational "impact" of the failure of non-safety HVAC duct work on safety-related equipment, there is no impact because non-safety HVAC

ducts do not serve safety-related equipment. To the extent that the finding refers to a physical "impact" (i.e., falling non-safety HVAC duct work impacting safety-related equipment), such impact will not occur, because HVAC duct work and equipment, whether safety-related or not, has been seismically supported in those buildings or areas classified as "safety-related" or housing safety-related equipment. Under either definition of "impact", no review was necessary.

Given the foregoing facts, it is clear that the above finding is erroneous and will have no impact on plant licensability.

QUADREX FINDING NO. 4.4.2.1(e) - HVAC TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(e) "The floor drainage system needs to be re-examined with respect to the availability of ECW leak detection capabilities (see Question H-23)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

In Quadrex's assessment of Brown & Root's response to Question H-23, Quadrex suggested that the safety classification of the floor drain sumps may be in error because the high level alarms for those sumps were the only means of detecting essential cooling water (ECW) leakage. Thus, Quadrex concluded that the floor drainage system may have to be upgraded to safety-grade in accordance with the Standard Review Plan (Revision 1, Page 9.3.3-2) (SRP) unless it could be demonstrated that the ECW system has other means of leak detection.

In fact, the ECW system has the following alarms and/or indications in addition to the sump alarms:

Parameter	Type of Monitor	Location
ECP Level	Recorder	Control Room
	Annunciator	Control Room
	Computer Alarm	Control Room
Pump Bay Level	Annunciator	Control Room
	Indicator	Control Room
	Recorder	Local
Pump Discharge Pressure	Indicator	Control Room
	Computer Indication	Control Room
	Computer Alarm	Control Room
Building Header Pressure	Annunciator	Control Room
Strainer Diff. Pressure	Annunciator	Control Room
	Computer Alarm	Control Room
Auto-Start Backup Train	Various	Control Room

The ECW sump alarm system, when combined with the above listed additional alarms and with normal operator surveillance, meets the acceptance criteria of the SRP.

Quadrex's assessment of Brown & Root's response to Question H-23 also states that the essential cooling pond (ECP) could potentially empty into the electrical auxiliary bay chiller room, which is at a lower elevation, in the event of an essential cooling water line rupture within the chiller room. This could also lead in Quadrex's view to a violation of the technical specification requiring a 30-day supply of water at all times in the ECP. Both of these statements are inaccurate. The ECW system is classified as a "moderate energy system" in accordance with Appendix A to SRP Section 3.6.1, "Criteria for Determination of Postulated Break and Leakage Locations in Higher and Moderate Energy Fluid Piping Systems Outside of Containment Structures." In accordance with these criteria, the rate of leakage postulated for a break in such a "moderate energy system" is very small. As a result, an extended period of time would be required to drain the ECP below the 30-day supply level, and it would take even longer to drain the ECP completely into the chiller room. Given the back-up alarms discussed above and operator surveillance, it is not reasonable to assume that the potential exists for such draining of the ECP.

In sum, the floor drainage system does not have to be re-examined with respect to the availability of ECW leak detection capabilities. Accordingly, the above Quadrex finding is erroneous and will have no impact on plant licensability.

QUADREX FINDING NO. 4.4.2.1(f) - HVAC TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(f) "Inconsistencies between the FSAR and other HVAC design documents need to be resolved (see Question H-11)."

BROWN & ROOT RESPONSE

Brown & Root agrees with the above statement as a general proposition, but disagrees with the conclusion that it may have a serious impact on plant licensability. Brown & Root has licensing procedures in place to resolve any inconsistencies between the FSAR and other HVAC design documents.

The refinement of the HVAC design for a nuclear project is an ongoing process. It is generally necessary to make revisions to the HVAC design documents during the engineering phase. This has been the case at STP. Brown & Root engineering procedures require that any change to a design document be evaluated against the current FSAR section, and that the Brown & Root Licensing Group be given annotated FSAR pages when the design change requires a revision to a previous FSAR position.

In addition, Brown & Root established the Systems Design Assurance Group (DAG) in 1980 (see Brown & Root's responses to Finding Nos. 4.4.2.1(d) and 3.1(a)). Part of this group's responsibility is to review the design to ensure consistency with FSAR commitments and to identify problems for resolution. This group was in operation during the Quadrex review and at that time had completed virtually all the Phase I reviews. One of the purposes of these reviews was to assure that the design in place is consistent with the FSAR commitments. The DAG was not consulted by Quadrex during the review.

In summary, any inconsistencies between the FSAR and HVAC design documents have been or are in the process of being resolved. Accordingly, this finding will have no impact on plant licensability.

QUADREX FINDING NO. 4.4.2.1(g) - HVAC TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

ANSI N45.2.11-1974, Paragraph 6.0, identifies the requirements regarding design verification and document reviews, which apply to HVAC design verification. All of these requirements have been addressed and are included in the STP Design Verification Procedure STP-DC-015. There is no industry standard or NRC regulation requiring the utilization of specific written criteria (checklists, etc.) for the selection of design verifiers. However, in accordance with Section 3.1.1(c) of STP-DC-015, the cognizant discipline engineer at STP assigns design verifiers and then notifies the Engineering Project Manager by memorandum of such assignments, with a copy of the memoranda to the Training Coordinator and the Design Quality Engineer. STP-DC-015 also requires attendance at a training session by the design verifier and the submission of each verifier's qualifications to the Personnel Coordinator. The information submitted usually includes the following:

1. Education.

2. Applicable experience (technical/licensing/codes and standards).

3. Specialized training, and

4. Program upgrading plans.

STP-DC-015 also defines the methodology which is used by the design verifier. This methodology requires the design verifier to certify that he followed approved procedures. The verifier is also required to sign a form which signifies the following:

- To the best of his knowledge, the document is correct and was prepared according to applicable procedures.

- The verifier was not the author of the document being verified.
- The verifier addressed all of the questions in Table 1 of the Procedure.

Brown & Root's design verification at a minimum is consistent with standard industry practice, and in some respects exceeds that practice. Quadrex is in apparent agreement. In Quadrex's assessment of Brown & Root's response to Question C-16, Quadrex states as follows:

> "Brown & Root's design verification procedure appeared to be adequate or above industry. standards on paper."

This verification procedure was utilized in the HVAC design. Accordingly, there is no basis for Quadrex to question the adequacy of the Brown & Root HVAC design verification process.

For these reasons, the above finding is erroneous and will have no impact on plant licensability.

QUADREX FINDING NO. 4.4.2.2(h) - HVAC TECHNICAL ADEQUACY ASSESSMENT

For the HVAC design, one finding is expected to impact on the generation of reliable power by STP.

> (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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The reference to Questions H-3 and H-10 in the finding indicates that Quadrex is referring to the HVAC design in relation to radioactive contamination control. In that connection, areas of the plant containing radioactive materials have been safely enclosed and are under administrative control. Access to such areas is through doors which, under normal circumstances, are kept closed. Hatches have been provided for maintenance and equipment removal, and will be utilized only for limited periods of time and will be closed during normal plant operation. Where necessary, these hatches have also been enclosed to limit migration of contaminated air to other areas of the plant. Thus, the "actual operating conditions" postulated by Quadrex are in fact abnormal conditions.

The HVAC systems in the radioactive areas of the plant are designed and balanced for "normal" conditions, which assume that doors and hatches are closed. As stated in the FSAR and SDD, pressure in all contaminated areas will be maintained at a level less than that maintained in clean areas of the plant. At the time of balancing, minimum air velocities at the entry point will be established with the doors and hatches closed. When the doors/hatches are opened, the air velocity decreases, but the air flow is still from clean areas to contaminated areas, preventing migration of contaminated air to clean areas of the plant. If a ventilation system were designed and balanced assuming open doors and hatches, a relatively large system would result. Such an overdesigned ventilation system would not only be expensive to build, operate, and maintain, but could cause increased differential pressure across doors and hatches under normal conditions, therefore making them difficult to open.

The design of the STP HVAC systems assumes appropriate administrative controls during maintenance periods as an economical alternative to over-designing the individual systems. Should the need arise to augment individual HVAC systems to facilitate maintenance, portable fans and, if necessary, temporary ducting could be used with appropriate contamination control. This approach is consistent with industry practice.

In view of the above facts, this finding will not impact on the generation of reliable power by STP.

SECTION 2.5 - PIPE RUPTURE FINDINGS

Contained in this section are the Brown & Root responses to the Quadrex findings in Sections 4.5.2 and 4.5.3 of Volume I of the Quadrex Report, which address the area of pipe rupture. Quadrex divides its pipe rupture findings into those related to ruptures inside containment and those related to outside containment ruptures. The Brown & Root responses contained in this section follow that format. The inside containment pipe rupture design was completed by EDS Nuclear under a sub-contract with Brown & Root. The outside containment pipe rupture design was to be completed by Brown & Root. For the pipe rupture area, Quadrex posed twenty-six (26) questions from which it made fifteen (15) "Most Serious" findings and two (2) "Serious" findings. The following is a summary overview of the Quadrex findings in the pipe rupture area and Brown & Root responses thereto.

SECTION 2.5.1 - SUMMARY OVERVIEW

A review of the Quadrex findings in this section indicates that Quadrex simply did not understand the Brown & Root design philosophy with regard to the timing and methods of addressing the effects of postulated pipe ruptures on safety-related equipment and structures. As Brown & Root explained to Quadrex during its review, Brown & Root made a design philosophy decision in the initial stage of the plant design to locate the majority of all high energy pipe lines within Containment or in the Isolation Valve Cubicle (IVC). This concentration of pipe lines inside containment, and the resulting concentration of pipe restraints and other devices in this area to counteract the effects from potential pipe ruptures, required Brown & Root to have the pipe rupture analysis for inside containment completed in the early stages of the project.

By the same token, the above design philosophy also resulted in there being only three high energy piping systems outside containment. This permitted the pipe rupture analysis for these piping systems to be performed at the present design stage, since the limited number of piping systems necessarily meant a limited amount of potential pipe rupture effects. This later analysis also gave Brown & Root the opportunity to generate actual pipe response data for use in the outside containment pipe rupture analysis, resulting in a more precise analysis.

The majority of the findings in this section reflect Quadrex's apparent failure to comprehend the above STP design philosophy. For example, in Quadrex Finding Nos. 4.5.3.1(a) and (c), Quadrex criticizes Brown & Root for failing to have a pipe rupture analysis completed for outside containment and for not having a Technical Reference Document (TRD) addressing this analysis. In Quadrex's view, this indicated a "general lack of understanding, planning, preparation and availability of procedures." However, as explained in the Brown & Root responses to these findings, not having a completed pipe rupture analysis for outside

containment at this stage of the STP design was appropriate and consistent with the STP design philosophy. Moreover, as indicated in the Brown & Root response to Quadrex Finding No. 4.5.3.1(d), Brown & Root informed Quadrex that an implementation TRD for the outside containment pipe rupture analysis was being developed at the time of the Quadrex review and was to be based on the criteria utilized in the inside containment analysis. This TRD was issued not long after the Quadrex review. Thus, if there is any "lack of understanding" in this area, it lies with Quadrex, not Brown & Root. (See also the Brown & Root response to Quadrex Finding No. 4.5.3.1(g)).

Another example of Quadrex's lack of understanding of the STP piping design is Quadrex Finding No. 4.5.2.1(b), which criticizes Brown & Root's use of preliminary load data in designing structural steel for inside containment. However, utilization of such data, which are reviewed and confirmed when actual load data are available, is once again totally consistent with the STP design philosophy which calls for an early inside containment pipe rupture analysis which necessarily must utilize preliminary data. Moreover, a review of the design which has been completed utilizing actual load data has determined that structural steel members have been adequately designed. Brown & Root believes that the remaining reviews will produce identical results. (See also the Brown & Root response to Quadrex Finding No. 4.1.2.1(h)).

In many of the findings, Quadrex disagrees with the design approach or method of analysis utilized by Brown & Root. (See Quadrex Finding Nos. 4.5.2.1(a), (c), and (d) and 4.5.3.1(b), (e), (j) and (k)). Although Quadrex is entitled to express its opinion about a particular design approach or mode of analysis, it has a professional obligation to indicate whether the approach or mode of analysis criticized is consistent with NRC requirements and/or industry practices. Quadrex failed to do this, despite the fact that in all instances where the Brown & Root design approach or mode of analysis was criticized, such approach or mode of analysis had a sound analytical basis and was consistent with NRC requirements and/or industry practice and standards.

Finally, several of the Quadrex findings in this section make factually inaccurate statements about certain areas of the STP design. (See Quadrex Finding Nos. 4.5.2.1(e) and 4.5.3.1(d), (f), (h), (i) and (l)). For example, in Finding No. 4.5.3.1(h) Quadrex criticizes Brown & Root's application of a section of the "no break zone" criteria to piping systems between containment isolation valves. Quadrex apparently made this criticism because it believed containment isolation was accomplished solely by one isolation valve per line penetrating containment, a situation that would have rendered the nomenclature "no break zone" criteria for piping systems "between valves" inappropriate.

However, had Quadrex studied the available STP design documents, it would have realized that there are various situations where containment isolation is achieved by means of two isolation valves, consistent with 10 CFR 50 Appendix A, GDC 55 and 56. Therefore, application of the "no break zone" criteria to the systems between these valves is appropriate.

In sum, the Quadrex findings contained in this section evidence that Quadrex misinterpreted the Brown & Root design philosophy relating to the analysis of pipe rupture effects, and both missed and misstated particular elements of the Brown & Root consideration of those effects.

From the foregoing facts, it is evident that none of the findings contained in this section will impact plant licensability.

SECTION 2.5.2

RESPONSE TO PIPE RUPTURE FINDINGS

QUADREX FINDING 4.5.2.1(a) - PIPE RUPTURE TECHNICAL ADEQUACY ASSESSMENT (INSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The criteria employed by Brown & Root to define the jet surface during a pipe rupture analysis are in accordance with NRC Branch Technical Position MEB 3-1. These criteria provide for a 10° half-angle expansion cone for two-phase jets and for zero expansion for sub-cooled non-flashing jets (fluid temperatures less than 212°F). To date the NRC has neither modified these requirements nor required the use of ANSI N-176. Brown & Root's approach is conservative and consistant with industry practice.

Brown & Root is aware of the requirements of ANSI N-176 which requires consideration of the more rapid jet expansion (greater than 10°) generated by a pipe rupture involving sub-cooled flashing jets (fluid temperatures equal or greater than 212°F). This more rapid expansion results in a slight increase in the sphere of influence of the jet near the rupture (approximately 5 pipe diameters from the rupture). However, due to this expansion, any load from the jet is significantly reduced and the effect of the more rapid expansion of the jet is limited to a small area near the rupture location. It should be noted that identification of jet targets is primarily determined by assuming rotation (whipping) of the ruptured pipe. Thus, the use of ANSI N-176 defined jets will not result in significant change on the identification of targets, because the difference in jet profile would rarely affect which potential targets are impacted.

Given these facts, the overall impact on the STP design resulting from Brown & Root's decision not to utilize a slightly larger jet expansion for pipe ruptures involving sub-cooled fluids will be minimal, if any. Brown & Root does not believe that it is necessary, nor warranted, to institute a change in design procedures, especially since current procedures are in accordance with NRC requirements.

Therefore, the above finding will have no impact on plant licensability.

QUADREX FINDING NO. 4.5.2.1(b) - PIPE RUPTURE TECHNICAL ADEQUACY ASSESSMENT (INSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

All load data submitted to Brown & Root by EDS were design verified. This design verification was performed in acccordance with EDS's Quality Assurance Procedures which are consistent with all NRC requirements.

The preliminary load data referred to in Questions C-4 and M-8, and cited by Quadrex in the above finding, concern the 130,000 lb. "sizing" load supplied to Brown & Root by EDS in 1975. In developing this conservative pipe rupture load, EDS relied on its extensive nuclear industry experience in addressing pipe rupture effects. This load represented an upper limit on the pipe rupture effects for piping systems 4" or smaller in diameter. This preliminary load was supplied to Brown & Root at an early stage of the design effort and allowed Brown & Root to develop a conservative design for structural members inside containment, while EDS was in the process of generating the actual load data as a part of its pipe rupture analysis. Upon the receipt of the actual rupture load data, the structural members were reviewed by Brown & Root to verify the adequacy of the initial design. Thus far, several designs of structural members have been reviewed, and the members have been shown to be adequately designed.

It should be noted that ANSI N45.2.11 specifically authorizes the use of preliminary load data, such as the 130,000 lb. "sizing" load, provided that they are identified and tracked until they become final. Brown & Root procedures control the use of such preliminary data by requiring not only that all final designs be verified when final data are available, but also that those who perform design verifications confirm the reasonableness of all preliminary input data.

Given the foregoing, it is evident that the above finding is erroneous and will have no impact on plant licensability.

QUADREX FINDING NO. 4.5.2.1(c) - PIPE RUPTURE TECHNICAL ADEQUACY ASSESSMENT (INSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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 investigated. 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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The potential pipe rupture effects in the design of nuclear power plant structures, components, and systems is an area of design which has evolved from using conservative techniques to performing detailed nonlinear dynamic evaluations. As design methods became more sophisticated, the conservatisms which were once built in the consideration of rupture effects have been reduced. However, with this reduced conservatism, secondary effects have received increased attention. The extent to which conservatisms are maintained, such as using upper-bound loadings or ignoring any load reduction due to non-linear structural responses, dictates the degree to which secondary effects must be addressed.

The STP design for rupture effects was initiated early in the nuclear industry's consideration of these effects and consequently utilized conservative analysis techniques. Although Brown & Root and EDS monitored evolving regulatory philosophy and industry criteria during the rupture restraint design of STP, these criteria were seen as consistent with the design of STP and did not indicate that any modification of design methods was warranted. As a result of the conservative design utilized, secondary effects from pipe ruptures need not be addressed separately at STP.

Quadrex criticizes Brown & Root for not adequately investigating potential pipe rupture damage to pipe supports. This criticism is unfounded. Industry practice and STP criteria for pipe rupture effects indicate that a "whipping" ruptured pipe will not damage other piping systems of equal or greater size and of equal or greater thickness. This position is in accordance with NRC Branch Technical ASB(APCSB)3-1.

Indeed, even if it is assumed that the supports on these larger piping systems could be damaged, the likelihood that any safety functions would be affected is minimal, because the impacted support would absorb a significant portion of the energy of the whipping pipes through elastic/plastic deformation, and any remaining energy would be transmitted through the larger piping systems to adjacent supports. Thus, Brown & Root believes that it has adequately addressed the potential pipe rupture damage to pipe supports.

Brown & Root also considered and provided for the out-of-plane loading on U-bar restraints by utilizing secondary and tertiary restraints. These secondary and tertiary restraints guide a whipping pipe in the primary direction of its restraint. Brown & Root is aware that even with these additional restraints, gaps and tolerances could allow minor variations in the primary load application which in turn could cause out-of-plane loading on the restraints. However, Brown & Root took into account this out-of-plane loading in its conservative development of the pipe-rupture analysis load and in utilizing 10% of this load as the out-of-plane force on any particular restraint. This is consistent with nuclear industry practice in the design of U-bar restraints.

Finally, the restraints' physical characteristics assumed in the response of the rupture evaluations are the same characteristics which have been used in the design specifications for those restraints. Therefore, the assumed response would closely approximate that of the actual restraint when installed.

In summary, Brown & Root's consideration of secondary effects of pipe ruptures has been adequate. The above finding, therefore, is erroneous and will not impact plant licensability.

QUADREX FINDING NO. 4.5.2.1(d) - PIPE RUPTURE TECHNICAL ADEQUACY ASSESSMENT (INSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

As an initial matter, it is important to note that application of the criteria for a "no break zone" (i.e., the "superpipe" referred to in the above finding) as discussed in NRC Staff Branch Technical Position ASB (APCSB) 3-1 (Protection Against Postulated Piping Failures in Fluid Systems Outside Containment) is an option which may be used in the containment penetration area and/or between containment isolation valves. Application of such criteria inside containment was not necessary at STP since space and structural considerations allowed the installation of pipe rupture restraints and jet shields near the containment wall.

These criteria were applied, however, in the containment penetration area outside containment, such as for the piping systems inside the Isolation Valve Cubicle (IVC). Brown & Root described to Quadrex how the superpipe criteria were applied to such piping systems. In response, Quadrex stated as follows in its assessment of Brown & Root's response to Question M-9:

> "The definition of superpipe as described and shown in Attachment M-9c is accurate."

Brown & Root also believes that an analysis which couples piping systems inside and outside containment is not necessary. Under the Brown & Root design, the piping systems inside containment are anchored at the penetration point by the penetration assembly. The assembly acts as an "anchor", separating the piping inside and outside of containment, and ensuring that piping loads from inside of containment are not transmitted to the piping outside of containment. This approach is consistent with industry practice. Moreover, subsequent to the Quadrex review, several detailed containment penetration reports have confirmed that the stiffness of the penetrations is sufficient to consider them as an anchor. A coupling analysis is, therefore, not required.

Thus, Brown & Root has adequately addressed the issues related to "superpipe" stress limits, and the above finding will not have any impact on plant licensability.

QUADREX FINDING NO. 4.5.2.2(e) - PIPE RUPTURE TECHNICAL ADEQUACY ASSESSMENT (INSIDE CONTAINMENT)

Due to the potential for longer time periods required to gain access for maintenance and inspection of components, the following finding appears to impact the generation of reliable power by STP:

> (e) "EDS did not apply controlled criteria for ALARA, ISI, and maintenance access in the design (see Questions M-26A and P-17)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

In responding to Question P-17, cited in the above finding, Brown & Root supplied the criteria documents utilized by EDS in its design for inside containment pipe ruptures. See EDS' response to Question P-17. These documents included "Access and Design Considerations for In-Service Inspection" as well as "Equipment Removal and Personnel Access" drawings, both of which were controlled and documented in accordance with the EDS Project Interface Control Instructions. These documents, augmented by the extensive experience of EDS in the design of nuclear piping systems, provided ample guidelines for the consideration of ALARA, ISI and maintenance access. Additionally, the Brown & Root/EDS interface agreement required that all design drawings be submitted to Brown & Root for review prior to formal issuance. This review was not only of the technical adequacy of the design in question, but also considered the requirements of access and ALARA.

For example, the design of pipe whip restraints inside containment has considered the requirements of access (as indicated in the Brown & Root response to Quadrex Finding No. 4.5.3.2(a)), as well as many other factors such as space, personnel access, system function, equipment layout, and plant availability. Also, the STP design philosophy of locating the majority of all high energy lines inside containment, resulted in the concentration of restraints inside containment creating some congestion in these areas. However, such concentration is preferable to the alternative of locating these restraints throughout the entire facility. Moreover, where necessary, removable mechanisms have been provided to facilitate access. In the above finding, Quadrex focused narrowly on the access aspect of the STP design without properly evaluating the trade-offs between access and total system design.

Quadrex's assessment of EDS's response to Question P-17 also criticizes the use of the minimum yield strength values in locating restraints from the break point. As indicated in Brown & Root's response to Quadrex Finding No. 4.7.3.2(n), this practice is typical in the industry with regard to the initial design of restraints. By utilizing the minimum yield strength values, the verification of actual yield strengths after the fact is ensured. If the opposite approach were employed, with higher yield values being used in the design, the actual yield strengths would have to be confirmed when the pipe was fabricated. In the event they were not of sufficient magnitude as required by the restraint design, a backfit would be necessary resulting in the potential scrapping of material. Therefore, the prudent approach is to design the restraint locations using the published minimum strengths and, on a case-by-case basis, factor in the actual material strengths when known. This approach, which was followed by Brown & Root, allows the engineer to address access problems after the design is completed without jeopardizing the overall design itself.

Finally, the Quadrex assessment of Question M-26A states that "controlled criteria for ALARA, ISI, and maintenance access were not applied in the design". This assessment is erroneous and is contradicted by the EDS response to Question P-17, which listed the controlled criteria documents used by EDS in its design. The Quadrex assessment of the response to Question P-17 found no fault with the criteria used by EDS. Different Quadrex reviewers evaluated both questions, and the contradiction between the two assessments illustrates the dangers of an insular review process that focuses on narrow issues without taking the overall design into consideration.

Given the foregoing, it is clear that EDS did apply controlled criteria for ALARA, ISI and maintenance access in the design. Accordingly, the above Quadrex finding is erroneous and will not impact on the generation of reliable power by STP.

QUADREX FINDING NO. 4.5.3.1(a) - PIPE RUPTURE TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

For the B&R pipe rupture scope, the following finding is expected to seriously impact plant licensability:

(a) "No analyses have been completed at this time, and no moderate energy systems were listed for evaluation. 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). No methodology for restraint design was available (see Question M-12)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

As an initial matter, it is important to note that the evaluation of the effects of pipe ruptures and/or cracks is a complex process. It requires not only detailed knowledge of a plant's layout for safety-related systems and equipment, but also a realization of the role played by these systems in bringing about the safe shutdown of the plant and a detailed knowledge of stress levels in each affected piping system. All of this information, taken together, dictates the extent to which pipe ruptures and/or cracks are postulated and the extent to which protective devices, such as whip restraints or jet impingement barriers, are needed to mitigate the effects of the ruptures or cracks.

It should also be noted that the concentration of safety-related piping systems and equipment into one area of a plant also results in the isolation of the potential rupture locations, their effects, and any protective devices to that same area. Thus, when safety-related piping and equipment are concentrated in one area, there is an elimination, or at least a reduction, of the pipe rupture evaluations needed for other areas of the plant. This is in accordance with NRC Staff Branch Technical Position ASB (APCSB) 3-1. Concentration of piping systems also has the benefit of allowing the use of multiple system restraint devices, such as frames, in those areas or buildings in which the greatest number of safety systems are located. Although the concentration of these restraint devices as well as the size of some of the multi-system frame structures in a particular area tends to reduce access to that area, one can effectively achieve an overall balance between system layout and restraint locations.

The design of STP is indeed one in which the maximum utilization of system layout was used to concentrate the majority of high energy piping systems inside Containment or in the Isolation Valve Cubicle (IVC). Thus, the amount of high energy piping outside of containment and IVC is limited to only the auxiliary steam piping, the letdown piping and the charging/seal injection piping.

As a result of the above design philosophy, the inside containment rupture evaluations were initiated early in the design cycle (approximately in 1975). The restraint mechanisms were also designed early so that placement of these restraints into the plant arrangement could be accomplished in the most effective manner, avoiding the need to engage later in expensive and time-consuming backfitting. However, with only three high energy systems in areas outside containment, it was not necessary to conduct early pipe rupture evaluations in those areas; more effective evaluations could be completed later once detailed stress information on the systems was known. In addition, given the smaller number of high energy lines outside containment, the number of restraint mechanisms for those lines will necessarily be limited and, will, therefore, not cause significant installation problems when they are installed at a later date in the project.

The above STP design philosophy for analyzing postulated pipe ruptures was explained to Quadrex during the Quadrex review. However, this philosophy was apparently misunderstood by Quadrex, for Quadrex mistakenly questioned both the extent and size of rupture restraints inside containment (which were the result of the early analysis of inside containment ruptures), and the lack of a completed pipe rupture analyses for outside containment.

The above finding also criticizes Brown & Root for not having a TRD in place addressing the outside containment pipe rupture analysis. However, Brown & Root indicated to Quadrex that the overall STP pipe rupture criteria are set forth in Brown & Root document L010RR064A. This document was also being used in the development of an implementation TRD for rupture evaluations outside of containment; this TRD utilizes a safe shutdown logic as a basis for identifying possible interactions with essential equipment or systems.

Quadrex was informed that this outside containment TRD was under development at the time of the Quadrex review. However, in Quadrex's view, Brown & Root was late in developing this TRD. In reality, the timing of the TRD development was appropriate in that the piping stress analysis was just being finalized and the as-built arrangement of safety equipment was being thoroughly defined. The TRD has been issued for review and comment subsequent to the Quadrex review, and contrary to Quadrex's assertion in the above finding, it includes the requirements for moderate energy systems.

Brown & Root also presented to Quadrex a preliminary interaction matrix form during the review. It was Brown & Root's intent to identify at a later date the types of interactions and the essential function of the interactions in the "remarks" column of the form. However, due to Quadrex's mistaken impression of the magnitude of the analytical effort required outside containment, Quadrex believed that the proposed interaction matrix was insufficiently defined. As with the implementation TRD, the interaction matrix was being completed in a timely fashion after the Quadrex review.

With respect to restraint design coordination, all rupture evaluation efforts are coordinated by the Mechanical Discipline and include input from the System Design Assurance Group (see Brown & Root's response to Quadrex Generic Finding No. 3.1(a)) to ensure an overall projectwide discipline integration. The restraint design for outside containment is the responsibility of the Civil/Structure Discipline. Brown & Root intends to utilize three types of whip restraints (rigid, yielding and crushable). This methodology is consistent with industry practice. The restraint design philosophy is also consistent with that used on the design of inside of containment restraints, with more advanced analysis techniques being used where necessary.

Given the foregoing, it is evident that Brown & Root had an adequate plan for addressing the effects of postulated pipe ruptures outside containment. Accordingly, the above finding will not impact on plant licensability.

QUADREX FINDING NO. 4.5.3.1(b) - PIPE RUPTURE TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

(b) "Isometric drawings do not show the location of restraints (see Question M-4)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The piping system isometric drawings do not show the locations of restraints. However, the lack of indication of these locations in the drawings is not a problem, because the restraints, which are passive devices, do not form a physical part of the piping system. Moreover, restraint locations are defined in the rupture analysis isometrics which are a part of the rupture analysis package. Restraint locations are also shown on individual restraint drawings issued for construction.

Thus, the above Quadrex finding will not have any impact on plant licensability.

QUADREX FINDING NO. 4.5.3.1(c) - PIPE RUPTURE TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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 Question M-1 and M-2)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding, which is a partial restatement of Quadrex Finding No. 4.5.3.1(a).

The design of STP is one in which maximum utilization of system layout was used to concentrate the majority of high energy piping systems inside Containment or in the Isolation Valve Cubicle (IVC). Thus, the amount of high energy piping outside of containment was limited to only three (3) systems, specifically the auxiliary steam piping, the letdown piping and the charging/seal injection piping

As a result of the above design philosophy, the inside containment evaluations were initiated early in the design cycle (approximately 1975). The restraint mechanisms were also designed early in the design cycle so that placement of these restraints into the plant arrangement could be accomplished in the most effective manner avoiding the need to engage later on in expensive and time-consuming backfitting. However, with only three high energy systems outside containment, it was not necessary to conduct early pipe rupture evaluations in these areas, and more effective evaluations could be completed later once detailed stress information was known. In addition, given the small number of high energy lines outside containment, the number of restraint mechanisms outside containment will necessarily be limited and will not cause significant installation problems when they are installed at a later date in the project.

The above STP design philosophy for analyzing postulated pipe ruptures was explained to Quadrex during the review. However, this philosophy was apparently misunderstood by Quadrex, for Quadrex mistakenly questioned both the extent and size of rupture restraints inside containment

(which were the result of the early analysis of inside containment ruptures) as well as the lack of a completed pipe rupture analysis outside containment. Hence, Quadrex's allegation in the finding that there is a "general lack of understanding, planning, preparation and availability of procedures" for outside containment pipe ruptures is erroneous.

The above Quadrex finding also criticizes Brown & Root for not having a criteria guideline document in place addressing the outside containment pipe rupture analysis. However, Brown & Root indicated to Quadrex that the overall STP pipe rupture criteria are set forth in Brown & Root document L010RR064A. This document was being used in the development of the implementation TRD for rupture evaluations outside of containment.

Quadrex was informed that the outside containment TRD was under development at the time of the Quadrex review. However, in Quadrex's view, Brown & Root was late in developing it. In reality, the timing of the TRD development was appropriate in that the piping stress analysis was just being finalized and the as-built arrangement of safety related equipment was being thoroughly defined. The TRD has been issued for review and comment subsequent to the Quadrex review.

Given the foregoing, it is clear that Brown & Root has an adequate understanding of the planning and procedures necessary to complete pipe rupture analyses for piping systems outside containment. Accordingly, the above finding is erroneous and will not impact on plant licensability.

QUADREX FINDING NO. 4.5.3.1(d) - PIPE RUPTURE TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Brown & Root stated during the Quadrex review that the specific guidelines and criteria for pipe ruptures outside containment would be provided in the implementation TRD, "Criteria and Methodology for Evaluation of Postulated Pipe Break and Crack Effects for STP Unit 1." This TRD was in the process of development at the time of the review and was drafted in accordance with the overall Project criteria document L010RR064A which provides the approach, methods, and philosophy for pipe rupture evaluations. The TRD has now been issued for review and comment. It provides the basis for conducting the pipe rupture and crack evaluations for the piping systems outside containment, and contains specific guidelines for deleting lines from the analysis.

With respect to the potential secondary effects of pipe whip or jet impingement on the Isolation Valve Cubicle (IVC) or the Mechanical Auxiliary Building (MAB) these effects were considered very early in the design of STP. Starting in 1976, secondary effects were accounted for on the primary systems outside of containment, (i.e., main steam and feedwater piping systems), through a subcontract with Teledyne Engineering Services. Teledyne has continued to provide consulting services to evaluate the rupture effects of these systems outside of containment, and in the process of doing so has generated resulting load data on the IVC wall.

Thus, Brown & Root has developed criteria to delete lines from the pipe rupture analysis, and has also considered potential secondary effects on the IVC and MAB. The above finding is, therefore, erroneous and will not impact on plant licensability.

QUADREX FINDING NO. 4.5.3.1(e) - PIPE RUPTURE TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(e) "Use of the 10° half angle may not be appropriate for jet impingement effects (see Question M-4)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding, which is virtually identical to Quadrex Finding No. 4.5.2.1(a).

The criteria employed by Brown & Root to define the jet surface during a pipe rupture analysis are in accordance with NRC Branch Technical Position MEB 3-1. These criteria provide for a 10° half-angle expansion cone for two-phase jets and for zero expansion for sub-cooled non-flashing jets (fluid temperatures less than 212°F). To date the NRC has not modified these requirements.

Brown & Root is aware of the requirements of ANSI N-176 which requires consideration of the more rapid jet expansion (greater than 10°) generated by a pipe rupture involving sub-cooled flashing jets (fluid temperatures equal or greater than 212°F) This more rapid expansion results in a slight increase in the sphere of influence of the jet near the rupture (approximately 5 pipe diameters from the rupture). However, this expansion of the jet substantially reduces any load from the jet itself. Thus, the effect of the more rapid expansion of the jet is limited to a small area near the rupture location. It should be noted that identification of jet targets is primarily determined by assuming rotation (whipping) of the ruptured pipe. Thus, the use of the ANSI N-176 defined jets will not result in a significant change on the identification of targets, because the difference in jet profiles would rarely affect which potential targets are impacted.

Given these facts, the overall impact on the STP design resulting from Brown & Root's decision not to utilize a slightly larger jet expansion for pipe ruptures involving sub-cooled fluids will be minimal. Brown & Root does not believe that it is necessary, nor warranted, to modify its design procedures, especially since current procedures are in accordance with NRC requirements.

Therefore, the above finding will have no impact on plant licensability.

QUADREX FINDING NO. 4.5.3.1(f) - PIPE RUPTURE TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(f) "Generally, dynamic analysis is required for all superpipe runs (see Question M-6)."

BROWN & ROOT RESPONSE

Brown & Root agrees with the statement that "generally, dynamic analysis is required for all superpipe runs," but disagrees with the inference that Brown & Root did not use dynamic analysis for all superpipe runs and further disagrees with Quadrex's assertion that this finding may have an impact on plant licensability.

During the Quadrex review, Brown & Root presented to Quadrex a general guideline which required dynamic analyses to be performed for all piping lines 14 inches in diameter and larger. This guideline was a minimum requirement. The guideline does not limit dynamic analysis to piping lines which are 14 inches and larger. In fact, as noted in Quadrex's assessment of Brown & Root's response to Question M-8, several other examples were cited by Brown & Root during the Quadrex review which showed that piping lines smaller than 14 inches in diameter were subject to dynamic analysis. Moreover, Brown & Root specifically stated during the review that dynamic analysis is presently being used and will continue to be used for all superpipe regions of piping systems.

Thus, the above Quadrex finding is erroneous in its implication that Brown & Root has performed no dynamic analyses for superpipe runs, and accordingly the finding will have no impact on plant licensability.

QUADREX FINDING NO. 4.5.3.1(g) - PIPE RUPTURE TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above Quadrex finding.

The only example of allegedly inconsistent or contradictory responses cited by Quadrex in its assessments of Brown & Root's responses to questions in this area relates to the Brown & Root guideline requiring a dynamic analysis for piping lines which are 14 inches in diameter and larger. Quadrex mistakenly interpreted this guideline as limiting dynamic analysis to such larger lines when in fact the guideline represents only a minimum requirement. When Brown & Root indicated to Quadrex that dynamic analysis had been performed on piping lines less than 14 inches in diameter, Quadrex saw this as a contradiction. See Brown & Root's response to Finding No. 4.5.3.1(f). In fact, no such contradiction existed.

As indicated in the Brown & Root responses to Quadrex Finding Nos. 4.5.3.1 (a) and (c), Quadrex simply does not understand the overall pipe rupture design philosophy employed by Brown & Root at STP. The lack of such an understanding has led Quadrex to question the efforts undertaken by Brown & Root in evaluating pipe rupture effects outside of containment, and produced the mistaken conclusion that Brown & Root lacks expertise with pipe rupture considerations.

In summary, it is clear that Brown & Root does have an adequate level of expertise in dealing with pipe rupture considerations. Accordingly, the above finding is erroneous and will not have any impact on plant licensability.

QUADREX FINDING NO. 4.5.3.1(h) - PIPE RUPTURE TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(h) "Not all the criteria stated for the no break zone appear to be applicable to STP (see Question M-9)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The "no break zone" as defined in NRC Branch Technical Position ASB(APCSB)3-1 and in Brown & Root's overall pipe rupture criteria document L010RR064A is a special requirement designed to prevent piping overstress in the containment isolation region, which is typically defined as the area between the containment isolation valves. This region, however, can be expanded to include the area between the containment penetration and the rupture restraint outside of the isolation valve. Brown & Root applied its "no break zone" criteria to this larger area recognizing that one of the most critical regions of containment isolation is inside the Isolation Valve Cubicle. Brown & Root explained this definition to Quadrex during the review. See Quadrex's assessment of Brown & Root's response to Question M-9. Quadrex indicated in its assessment of Brown & Root's response to Question M-9 that Brown & Root had correctly applied the "no break" criteria.

Nonetheless, as evidenced by the above finding, Quadrex failed to understand Brown & Root's "no break" criteria. The Brown & Root presentation to Quadrex contained an example showing only one isolation valve, from which Quadrex erroneously concluded that isolation of the containment at STP would in every case be achieved through only one isolation valve. Then, when Quadrex found that the "no break" criteria were said to apply to "piping between containment isolation valves," it concluded that those criteria could have no applicability to the one isolation valve design of STP. Actually, there are instances at STP where containment isolation is achieved through two valves, a point which should have been readily apparent to Quadrex after a review of the STP design. For two valve isolation, the "no break zone" criteria definition between isolation valves is appropriate.

Thus, the above finding is erroneous and will not have an impact on plant licensability.

QUADREX FINDING NO. 4.5.3.1(i) - PIPE RUPTURE TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(i) "B&R does not plan to look at field installed instrument lines for interaction analysis (see Question M-10)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The reach of this finding is unclear because it suggests that there is a distinction between "field installed" instrument lines and other lines not "field installed." Actually, all lines (whether instrument, air, or fluid) are "field installed." Surely, Quadrex does not mean that Brown & Root is not planning to look at <u>any</u> instrument line for interaction analysis; if it does, the finding is erroneous.

If, on the other hand, the finding attempts to suggest that no interaction analysis will be performed with respect to those safety-related instrument lines which are field <u>designed</u> and/or <u>routed</u>, the finding is also erroneous. At STP all safety-related lines are analyzed, designed, and routed at the home engineering offices and not in the field, and as such <u>are</u> included in the pipe rupture interaction evaluations and are within the scope of review of the Safety Systems Hazard Analysis.

Given the foregoing facts, it is clear that the above Quadrex finding is erroneous and will not impact on plant licensability.

QUADREX ASSESSMENT NO. 4.5.3.1(j) - PIPE RUPTURE TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

The following findings may have serious impact on plant licensability or deserve licensing attention:

* * * *

(j) "B&R response on bi-linear idealization of restraint stiffnesses was unclear (see Question M-18)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The Quadrex assessment of Brown & Root's response to Question M-18, cited in the above finding, evidences a lack of understanding by Quadrex of the techniques used by Brown & Root in the pipe rupture analysis. Two different techniques were used: energy balance methods and elastic-plastic methods. For the energy balance analyses, it is appropriate to approximate the stress-strain curve (that is, the restraint stiffness characteristics) by power functions. These functions are then easily integrated to determine the energy absorbed by the restraint. On the other hand, when a non-linear, elastic-plastic analysis is made, the restraint stiffness is represented by a piecewise linear function which becomes the input to a computer code.

Thus, there was no inconsistency when Brown & Root referred to both the power series and the bilinear representation of stiffness in its response to Question M-18. Therefore, the above finding is erroneous and will have no impact on licensability.

QUADREX ASSESSMENT NO. 4.5.3.1(k) - PIPE RUPTURE TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

The following findings may have a serious impact of plant licensability or deserve licensing attention:

* * * *

(k) "Acceptance criteria for pipe whip are not well formulated (see Question M-26)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

As indicated in the Brown & Root responses to Quadrex Finding Nos. 4.5.3.1(a) and (c), Quadrex apparently misunderstands the Brown & Root design philosophy relating to pipe rupture analyses. This philosophy was evidenced in the acceptance criteria discussed in Brown & Root document L010RR064A, which include acceptance criteria for pipe whip. This document was made available to Quadrex and is the predecessor of the implementing TRD on this subject. This TRD was under timely development during the Quadrex review and is based on a thorough understanding of pipe rupture techniques. This TRD was subsequently issued, and the acceptance criteria it contains are in accordance with the criteria indicated in Branch Technical Position ASB(APCSB)3-1, and with industry practice. Therefore, the acceptance criteria for pipe whip at STP are well formulated.

Quadrex comments in its assessment of Brown & Root's response to Question M-26 that the accceptance criteria "are obviously not well formulated" and that "very little consideration has been given to this problem." These comments are without basis and erroneous. Brown & Root's criteria are clearly formulated in the referenced documents and are consistent with the position of the NRC Staff.

Given the foregoing facts, it is evident that the above finding is erroneous and will have no impact on plant licensability.

QUADREX FINDING NO. 4.5.3.2(I) - PIPE RUPTURE TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

For the B&R pipe rupture scope, the following finding appears to impact the generation of reliable power by STP:

> (I) "B&R does not have controlled criteria for maintenance access, ALARA or ISI (see Question M-26A)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding, which is identical to Finding No. 4.5.2.2(e).

Contrary to the Quadrex finding, Brown & Root does have controlled criteria for maintenance access, ALARA, and ISI (In-Service Inspection). Moreover, there is no factual support for this Quadrex finding in the discussion material for Question M-26A which is cited in the finding. Indeed, the finding is contradicted (at least in part) by the assessment of another Quadrex reviewer in Question M-36. The Quadrex assessment of Brown & Root's response to Question M-36 relates to the Brown & Root ISI Manual U010MM001C and draft ISI TRD 4U010PQ007 and states as follows:

> "The above referenced Brown & Root documents were reviewed and are considered adequate. (See Volume I report regarding ISI)."

Quadrex's assessment of Question M-26A also charges that Brown & Root does not have an individual designated to follow equipment layout or piping layout. This charge is erroneous. The supervisor of the ISI group is designated to follow both equipment and piping layout. Had Quadrex included the ISI group in its review, this fact would have been apparent.

In addition, ALARA criteria are contained in the controlled document STP-DC-016. See also Brown & Root's response to Generic Finding No. 3.2(n) for a more extensive discussion of ISI considerations.

Given the foregoing, it is evident that Brown & Root has adequately addressed maintenance access, ISI and ALARA considerations. Accordingly, the above Quadrex finding is erroneous and will not impact on the generation of reliable power by STP.

SECTION 2.6 - MECHANICAL DESIGN FINDINGS

Contained in this section are the Brown & Root responses to the Quadrex Findings in Section 4.5.5 of Volume I of the Quadrex Report, which address the technical adequacy of the STP design performed by the Brown & Root Mechanical Discipline.

For the Mechanical Discipline technical adequacy assessment, Quadrex posed twenty-six (26) questions, which resulted in seven (7) "Most Serious" findings and two (2) "Serious" findings. The following is a summary overview of the Quadrex findings in the Mechanical Design area and Brown & Root's responses thereto.

SECTION 2.6.1 - SUMMARY OVERVIEW

In its overall assessment of the Mechanical Design, Quadrex asserts that

> "the technical adequacy of the Mechanical discipline is not presently adequate. There are two major concerns; namely, their understanding and implementation of code and industry requirements, and the apparent lack of results from an integrated systems review function."

Although it is difficult to correlate these broad generalizations with specific findings, it would appear that the first alleged concern is based on Quadrex Finding Nos. 4.5.5.1(a), (b), (d), (e) and (f); the second concern is apparently based on Finding Nos. 4.5.5.1(c) and 4.5.5.2(h) and (i). These two Quadrex concerns are unfounded, and the findings upon which they are based are erroneous.

Two of Quadrex's "Most Serious" findings in this area allege violations by Brown & Root of the NRC's Standard Review Plan criteria for demonstrating operability of active components (see Quadrex Finding No. 4.5.5.1(a)), and of the ASME Code normal or upset limits for active components (see Quadrex Finding No. 4.5.5.1(b)). However, as demonstrated in Brown & Root's responses to those findings, the Brown & Root practices for demonstrating the operability of active components, and for defining the stress limits that such components will experience during postulated faulted plant events, are consistent with industry practices and do satisfy NRC guidelines and Code requirements.

Three "Most Serious" findings assert that the Brown & Root design is inadequate in the areas of safety designation of analyses, definition of active versus passive components, and active valve acceptance criteria. See Quadrex Finding Nos. 4.5.5.1(d), (e) and (f). In fact, Brown & Root's design decisions in each of these areas are appropriately conservative (see Brown & Root's response to Finding No. 4.5.5.1(d)), clearly documented (see Brown & Root's response to Finding No. 4.5.5.1(e)), and consistent with industry practice (see Brown & Root's response to Finding No. 4.5.5.1(f)).

The other "Most Serious" finding, No. 4.5.5.1(g), refers to an error in using a 3.3 factor (instead of a correct 3.0 factor) in the determination of stress allowables for upset loads in containment mechanical penetrations. This error was the result of Brown & Root's use of an ASME Code definition which itself contained a typographical error. Not only has the error now been corrected in accordance with STP procedures, but the parameter containing the error was not the limiting design parameter for containment mechanical penetrations, hence the error was inconsequential.

The remaining findings (categorized as "Serious" by Quadrex) allege that Brown & Root has adopted without effective review Westinghouse Corporation's definitions of the loading conditions for plant design events (see Quadrex Finding No. 4.5.5.2 (h)), and Westinghouse's specification of startup/shutdown cycles (see Quadrex Finding No. 4.5.5.2 (i)). In reality, Brown & Root has either developed or reviewed all static and dynamic loads utilized in the design of outside containment equipment, and has conducted a series of analytical assessments to ensure that balance of plant transients do not impact on plant availability or its economic operation. Brown & Root also reviewed Westinghouse's definition of NSSS equipment startup/shutdown cycles for STP, found it to be a matter of concern, and sought resolution of the matter between HL&P and Westinghouse.

From the foregoing discussion, it is evident that the Quadrex findings and concerns with respect to the mechanical design at STP are erroneous, and that none of the findings in this section will impact on plant licensability.

SECTION 2.6.2

RESPONSE TO MECHANICAL DESIGN FINDINGS

QUADREX FINDING NO. 4.5.5.1(a) - MECHANICAL DISCIPLINE TECHNICAL ADEQUACY ASSESSMENT

The following finding is expected to seriously impact plant licensability:

(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."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

As an initial matter, it should be noted that the NRC Standard Review Plan (SRP) is by definition a guide to be used in the review of plant design for licensing purposes only and does not establish criteria or regulatory requirements for plant design or construction. Further, although the SRP describes testing as being the preferred method of demonstrating operability, it does not preclude the use of analysis alone (particularly when realistic testing cannot be performed).

With regard to Quadrex's criticism of the method used for demonstration of operability of pumps, it is common practice in the industry to perform environmental testing on pump motors. 1/ Also, due to the impracticality of testing, seismic operability of pumps (including motors) is demonstrated analytically utilizing conservative analytical techniques such as those employed by the STP pump suppliers. This is also common industry practice.

With regard to Quadrex's criticism of Brown & Root's treatment of valves, Brown & Root specifications require that the structural integrity and functional operability of all active valves be demonstrated under seismic loading conditions by testing and analytical means. 2/ In accordance with those specifications, all active motor

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1/ See Westinghouse, Topical Report WCAP 8587

2/ See Brown & Root "ASME Section III", noncontrol type, valve specifications.

BROWN & ROOT RESPONSE 4.5.5.1(a) - CONT.

operated valves within Brown & Root's scope of supply (as listed in Table 3.9-1.2 of the FSAR) at STP are qualified by type-testing in accordance with ANSI N278.2.4, draft number 3, dated January, 1978. (See Brown & Root response to Quadrex Finding No. 4.5.5.1(f)).

From the foregoing, it is evident that the above finding is erroneous and will not impact on plant licensability.

QUADREX FINDING NO. 4.5.5.1(b) - MECHANICAL DISCIPLINE TECHNICAL ADEQUACY ASSESSMENT

The following finding may have an impact on plant licensability or deserve licensing attention:

(b) "Brown & Root used the Westinghouse definitions of transients and plant design events. However, for all systems, Brown & 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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The above finding suggests that, in designing systems and components needed for the safe shutdown of the plant in the event of a faulted plant condition, Brown & Root used as its only design basis the requirement of ensuring the structural integrity of the equipment, without regard for equipment operability. In other words, Quadrex alleges that the stresses were correlated "1 to 1" to the postulated plant design events. This allegation is erroneous and denotes a misunderstanding by Quadrex of the design basis for the emergency safeguard systems.

In essence, the design of emergency safeguard systems is intended to ensure, through special design considerations, that the plant's engineered safety features (ESF) systems will operate during and following postulated plant events. These special design considerations make certain that stresses in those systems during faulted events do not cause such permanent deformation in the system components as to prevent their operability.

These special design considerations were utilized by Brown & Root in the design of STP. The plant ESF systems which are required to operate during a faulted plant event have been identified through the safe shutdown logic of the plant. For these systems, the components which are required to function during and after a faulted event have been classified as "active components"; active components are required by specification to remain functional as the plant receives the impact from the loads of the faulted event. As defined by Brown & Root specification, operability must be demonstrated by analysis or test. See Brown & Root's response to Quadrex Finding No. 4.5.5.1(a). In addition to demonstrating operability, the design of the ESF system components must be shown to have stress levels during faulted conditions that are below the yield strength of the material. Active components subject to these requirements include the valves and pumps of each ESF system.

In accordance with the above requirements, the internal mechanisms of the valves classified as active components must be capable of functioning during the maximum deflections due to the faulted load combinations. In addition, the piping nozzle loads at valves are limited to a maximum value no greater than those which result in a stress in the piping system of 75% of the material yield strength. Since the valve bodies are designed to be at least 110% stronger than the attached piping, the resulting stresses in the valves due to these nozzle loads would be even further below their material yield strength.

In the case of active pumps, similar requirements to those for valves are imposed within the pump design specification. Again, operational requirements are imposed to ensure that internal mechanisms do not rub or deflect in such a manner as to adversely affect the operation of the pumps. Stresses in the pumps due to piping loads are also limited below the yield strength of the material. Finally, the piping within the safeguard systems has been designed using a direct correlation to the plant service levels, in accordance with industry practice employed on many other nuclear facilities. The conservatisms of the ASME Code were deemed adequate to ensure minimum flow requirements through the pipe; coupled with the aforementioned operability requirements for active components, these conservatisms will ensure the functioning of the safeguard systems.

The combination of imposing functional testing and/or analysis requirements to demonstrate component operability, and limiting stresses that the components are allowed to see to values well below the material yield strength, is equivalent to, and in some cases more conservative than, limiting stresses to the normal or upset limits of the ASME Code (Levels A & B). These requirements will ensure operability and long term survivability of the equipment. Thus, Quadrex's concern with the service level classification of the equipment at STP is without foundation.

Given the foregoing, it is evident that the above Quadrex finding is erroneous, and accordingly, will not impact on plant licensability.

QUADREX FINDING NO. 4.5.5.1(c) - MECHANICAL ANALYSIS TECHNICAL ADEQUACY ASSESSMENT

The following findings may have an impact on plant licensability or deserve licensing attention:

* * * *

(c) "Although vendor design calculations and data submittals were receiving a technical review by Brown & 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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Regarding the review of vendor design calculations and data submittals, Brown & Root's position prior to mid-1980 was that it was the responsibility of the vendor or supplier to furnish certified and correct documentation, test results, and other data, all stamped by a Professional Engineer. Brown & Root, acting for HL&P, was only required to conduct a review that ensured that all required information was included in the design report and that the conditions specified in the design specification were considered. It was not Brown & Root's responsibility to complete a detailed check of calculations or the design factors used in the design reports, although those reports were from time to time checked for content.

By mid-1980, however, the NRC and the industry were becoming more demanding in the area of vendor documentation. Brown & Root was aware of this trend, and by July, 1980, had added additional personnel to review the vendor design reports for compliance with NRC requirements. This detailed review included not only the new qualification reports submitted by vendors, but also a second review of those reports previously received. The second review of previously submitted reports began in August, 1980, and was being actively pursued by Brown & Root prior to the Quadrex review. During the second review, some reports were found to contain insufficient information to describe adequately the equipment qualification and were returned to the vendor for rework. Approximately 400 documents were involved in the qualification effort; over half were subjected to second reviews.

Corporate Consulting and Development Company was given a contract to provide qualification review assistance to Brown & Root in order to expedite the review effort.

The following comments address the statements, concerns, and assessments in Questions M-30, M-41, M-49, M-50, and M-51 cited in the above finding.

In its assessment of Brown & Root's response to Question M-30, Quadrex discussed five particular specifications. Quadrex expressed 26 concerns and labeled these concerns as "deficiencies." Brown & Root reviewed all 26 alleged deficiencies and found only one to be a valid (if minor) concern. Brown & Root promptly revised the specification in question to remove the deficiency. See Attachment "A" for a detailed discussion of each of the 26 concerns raised in Question M-30.

Quadrex's assessment of Brown & Root's response to Question M-41 expresses a concern about the general lack of documentation showing the depth and the findings of the Brown & Root review of vendor design calculations and data submittals. This contention is plainly erroneous in light of the design review program described above.

The Quadrex assessment of Brown & Root's response to Question M-49 stated that Brown & Root's review of the vendor's stress report for the Hills-McCanna butterfly valves was seriously deficient. The vendor document in question was shown to the Quadrex review team with the warning that it was an outline only, that it was preliminary, and that it was a sample for use in preparation of a final submittal by Hills-McCanna. Many of the required data had not been inserted in this outline document; the document had also not been checked or reviewed as a vendor submittal by the Brown & Root Stress Group. The document included a list of further items to be completed before qualification; it also contained no signature, no approvals, and had no Brown & Root review comments incorporated into it. Despite all of these clear indications of the document's preliminary nature, Quadrex chose to treat it as the final design documentation and concluded that Brown & Root's then incomplete review was insufficient. In fact, it was at Brown & Root's request that this preliminary report was submitted, so that Brown & Root could assist the vendor in making sure that proper documentation of equipment qualification was ultimately furnished.

This document has since been finalized and submitted by Hills-McCanna and has been approved with minor comments. Consequently, Quadrex's assessment of Brown & Root's review as "seriously deficient" is inaccurate.

In the assessment of Brown & Root's response to Question M-50, Quadrex stated that a 2:1 ratio for qualifying valve groups "seems high". Although

BROWN & ROOT RESPONSE 4.5.5.1(c) - CONT.

Brown & Root agrees that, for large valves, judgment has to be exercised before deciding to use high modeling ratios (such as 2:1), Brown & Root had explained to Quadrex that ANSI N278.2.4 Appendix H, and a later proposed ANSI B16.41-19, draft 3, Revision 8, May 1979 Appendix 1, document the acceptability of these ratios. Brown & Root paid special attention to the valve qualification programs using high modeling ratios and, where appropriate, avoided the use of the upper modeling limit for the qualification of large valves. As a typical example, on various large Hills-McCanna valves, Brown & Root was extensively involved in the vendor's testing program, which was conducted using modeling ratios of 1:66 to 1 and smaller. Brown & Root is of the opinion that using the ANSI standard as a guideline, and supplementing it by giving special attention to large valves, is a reasonable and adequate method for qualifying valves.

Quadrex further stated in its assessment of Brown & Root's response to Question M-50 that, "Brown & Root has no procedure providing guidelines for the consistent review and approval of vendor reports." Vendor reports cover a wide range of different equipment, utilize different methods of qualification, and are subject to different requirements. Moreover, the applicable documentation requirements, etc. are clearly outlined in criteria documents such as IEEE 323, IEEE 344 and NUREG-0588. Consequently, a single procedure for the review and approval of vendor reports is neither feasible nor necessary. Brown & Root, however, has issued as part of its specifications, a seismic qualification appendix which dictates the generic methods for the qualifications of equipment. This specification provides the guidelines which result in the qualification program implemented by each vendor for his specific equipment.

Given the foregoing, it is evident that the above finding is erroneous and will have no impact on plant licensability.

ATTACHMENT "A" TO BROWN & ROOT RESPONSE TO QUADREX FINDING NO. 4.5.5.1(c)

Responses to Specific Quadrex Comments on Brown & Root Specifications Made in the Question M-30 Assessment

SPECIFICATION NO. 2R019NS014-D - "FIELD ERECTED STAINLESS STEEL TANKS:"

Quadrex Comment

1. "Throughout this specification, reference is made to codes such as ASME Section III, without referencing the contractor to a specific paragraph number (e.g., see Page 8 of the specification, Paragraph 4.2.2). Most fabricators are not that familiar with the codes, such that there is a high potential for vendors non-conformance to the specification."

BROWN & ROOT RESPONSE

All vendors qualified to design and fabricate N-stamped components are qualified by ASME based on a familiarity with the Code and the ability to meet Code requirements.

Quadrex Comment

2. "The year and version of referenced codes was not specified (see page 2, paragraph 2)."

BROWN & ROOT RESPONSE

This information is being identified in all new specifications. The purchase order for this specification was awarded in December, 1976. The P. O. Award date is identified in the specification as establishing the applicable editions of each standard.

Quadrex Comment

3. "Operability requirements during seismic events for components of the tanks (e.g., valves, relays, etc.) were not identified."

BROWN & ROOT RESPONSE

There are no active components associated with this specification or purchase order, and therefore operability requirements during a seismic event are not required.

ATTACHMENT "A" TO BROWN & ROOT RESPONSE 4.5.5.1(c) - CONT.

Quadrex Comment

4. "In Section 2.0, Regulatory Guide 1.48 was not referenced for Seismic Category I tanks."

BROWN & ROOT RESPONSE

The allowable stress criteria for these components included in the component design specifications are consistent with the FSAR commitments. Reference to the Regulatory Guide is unnecessary and may even lead to confusion as the vendor may misinterpret the guide or the project position with respect to commitment to the guide.

Quadrex Comment

5. "Evaluation of sloshing during seismic event should be considered in Appendix A."

BROWN & ROOT RESPONSE

Per Paragraph 3.3.1, analysis per TID-7024 is allowed. This document outlines a procedure for the seismic design of large tanks. Sloshing is considered in the analysis.

Quadrex Comment

6. "The 24" RWST nozzle loads, particularly pipe rupture loads, are not clearly specified in Attachment E, Page E-4. The spectra provided in the specification were not keyed to the plant location of a given tank."

BROWN & ROOT RESPONSE

a) The 24" nozzle loading on the RWST was specified differently from the other nozzles. A special anchor is to be provided to reduce piping loads on the tanks. Pipe rupture loads are not applicable to the RWST as the tank is not in a high energy system.

b) The seismic response spectra were interpreted by Brown & Root and an enveloping spectrum applicable to all the tanks covered by this specification was provided. (See Page A-12).

Quadrex Comment

7. "Each tank should be identified with appropriate seismic spectra from Attachment A."

BROWN & ROOT RESPONSE

See response to Item 6(b).

Quadrex Comment

8. "Section 2.0 - Appropriate ANSI standards for flanged nozzles were not identified."

BROWN & ROOT RESPONSE

Quadrex is incorrect. The last line of Section 2.0 which identifies the list of piping dimensional standards provides this reference.

Quadrex Comment

9. "DCN 3/21/79 - paragraph 3.2.2.2. Allowable ASME weld preparations for nozzles were not identified."

BROWN & ROOT RESPONSE

Quadrex is incorrect - Paragraph 3.2.2.4 of DCN 3/21/79 refers to Appendix D of the specification for weld joint design.

SPECIFICATION NO. R209NS011-D - "COMPONENT COOLING WATER PUMP:"

Quadrex Comment

1. "Pipe rupture and jet impingement loads were not identified."

BROWN & ROOT RESPONSE

Rupture and jet impingement loads are not applicable to these pumps.

Quadrex Comment

2. "Section 3 - Methods to demonstrate that pump meets radiation, thermal, and aging requirements were not provided."

BROWN & ROOT RESPONSE

Appendix C of the specification provides the requirements for motor qualification and refers to reference 2.1.f.2 (1E019RQ005-B) and to IEEE-323 for qualification testing and documentation requirements.

Quadrex Comment

3. "Section 5.2, Page 17 - HI standards were not defined."

BROWN & ROOT RESPONSE

The Hydraulic Institute publishes a manual identified only as Standards for Pumps. This manual of standards is not itself identified by a number nor are the "standards" identified by number. HI Standards referenced in a pump specification are understood by vendors and others knowledgeable in the area to be references to the HI Standards for Pumps.

Quadrex Comment

4. "Section 2.0 - Regulatory Guide 1.48 was not referenced."

BROWN & ROOT RESPONSE

The allowable stress criteria for these components included in the component design specifications are consistent with the FSAR commitments. Reference to the Regulatory Guide is unnecessary and may even lead to confusion as the vendor may misinterpret the guide or the project position with respect to commitment to the guide.

SPECIFICATION NO. 2C099NS054-E - "CONTAINMENT MECHANICAL PENETRATIONS:"

Quadrex Comment

1. "Table 3.1, page 33, provides a primary plus secondary membrane and bending stress allowable of $3.3S_m$ for upset loads. This is contrary to ASME Code Stress allowable of $3.0S_m$ (see ASME III, Appendix XIII, Article 1145 and Figure XIII-1141-1*). A stress limit of $3.3S_m$

"*/At one time there was an unfortunate typographical error in the Hopper stress allowable diagrams of ASME Section III, Appendix XIII and ASME Section VIII, Division 2. This error indicated an allowable stress of $3.0KS_m$, where K=1.1 for upset loads. However, in both codes the main text did not have this typographical error. Section VIII was corrected in the Summer, 1974 addenda to the 1974 Edition, and Section III was corrected in the Winter, 1978 Edition to the 1977 version."

Quadrex Comment 1 - Cont.

> is 10% in excess of the equivalent shakedown stress of 2 and would permit considerable plastic ratcheting to occur during plant upset conditions."

BROWN & ROOT RESPONSE

This specification concern has been resolved through the issuance of PCN No. 3. See Brown & Root Response to Quadrex Finding No. 4.5.5.1(g).

SPECIFICATION NO. 1L529TS100-D - "GATE, GLOBE, AND CHECK VALVES:"

Quadrex Comment

1. "The stress and seismic reports (schedule provided by purchase order) were not required to be submitted for approval prior to manufacturing. This will allow time for any necessary re-analysis and/or redesign."

BROWN & ROOT RESPONSE

This does not constitute a deficient specification. The valve manufacturer is still responsible for complying with the code and the specification.

Quadrex Comment

2. "Regulatory Guide 1.48 was not referenced for Seismic Category I valves."

BROWN & ROOT RESPONSE

The allowable stress criteria for these components included in the component design specifications are consistent with the FSAR commitments. Reference to the Regulatory Guide is unnecessary and may even lead to confusion as the vendor may misinterpret the guide or the project position with respect to commitment to the guide.

Quadrex Comment

3. "Section 2.0 - Regulatory Guide 1.73 was not identified with IEEE-382."

BROWN & ROOT RESPONSE

Regulatory Guide 1.73 is not a "code" or "standard", thus it is not listed in "Section 2.0 Codes and Standards." It is however, referenced in conjunction with IEEE STD 382-1972 in Paragraph 3.2.2.3.i. This reference is sufficient.

SPECIFICATION NO. 3R209NS033-D -
"COMPONENT COOLING WATER HEAT EXCHANGER:"

Quadrex Comment

1. "Paragraph 4.2.3.1.C, page 19- Specific paragraphs in the ASME III Code were not referenced. This will reduce the potential for a vendor misinterpretation and non-conformance."

BROWN & ROOT RESPONSE

The reference to ASME III Code was used in a discussion of liquid penetrant test acceptance criteria. These criteria were readily located in the Code under Examinations. Thus, there should be no cause for misinterpretation.

Quadrex Comment

2. "Appendix I, Item 12 - Specific paragraphs in the ASME Code were not referenced."

BROWN & ROOT RESPONSE

The hydrotest section of ASME III is easily understood. Additionally, the test procedures were reviewed by Brown & Root. The lack of reference to a specific paragraph of the Code caused no problems to the vendor or the testing procedure.

Quadrex Comment

3. "Section 2.0 - Regulatory Guide 1.48 was not referenced for Seismic Category I heat exchangers."

BROWN & ROOT RESPONSE

The allowable stress criteria for these components included in the component design specifications are consistent with the FSAR commitments. Reference to the Regulatory Guide is unnecessary and may even lead to confusion as the vendor may misinterpret the guide or the project position with respect to commitment to the guide.

ATTACHMENT "A" TO BROWN & ROOT RESPONSE 4.5.5.1(c) - CONT.

Quadrex Comment

4. "Pipe rupture and jet impingement loads were not identified."

BROWN & ROOT RESPONSE

Pipe rupture and jet impingement loads are not applicable as there are no high energy lines in the vicinity of these heat exchangers.

QUADREX FINDING NO. 4.5.5.1(d) - MECHANICAL DISCIPLINE TECHNICAL ADEQUACY ASSESSMENT

The following findings may have an impact on plant licensability or deserve licensing attention:

* * * *

(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.)"

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Part of the load information needed to design the main steam line piping is the safety relief valve blowdown force on the discharge elbow. Because the main steam line was a critical path item in the plant design, information on this blowdown force was needed early in the design, prior to its availability from the relief valve vendor. Accordingly, Brown & Root developed a conservative preliminary estimate of the blowdown force prior to receipt of the actual value from the vendor. Although a non-safety-related computer program was used to arrive at this preliminary estimate, this program has been used for many years in the fossil power plant industry and is adequate for generating preliminary information. Moreover, the stress analysis which used the blowdown force estimate was a safety-related calculation and as such required, and received, design verification. As a result, the blowdown force estimate used in this safety-related calculation was (as required by Brown & Root procedures) properly identified as preliminary with its status being noted (see Brown & Root response to Quadrex Finding No. 4.1.2.1(h)). As final vendor loading information becomes available, this information will be incorporated into the final calculation. Both the final loading and the calculation using it will be design verified and will utilize safety-related computer codes. The use of information from a nonsafety-related calculation in a preliminary safety-related analysis is acceptable under ANSI N45.2.11 guidelines and the STP procedural requirements. (See STP-DC-008 and STP-DC-015).

Given the foregoing, it is evident that the above finding will not impact on plant licensability.

QUADREX FINDING 4.5.5.1(e) - MECHANICAL DISCIPLINE TECHNICAL ADEQUACY ASSESSMENT

The following findings may have an impact on plant licensability or deserve licensing attention:

* * * *

(e) "B&R 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 qualification of these components (see Questions M-49 and M-51)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The definitions of active and passive components are clearly presented in FSAR Sections 3.9.2.2 and 3.9.3.1.1 and TRD RQ004, which are consistent with Regulatory Guide 1.48. As pointed out by Brown & Root during the Quadrex review, those valves and pumps which are required to perform a function during and/or after a faulted plant condition are procured as active components. Certain passive components are analyzed and some tested to demonstrate that their structural (pressure boundary) integrity is maintained during and after a faulted plant condition. However, operability of these components during faulted conditions is not required to maintain plant safety. Functioning of these components is not necessary to mitigate the effects of faulted plant conditions, nor is credit taken for their operability during such conditions. Therefore, the asserted uncertainty in the definition of "active" and "passive" components lies with Quadrex rather than with Brown & Root.

Given the foregoing, it is evident that the above Quadrex finding is erroneous and will not have an impact on plant licensability.

QUADREX FINDING NO. 4.5.5.1(f) - MECHANICAL DISCIPLINE TECHNICAL ADEQUACY ASSESSMENT

The following findings may have an impact on plant licensability or deserve licensing attention:

* * * *

(f) "Licensing acceptability of ANSI N278.2.4 should be confirmed (see Question M-50)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

ANSI N278.2.4 reflects a long standing industry position on type-testing of valves and represents the best available method for qualification testing. Use of ANSI N278.2.4, supplemented with the exercise of engineering judgment for large valves, is a typical approach in the industry and has been accepted in the licensing of other nuclear power plants. There is no reason to believe that it will not be accepted by the NRC in the case of STP. See also Brown & Root's response to Quadrex Finding No. 4.5.5.1(c).

Given the foregoing, it is evident that the above Quadrex finding will not have an impact on plant licensability.

QUADREX FINDING NO. 4.5.5.1(g) - MECHANICAL DISCIPLINE TECHNICAL ADEQUACY ASSESSMENT

The following findings may have an impact on plant licensability or deserve licensing attention:

* * * *

(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 Questions M-30 and M-39)."

BROWN & ROOT RESPONSE

Brown & Root agrees that a stress allowable for upset loads of 3.3 S_m was used in the specification for the containment penetrations, but disagrees that this finding will have any impact on plant licensability.

Use of the 3.3 S_m value was the result of a typographical error in the Hopper stress allowable diagrams of ASME Section III, Appendix XIII and ASME Section VIII, Division 2. This ASME Code error indicated an allowable stress of 3.0 KS_m where K=1.1 for upset loads.

On March 25, 1981, EDD 81-0417 was written against containment mechanical penetrations specification 2C099NS054E as a result of a Quadrex review finding and was processed in accordance with Brown & Root procedures. On April 16, 1981, PCN#3 to 2C099NS054E was initiated to change the 3.3 S_m limit to 3.0 S_m. This became effective on May 21, 1981.

Brown & Root completed a detailed review of the use of the above stress limit and determined that it was not the limiting design parameter for mechanical penetrations, since faulted pipe rupture loads govern the design. Therefore, there should be no licensing implications to this error. In any event, the error in the specification has now been resolved by PCN #3. Quadrex's additional concern that this error might have been "promulgated" to other components is unfounded, for there are no other vessels at STP in Brown & Root's scope of responsibility whose design utilized the value in question.

Given the foregoing facts, it is evident that the above Quadrex finding will not have an impact on plant licensability.

QUADREX FINDING NO. 4.5.5.2(h) - MECHANICAL DISCIPLINE TECHNICAL ADEQUACY ASSESSMENT

The following findings are expected to impact the generation of reliable power by STP:

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Part of the design event definition function is the determination of loading conditions for each event. The more realistic the definition of the loading conditions, the better the resulting design will be.

Loads are generally divided into two broad categories, static and dynamic. The distinction is based upon the relationship of the time span for the load variation to the response of affected components. Thus, loads which may be defined as static loads may in fact vary with time.

Static loads for all STP systems and components have been either reviewed or developed by Brown & Root. Dynamic loads for system and components which have been supplied by Westinghouse or which directly interface with Westinghouse systems have also been reviewed or developed by Brown & Root and are in compliance with ANSI 18.2-1973. For all systems designed or reviewed by Brown & Root, economic factors were considered in that a balance was sought between increasing component design margins and avoiding designing for conditions more severe than the components are expected to encounter.

Thus, for outside containment equipment, (e.g., circulating water system, feedwater system, condensate system, etc.), the impact of transients on plant availability or economic operation was a major design consideration. Throughout the design of STP there have been a series of analytical assessments conducted to evaluate, and where necessary control, balance of plant transients to ensure that they do not adversely affect plant operation. This effort was continuing as the STP plant design evolved. For example, analytical simulation of the STP feedwater and condensate systems is presently being developed by the NUS Corporation to facilitate future analyses.

Given the foregoing, it is evident that the above finding is erroneous and will not impact the generation of reliable power at STP.

QUADREX FINDING NO. 4.5.5.2(i) - MECHANICAL DISCIPLINE TECHNICAL ADEQUACY ASSESSMENT

The following findings are expected to impact the generation of reliable power by STP:

* * * *

(i) "W specified startup/shutdown cycles may not be sufficient for a 40 year plant life (see Question M-31)."

BROWN & ROOT RESPONSE

Brown & Root agrees with the above finding.

Brown & Root informed Quadrex of its concern in this matter during the review. However, the systems to which this finding applies are neither provided nor designed by Brown & Root. Any concerns in this area should be resolved by Westinghouse. Brown & Root understands that Westinghouse and HL&P are pursuing the matter.

Brown & Root takes no position with respect to the impact, if any, of this finding on the generation of reliable power at STP.

SECTION 2.7 - NUCLEAR ANALYSIS FINDINGS

Contained in this section are the Brown & Root responses to the Quadrex findings relating to Nuclear Analysis, which are contained in Section 4.6.2 of Volume I of the Quadrex Report. For the Nuclear Analysis area, Quadrex posed thirty-three (33) questions from which Quadrex made fifteen (15) "Most Serious" findings and one (1) "Serious" finding. The following is a summary overview of the Quadrex findings in the Nuclear Analysis area and the Brown & Root responses thereto.

SECTION 2.7.1 - SUMMARY OVERVIEW

The principal allegations made by Quadrex with respect to the Nuclear Analysis Discipline is that the analyses made by Nuclear Analysis have not been timely to support other engineering and construction activities, and that the analyses already performed contain errors or are obsolete. All of these allegations are erroneous.

Two of the sixteen findings addressed in this section criticize Brown & Root for having an allegedly insufficient number of environmental analyses completed at this stage of the project (see Quadrex Finding Nos. 4.6.2.1(b) and (c)). However, as indicated in the Brown & Root response to Finding No. 4.6.2.1(b), many of the environmental analyses for inside containment had been completed and reported in the FSAR prior to the Quadrex review. In addition, the most recent data on mass-energy release in the Isolation Valve Cubicle (IVC) were available at the time of the Quadrex review, and the environmental analysis in the IVC was in progress at that time. These analyses were being completed to ensure that the equipment was qualified for the postulated worst case accident and were being updated to incorporate the latest available data consistent with all other project requirements. With regard to the few environmental analyses of non-IVC piping outside containment, those analyses have not yet been performed, but were scheduled for completion at the time of the Quadrex review. Performing those analyses at this stage of the project is consistent with the overall piping design philosophy of locating only a small number of high energy lines outside containment. See Brown & Root's response to Finding No. 4.5.3.1(a).

Eight of the Quadrex findings reflect a difference of opinion between Quadrex and Brown & Root as to the methodology or approach utilized by Brown & Root in doing a particular analysis, or evidence Quadrex's misunderstanding of the methods and design approach used by Brown & Root. See Quadrex Finding Nos. 4.6.2.1(a), (d), (e), (l), (m), (n) and (o) and 4.6.2.2(p). The Brown & Root responses to those findings demonstrate that in each instance Brown & Root's analysis is correct and appropriate. For example, Quadrex Finding No. 4.6.2.1(e) criticized the use of a computer code (RELAP 3) by a Brown & Root sub-

contractor in performing the annulus pressurization analysis. However, as explained in Brown & Root's response to that finding, the analyses utilizing RELAP 3 are correct and the NRC has accepted and continues to accept them. As another example, Quadrex Finding No. 4.6.2.1(m) alludes to a difference in the Essential Cooling Pond initial temperature assumptions utilized by Nuclear Analysis and Heavy Civil. However, as explained in Brown & Root's response to that finding, the two analyses were used for different purposes and assumed totally different environmental and plant operating conditions. Apparently, Quadrex failed to understand these differences.

Five of the Quadrex findings contained in this section erroneously state that the level of knowledge or awareness of Brown & Root's Nuclear Analysis group is inadequate in a particular area. See Quadrex Finding Nos. 4.6.2.1(f), (g), (h), (i) and (k). in reality, the Nuclear Analysis level of knowledge in all areas criticized is more than adequate. For example, Quadrex Finding No. 4.6.2.1(i) questioned the adequacy of Nuclear Analysis' knowledge in the area of valve performance and qualification. As indicated in Brown & Root's response to that finding, Nuclear Analysis understands the requirements for performance of active systems, such as valves, in modeling postulated system breaks.

The remaining Quadrex Finding (No. 4.6.2.1(j)) alleges an inconsistency between the IVC break analyzed by Brown & Root and the type of break committed to be analyzed. However, as explained in the Brown & Root response to that finding, the analysis actually performed is for a condition giving a more severe pressure transient than that resulting from the break specified in the STP licensing commitment. Moreover, the analysis committed to has now also been performed so that the Quadrex finding, even if it had been valid, is of no significance.

In summary, the Quadrex findings fail to uncover any significant deficiency in the work of the Nuclear Analysis group, and accordingly these findings will not impact on plant licensability.

SECTION 2.7.2

RESPONSE TO NUCLEAR ANALYSIS FINDINGS

QUADREX FINDING NO. 4.6.2.1(a) - NUCLEAR ANALYSIS TECHNICAL ADEQUACY ASSESSMENT

The following findings are expected to seriously impact plant licensability:

(a) "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). 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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Quadrex initially criticizes Nuclear Analysis' lack of control over other disciplines' use of Nuclear Analysis design data. This criticism has no basis in fact. Nuclear Analysis has functioned in accordance with STP procedures regarding the use by other disciplines of information generated by it. These procedures provide various controls to ensure that the design data published by Nuclear Analysis are correctly used. These procedures do not require a personal follow-up by Nuclear Analysis. Thus, the follow-up suggested by Quadrex is neither required nor necessary. Nuclear Analysis does, however, interface with other disciplines on a timely basis to ensure an adequate understanding of how the Nuclear Analysis design data were developed and how they are to be used.

Quadrex also criticizes Brown & Root for utilizing saturation temperatures rather than actual temperatures inside containment for equipment qualification. In spite of a lengthy presentation on this subject to Quadrex during the review meetings, Quadrex has failed to understand the Brown & Root approach.

In the first place, Quadrex's statement that saturation temperatures were used for qualifying equipment inside containment is erroneous. The environmental qualification of equipment inside containment is based on the actual temperature during a loss of coolant accident (LOCA), including margins, set forth in IEEE-323. From a thermodynamic viewpoint, this LOCA temperature is the saturated temperature corresponding to the peak

containment pressure. Further, in accordance with the requirement of IEEE-323, an analytical method has been used to establish with reasonable assurance that the temperatures acquired by the equipment in any other postulated accident, such as a main steam line break (MSLB), would be lower than the LOCA temperature. The reason for this is that the superheated steam environment due to an MSLB exists for a relatively short period of time, and under the condensing mode of heat transfer to the equipment, the equipment's response to the MSLB environment is such that the environmental temperature drops below the LOCA temperature before the equipment temperature exceeds the LOCA temperature for which it is qualified. This was explained to Quadrex, with examples, during the review.

Brown & Root's position on the temperature to be used for qualification of equipment inside containment is set forth in the response to an NRC question (032.2) in the FSAR, where Brown & Root stated that equipment temperature in an MSLB environment is lower than equipment temperature qualification criteria based on the LOCA event (see FSAR Q&R 3.11-2, Amendment 2, 10-9-78). This statement to the NRC is based on analyses performed by Nuclear Analysis for both small and large pieces of equipment. More recent analyses of the inside containment temperatures have confirmed Brown & Root's position and have indicated the conservatism of the initial MSLB temperature values.

The same analytical procedure used for inside containment analyses is used for establishing the environment for qualifying equipment in the isolation valve cubicle (IVC).

With respect to equipment outside containment, the safety-related equipment necessary for safe shutdown of the plant is isolated away from the areas containing high energy lines. Therefore, the environmental effect of line breaks on equipment outside containment will be minimal. This will be verified by analysis.

In sum, the various statements made by Quadrex in the above finding are erroneous and, accordingly, this finding will not impact on plant licensability.

QUADREX FINDING NO. 4.6.2.1(b) - NUCLEAR ANALYSIS TECHNICAL ADEQUACY ASSESSMENT

The following findings are expected to seriously impact plant licensability:

* * * *

(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 Questions N-3 and N-13). Brown & 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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

With respect to inside containment environmental analyses, many of the analyses had been completed and reported in the FSAR prior to the Quadrex review. Thus, with regard to inside containment, there is no basis for the Quadrex finding that there were an "insufficient number" of such analyses.

For outside containment environmental effects, contrary to the finding, the most recent data on mass-energy release in the Isolation Valve Cubicle (IVC) were available at the time of the Quadrex review. It was also stated at the time of the review that environmental analysis using these recent data in the IVC was in progress (see Brown & Root Response to Question N-3). The analysis was being updated to incorporate the latest data and was scheduled in a timely manner taking into account project requirements. The timeliness of this analysis is also discussed in the Brown & Root response to Quadrex Finding No. 4.6.2.1(c). With regard to environmental analyses for non-IVC piping systems outside containment, those analyses have been scheduled for completion. Performing these analyses at this stage of the project is consistent with the overall pipe break philosophy, given the small number of high energy lines contained in these piping systems. See Brown & Root's response to Finding No. 4.5.3.1(a).

Addressing the specific error allegations contained in this finding, the Quadrex conclusion that "the only environmental analysis performed by Brown & Root contained a gross error" is incorrect. The calculation in question (see Quadrex's assessment of Brown & Root's response to Question N-13) was an IVC analysis provided to Quadrex as a sample of the analytical work done for the IVC. The calculation utilized an enthalpy (h) value of h=1180 BTU/lb, which was the basis for the data supplied to the NRC on this subject. The calculation had, as an attachment, an evaluation of the sensitivity of the results to varying the enthalpy values. This attachment contained a value of h=1306 BTU/lb corresponding to superheated conditions. Quadrex misunderstood the use of this higher value and did not seek clarification from Brown & Root. Accordingly, in its assessment of Brown & Root's response to Question N-13, Quadrex stated there was an "obvious input error" in the utilization of the 1306 BTU/lb value. Had Quadrex reviewed this matter with Brown & Root, its confusion would have been cleared.

Another alleged error cited by Quadrex refers to an NUS analysis for inside containment temperatures after a main steam line break (MSLB) (see Question N-1). However, no error was committed in this instance either. The NUS analysis was correct, although based on conservative input data rather than actual data. As actual design data were made available, the known excess conservatisms were removed from the subsequent reanalysis, and the reanalysis results were presented in amendment 14 to the FSAR in December 1980 prior to the Quadrex review.

BROWN & ROOT RESPONSE 4.6.2.1(b) - CONT.

The upgrading of analyses to reflect actual design data is part of the normal design evolution process.

There is also no merit to the general statement that, except for containment heat sink surface area analysis and an NUS LOCA analysis, none of the analyses performed by the Nuclear Analysis Group were sufficient, correct, and current. Specifically:

i. With regard to the adequacy of the environmental analyses and the verification of data for these calculations, this has been discussed above. Additional discussion of the status of the environmental analyses is included in the Brown & Root response to Quadrex Finding No. 4.6.2.1(a).

ii. Contrary to the Quadrex assessment of Question N-1, use of RELAP 3 for the annulus pressurization analysis was and is accepted by the NRC as a method of performing this type of calculation. Brown & Root and NUS are systematically updating the analysis from RELAP 3 to COMPARE where to do so will enhance the confidence level of previous analyses or will assist in providing confirmatory reanalyses. Brown & Root is sensitive to the necessity for submittal of technical information to the NRC consistent with the regulatory review schedule in order to avoid licensing delays. Additional discussion of this item is provided in the Brown & Root Response to Quadrex Finding No. 4.6.2.1(e).

iii. The bounding analyses required to evaluate the adequacy of the Essential Cooling Pond (ECP) for various plant conditions were completed prior to the Quadrex review. These analyses, as well as others previously completed several years earlier were scheduled for final updating and for case variation studies to incorporate updated design data currently known and being finalized. In addition, also scheduled was the ECP evaluations of the non-limiting plant operating conditions. This revised data and the resulting operating temperature information would then be utilized to confirm the adequacy of the equipment affected by the ECP. These ECP evaluations and subsequent equipment qualification reviews have been completed and indicate the adequacy of the ECP to effect an orderly shutdown of the plant in accordance with Regulatory Guide 1.27 under the most adverse conditions.

Quadrex has also suggested a possible discrepancy or error in ECP temperatures as evaluated by Nuclear Analysis and by Heavy Civil disciplines.

The differences between temperatures evaluated by Nuclear Analysis and by Heavy Civil are neither discrepancies nor errors. The technical bases for different input assumptions for the two sets of temperatures are valid and were fully explained to Quadrex. (See Brown & Root response to Quadrex Finding No. 4.6.2.1(m)).

iv. With regard to the Quadrex concern on battery room hydrogen concentration, an adequate battery room hydrogen analysis was available at the time of the Quadrex review. The basis for the 2% hydrogen concentration value used in the calculation is clearly identified in the calculation. The NRC requested verification in question 010.26, dated 6/11/79, that the hydrogen concentration would not exceed 2%. The response is located with the question in FSAR Question and Response Volume, page 9.4-1. Additional discussion of this item is provided in the Brown & Root responses to Quadrex Finding Nos. 4.4.2.1(c) and 4.6.2.1(o).

From the above discussion, which covers a wide range of analyses, it is difficult to understand the Quadrex generalization that "analyses were either obsolete, insufficient in basis, or contained errors." In fact, the entire finding is erroneous and will not have any impact on plant licensability.

QUADREX FINDING NO. 4.6.2.1(c) - NUCLEAR ANALYSIS TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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".

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

This finding is essentially a partial restatement of finding 4.6.2.1(b), and, as discussed in Brown & Root's response to that finding, is based on erroneous assessments by Quadrex. In addition to the large number of analyses performed by Brown & Root prior to the Quadrex review, as reported in the FSAR, Brown & Root worked with NUS in scoping, scheduling, and performing other required environmental analyses. Thus, all important analyses, such as containment pressure-temperature and subcompartment pressure analyses, have been completed and appropriate modifications and/or re-evaluations to account for as-built or as-designed data were under way. Of course, each of these analyses would be updated as needed to reflect any future STP design changes. Thus, contrary to Quadrex's finding, there are a sufficient number of environmental analyses in place given the present state of STP design and construction.

The few analyses which remain to be done related primarily to the high energy line pipe rupture analysis for the MAB. These analyses are scheduled to be performed in the near future and do not constitute more than 10 percent of all of the analyses performed to date. They also are not on the critical path of the project schedule. (See Brown & Root's response to Quadrex Finding No. 4.5.3.1(a) for additional information). Moreover, a schedule of Nuclear Analysis activity, supportive of STP design and construction, was generated prior to the Quadrex review. This schedule evidences the timeliness of the analyses performed by the Nuclear Analysis discipline.

In sum, Nuclear Analysis has scoped and either performed or had others perform those environmental analyses which should have been performed given the present state of the STP design and construction. Accordingly, the above Quadrex finding will have no impact on plant licensability.

QUADREX FINDING NO. 4.6.2.1(d) - NUCLEAR ANALYSIS TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(d) "An identification of Nuclear Analysis calculations needed to support other disciplines was not evident (see Question N-1)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

All of the Nuclear Analysis thermal hydraulic analyses, essential cooling pond analyses and containment analyses are performed in support of other disciplines.

As indicated in the Brown & Root Management Plan for STP, Brown & Root had developed, prior to the Quadrex review, a schedule of Nuclear Analysis activities which provides adequate identification of the Nuclear Analysis calculations needed to support other disciplines on the project. The schedule also establishes priorities for interdisciplinary interaction. Brown & Root demonstrated this discipline interaction during the Quadrex review meeting through the use of several analyses as examples. Brown & Root also presented the documents which demonstrate how information is transmitted from Nuclear Analysis to the appropriate disciplines.

Thus, Brown & Root had, prior to the Quadrex review, sufficiently identified the Nuclear Analysis calculations needed to support other disciplines. The above finding is therefore erroneous and will have no impact on plant licensability.

QUADREX FINDING NO. 4.6.2.1(e) - NUCLEAR ANALYSIS TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(e) "The annulus pressurization analysis performed by NUS was well modeled but used an inappropriate computer program (RELAP 3). They should have used COMPARE as they had done earlier for another plant. Brown & Root should have pursued re-analysis as the annulus pressurization analysis as (sic) 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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Contrary to Quadrex's assertion in the finding, the use of RELAP 3 for the annulus pressurization analysis is appropriate since that program is accepted by the NRC for this type of calculation. Indeed, the NRC continues to accept submitted analyses in this area using RELAP 3. Although the NRC has recently indicated a preference for COMPARE, in stating this preference the NRC in no way questioned the adequacy of previous RELAP 3 analyses. A recent inquiry by Brown & Root indicated that to date few plant owners have submitted analyses to the NRC based on COMPARE.

The annulus pressurization analyses performed by NUS for Brown & Root utilized RELAP 3; those analyses were submitted to the NRC in a timely manner, and were accepted by the NRC. As part of the normal design process, analyses are upgraded as better modeling tools and/or design parameters become available. Thus, Brown & Root and NUS are changing systematically from RELAP 3 to COMPARE for subcompartment analyses where the use of COMPARE will help to provide confirmation of previous analyses, or where the COMPARE reanalyses will provide a more realistic assessment by removing known over-conservatisms. Because of the conservatism in the original analysis, the orderly updating process being carried out will have no impact on licensing.

BROWN & ROOT RESPONSE 4.6.2.1(e) - CONT.

Quadrex also alleges in this finding that Brown & Root does not fully appreciate the need to submit analyses to the NRC in a timely manner to avoid licensing delays. There is no basis for this claim. It is precisely because of Brown & Root's awareness of potential licensing delays that Brown & Root relied on the use of NRC accepted codes such as RELAP 3.

Given the foregoing, it is clear that Brown & Root's annulus pressurization analysis work satisfied both NRC requirements and industry practice. Accordingly, the above finding will not impact on plant licensability.

QUADREX FINDING NO. 4.6.2.1(f) - NUCLEAR ANALYSIS TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(f) "Awareness of the proper methodology for handling potential flow paths during environmental analysis was not evident (see Question N-8)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Brown & Root has submitted numerous PSAR and FSAR subcompartment analyses to the NRC. None of these analyses were questioned by the NRC with regard to the methodology utilized by Brown & Root for handling potential flow paths. Moreover, during the Quadrex review, Brown & Root repeatedly told Quadrex that the specific treatment of potential flow paths and door positions in subcompartment analyses must be and is considered by Brown & Root on a case-by-case basis. It is not practical to predetermine potential flow paths, including door positions, for all design configurations and operating conditions. Depending on the particular design configuration under review and its safety significance, and the functional and operational requirements of the area in question, the positioning of doors and other potential flow paths would be appropriately considered. (See Brown & Root's response to Quadrex Finding No. 4.4.2.1(a)).

Thus, as demonstrated during Quadrex's review, Brown & Root is aware of the adequate methodology for handling potential flow paths during environmental analysis. Accordingly, the above finding is erroneous and will have no impact on plant licensability.

QUADREX FINDING NO. 4.6.2.1(g) - NUCLEAR ANALYSIS TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(g) "Awareness of the need to model makeup supplies of water for long term environmental analysis was not evident (see Question N-10)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The specific details of modeling sources of makeup, emergency, or auxiliary water supply depend on the mass and energy release of the particular pipe break under consideration. For the piping systems inside containment, the mass and energy analysis was performed by NUS. The NUS model for makeup supplies used in that analysis was found to be acceptable by Quadrex. For the piping systems in the isolation valve cubicle (IVC), the mass and energy release analyses have been developed by Westinghouse. These analyses have been reviewed by Brown & Root and were utilized by NUS to develop long term environmental conditions.

As indicated by the specific examples listed below, Nuclear Analysis is aware of the need to model makeup supplies of water for long-term environmental analysis:

> Long-term mass and energy releases in the IVC due to an 8" feedwater bypass line break and a 4" auxiliary feedwater pump turbine supply line break are presently being analyzed. In both of these cases, makeup supplies of water are considered in the development of the model.
>
> In the case of the 8" feedwater bypass line break, the auxiliary feedwater makeup supply is being analyzed. The flow from the 500,000 gallon condensate storage tank via the auxiliary feedwater system after isolation is being considered as a part of this analysis. There is also a possibility that, in certain instances, the introduction of cold water would provide a mitigating effect on the transient. For this reason, the possibility of conservatively neglecting auxiliary feedwater flow will be considered.

> In the case of the 4" auxiliary feedwater pump turbine supply line break, makeup supply from the condensate storage tank is also being considered. In this analysis, it is assumed that the auxiliary feedwater is initiated at the time of isolation and continues for a period of 1/2 hour at which time operator action is assumed to isolate this system.

The above facts demonstrate that Brown & Root is aware of the need to model makeup supplies of water for long-term environmental analyses, and such modeling is in fact part of past and future analyses. Accordingly, the above Quadrex finding is erroneous and will not have an impact on plant licensability.

QUADREX FINDING NO. 4.6.2.1(h) - NUCLEAR ANALYSIS TECHNICAL ADEQUACY ASSESSSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(h) "Awareness of W trip logic for MSIVs appeared weak (see Question N-11)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Nuclear Analysis is aware of the Westinghouse logic for the MSIVs and draws specific information as necessary from other disciplines having more detailed knowledge of the logic, logic diagrams, and other characteristics of the MSIVs. Brown & Root also informed Quadrex that specific detailed information on the Westinghouse MSIV trip logic was contained in project documents including the FSAR. Examples of the plant conditions which could trip the MSIVs were also presented to Quadrex.

Nonetheless, Quadrex insisted during a review meeting that Nuclear Analysis make an oral presentation of the complete set of STP trip signals and valve closure characteristics. Brown & Root declined to make such a presentation at that time on the grounds that the Mechanical Discipline had the detailed knowledge of those signals and characteristics and would therefore be able to provide a more comprehensive oral presentation. See Brown & Root's response to Quadrex Finding No. 4.6.2.1(i). Quadrex then mistakenly reported that Brown & Root was not knowledgeable as to the trip characteristics.

Given the fact that Brown & Root Nuclear Analysis has a general awareness of the MSIV trip logic and can easily obtain additional information when needed, the above finding is erroneous and will not have any impact on plant licensability.

QUADREX FINDING NO. 4.6.2.1(i) - NUCLEAR ANALYSIS TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(i) "Nuclear Analysis did not appear to be sufficiently knowledgeable in the area of valve performance and qualifications (see Question N-12)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The Nuclear Analysis Discipline does not have the primary responsibility on STP for detailed expertise in the valve performance and qualification areas; however, the Discipline is sufficiently knowledgeable to understand the requirements for performance of active systems, such as valves, in modeling postulated system breaks. In fact, Nuclear Analysis presented calculations during the Quadrex review in which the actuation or non-actuation of valves was included in the modeling approach.

Moreover, it is the Mechanical Discipline which is expected to have (and has) a very detailed knowledge of valve performance and qualification. The Mechanical Discipline's expertise in the valve area was acknowledged in Quadrex's assessment of Question N-12, which states that the "Mechanical Group is aware of valve qualification needs." To the extent Nuclear Analysis needs very detailed valve information, it can obtain such information from the Mechanical Discipline.

In Quadrex's assessment of Brown & Root's response to Question N-12, cited in the finding, Quadrex suggested that Brown & Root had not considered valve performance qualification requirements near break locations. Indeed, for the various short duration accident evaluations questioned by Quadrex in its assessment of Question N-12, valve performance (or in fact, valve actuation) was not considered in Brown & Root's modeling of the systems involved, for the conservative approach is not to take credit for valve functioning in assessing the consequences of subcompartment lines breaks. This approach is more conservative and practical than relying on "as specified" performance of valves for the mitigation of adverse flow conditions. Therefore, the very detailed knowledge of environmental qualification of valves expected of Nuclear Analysis Discipline is not relevant to the analysis.

Given the foregoing, it is clear that Nuclear Analysis does have sufficient knowledge in the area of valve performance and qualifications. Accordingly, the above Quadrex finding is erroneous and will not have any impact on plant licensability.

QUADREX FINDING NO. 4.6.2.1(j) - NUCLEAR ANALYSIS TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention.

* * * *

(j) "Analysis for a double ended break rather than a crack break disagrees with a FSAR commitment (see Question N-13)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

"No break criteria", as specified by NRC Branch Technical Position MEB 3-1, were utilized by Brown & Root to design piping systems within the Isolation Valve Cubicle (IVC). These criteria minimize the likelihood that a pipe rupture would occur. Nonetheless, the NRC required that HL&P postulate a non-mechanistic break and show that there were no adverse effects on the structure or safety-related equipment. Accordingly, FSAR Table 3.11-1 entitled "Environmental Design Requirements" states that the MSIV cubicle be "qualified for a non-mechanistic break." The break area as established by the NRC was equivalent to a single ended flow area and was the minimum area to be postulated for this condition. (See ST-HL-AE-197, Ref. 2).

Based on the NRC-defined break size, Brown & Root performed a short term structural IVC analysis. Single-ended break mass and energy data were not available from Westinghouse at the time the analysis was performed; therefore, a double ended main steam line break was analyzed using RELAP 3. IVC design changes and analysis results were transmitted to the NRC and were found acceptable. The NRC concurred with this approach, and with the use of RELAP 3 in the analysis. (See ST-AE-HL-004).

Since the analysis performed is for a break giving a more severe pressure transient than that which would result from the break defined by the licensing commitment, the existing analysis will not adversely impact plant licensability. The short-term IVC analysis will be updated consistent with long-term thermal response requirements. As part of the update, a single-ended crack break has been analyzed using the COMPARE code and the appropriate short-term mass and energy release data generated by Westinghouse in 1980-81. In fact, for long-term effects, a spectrum of break sizes smaller than a single-ended break area are analyzed in order to bound the problem. The NRC has concurred with this approach.

Given the foregoing, it is clear that the above Quadrex finding will have no impact on plant licensability.

QUADREX FINDING NO. 4.6.2.1(k) - NUCLEAR ANALYSIS TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(k) "B&R does not appear to be sufficiently aware of high energy lines in the MAB (see Question N-13)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with this finding.

Brown & Root repeatedly informed Quadrex during its review that the only high energy lines in the Mechanical Auxiliary Building (MAB) are the charging/seal injection and letdown lines in the Chemical and Volume Control System and the auxiliary steam line to the liquid waste concentrator. (See Brown & Root response to Finding No. 4.5.3.1(a)). These lines are shown on the Safety Systems Hazards Analysis drawings and are included in the pipe break analysis for pipe whip and jet analysis. Therefore, there can be no question that Brown & Root is well aware of the presence of these lines in the MAB.

The above finding is erroneous and will have no impact on plant licensability.

QUADREX FINDING NO. 4.6.2.1(I) - NUCLEAR ANALYSIS TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(I) "B&R stated that documents are not issued without verified analysis. However, SDD (sic) 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."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The environmental data provided in TRD 4E010EQ004-A for inside containment are current, accurate, and adequate for qualification of equipment. These data were developed on a timely basis, are design verified and have a reasonable analytical basis, as explained in Brown & Root's response to Quadrex Finding No. 4.6.2.1(a).

The equipment outside containment has not been qualified on the basis of an accident analysis. However, an analysis addressing short-duration harsh environments is of considerably less importance outside containment because there are only three high energy lines outside containment and the equipment needed for the safe shutdown of the plant is isolated from these lines. See Brown & Root's responses to Finding Nos. 4.5.3.1(a) and 4.6.2.1(a). Nonetheless, additional environmental analyses outside containment had been scheduled for timely completion as part of the Safety System Hazards Analysis.

Given the foregoing, it is clear that Brown & Root has acted in accordance with sound engineering judgment in developing the temperature data utilized in qualifying equipment both inside and outside containment. Accordingly, the above Quadrex finding is erroneous and will have no impact on plant licensability.

QUADREX FINDING NO. 4.6.2.1(m) - NUCLEAR ANALYSIS TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(m) "Differences in ECP initial temperature assumptions were observed between Nuclear Analysis and Heavy Civil (See Question N-17)."

BROWN & ROOT RESPONSE

Brown & Root agrees with the above finding, but disagrees that it will have any impact on plant licensability.

The differences between temperatures utilized by Nuclear Analysis and Heavy Civil for the Essential Cooling Pond (ECP) in their analyses are neither discrepancies nor errors. The technical bases for the two sets of temperatures are different and were fully explained to Quadrex during the design review.

The physical design of the ECP is the responsibility of the Brown & Root Heavy Civil Discipline. The ECP temperature limit of 95°F is the criterion used by Heavy Civil in sizing the ECP and is based on plant operating conditions and the extreme temperatures encountered in the area, as determined from historical meteorological data. Except for very rare instances of extremely hot weather conditions, actual ECP temperatures are expected to be well below the 95°F criterion, which is embodied in the technical specifications governing normal plant operation.

Once the ECP size was established, the Nuclear Analysis Discipline evaluated ECP performance under a variety of off-normal and accident plant conditions, assuming hypothetical worst-case climatology and utilizing the conservative assumptions of Regulatory Guide 1.27 to assure the safe operation and/or shutdown of the plant. These analyses were performed to establish the most severe temperature profiles that could possibly be experienced by safety-related systems and equipment serviced by the Essential Cooling Water System, to ensure that the equipment was operable under those conditions, and to demonstrate that the ECP was capable of providing sufficient cooling capacity to effect a safe shutdown of the plant.

In accordance with NRC Regulatory Guide 1.27, the highly conservative assumptions employed by Nuclear Analysis in its evaluation of off-normal and accident conditions have resulted in ECP temperatures higher

than 95°F for limited periods of time following certain plant events. It is important to note that the calculated pond temperatures in these analyses, which exceed the 95°F normal operation Technical Specification limit, do not imply that the design of the ECP is inadequate. Rather, these temperatures are only a reflection of increased heat loads generated by the "postulated" worst-case accident conditions and do not fall under the normal operating temperature limit of the pond. Therefore, the normal operating temperature limits in the Technical Specifications are not applicable to the accident analysis completed by Nuclear Analysis. These distinctions were described to Quadrex during the design review; Quadrex apparently failed to grasp them.

It should be noted that Nuclear Analysis' evaluation of the ECP under accident conditions was not complete at the time of the Quadrex review and has subsequently been finalized. Some of the ongoing analyses shown to Quadrex indicated ECP temperatures slightly higher than those eventually obtained in the final evaluation. This final evaluation has demonstrated the adequacy of the ECP to provide cooling capacity for safe plant shutdown. In addition, an equipment qualification review to take into account the temperatures during certain off-normal conditions at the plant has indicated that these temperatures are within the range of operability of the equipment.

Given the foregoing, it is evident that the above finding is erroneous and will have no impact on plant licensability.

QUADREX FINDING NO. 4.6.2.1(n) - NUCLEAR ANALYSIS TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(n) "Assumptions regarding the availability of various heat sinks under varying plant conditions should be re-examined (see Question N-17)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The above finding is essentially an extension of Quadrex Finding No. 4.6.2.1(m) relating to temperature assumptions utilized in Essential Cooling Pond (ECP) analyses. In calculating a worst case ECP temperature, Brown & Root minimized the effects of heat sinks by making the following conservative modeling assumptions:

1) Passive heat sinks within containment were minimized in the ECP "loss of coolant accident" containment analysis (only about 5% of the total energy released to the containment is assumed to be absorbed by the heat sink). Thus, transferred heat from containment to the ECP by the heat removal systems was maximized.

2) No credit was taken for heat transfer to the atmosphere via the containment walls.

3) No credit was taken for heat losses in piping components.

These assumptions minimize heat sink effects and ensure that the ECP temperature analyses maximizes the heat transfer to the ECP. Thus, the results of the ECP temperature analyses are appropriately conservative. Because of this modeling approach, Brown & Root does not see the need for re-examination of heat sinks at this stage of design.

Given the foregoing, it is evident that the above Quadrex finding is erroneous and will not impact on plant licensability.

QUADREX FINDING NO. 4.6.2.1(o) - NUCLEAR ANALYSIS TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(o) "The battery room hydrogen analysis did not address the true problem of hydrogen concentration near the top of the room. This analysis was not properly classified as safety related (see Question N-25)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Hydrogen concentration "near the top of the (battery) room" was not given individual consideration in the STP battery room hydrogen analysis. However, Brown & Root disagrees with the implication in the above finding that giving separate consideration to such concentration was necessary, because the Brown & Root design precludes localized hydrogen concentration due to the extremely high air flow rates within these rooms. Further, Brown & Root disagrees that the referenced battery room hydrogen analysis should have been classified as safety-related, although it agrees that the battery room itself is a safety-related structure enclosing safety-related systems.

The STP HVAC systems are designed to promote circulation throughout each structure; the HVAC duct in the battery room is positioned so that supply air enters the battery room at or near the ceiling, with the exhaust air leaving at or near the ceiling across the room from the supply. The air flow rate is at least 300 times the hydrogen generation rate. The battery rooms are also designed with no high points or pockets; this design prevents local concentrations of hydrogen. Thus, Brown & Root did not consider it necessary to calculate localized hydrogen concentration near the top of the battery room. This Brown & Root design approach is consistent with industry practices and NRC views on the issue. Thus, contrary to Quadrex's allegation, there is no "true problem" of hydrogen concentration near the top of the room.

With regard to Quadrex's allegation that the battery room hydrogen analysis was not properly classified as safety-related, Brown & Root notes

that the original design-basis analysis of the hydrogen concentration in the battery room was performed in 1974 and was properly classified as safety-related. The subsequent analysis performed by the Nuclear Analysis Discipline referenced in the above finding was performed to respond to a specific NRC question concerning hydrogen concentration limits. See Brown & Root's response to Quadrex Finding No. 4.4.2.1(c). Since the Nuclear Analysis calculation was not intended to be used as part of the STP design basis calculational set, it did not need to be classified as safety-related. In any event, as part of the HVAC design re-evaluation, a safety-related design verified calculation of hydrogen concentration in the battery room was recently re-performed. This latter calculation confirmed the Nuclear Analysis Discipline's earlier results.

Given the foregoing, it is evident that the Brown & Root battery room hydrogen analysis was consistent with industry practices and also with NRC requirements. Accordingly, the above Quadrex finding will not impact on plant licensability.

QUADREX FINDING NO. 4.6.2.2(p) - NUCLEAR ANALYSIS TECHNICAL ADEQUACY ASSESSMENT

The following finding in the Nuclear Analysis area is expected to impact the generation of reliable power by STP:

> (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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The need for analysis of high energy lines in the MAB or IVC arises from an NRC safety requirement to minimize the potential impact of ruptures in these lines on safety-related systems. With regard to the IVC, a list of high energy lines that would be analyzed in the IVC to meet NRC requirements was provided to Quadrex and the need for the analysis fully explained in a Quadrex review meeting. Brown & Root's decision was based on Brown & Root's assessment of the potential impact of ruptures in IVC lines on safety-related systems. With regard to the MAB, Brown & Root explained repeatedly to Quadrex that the only high energy lines in the MAB are the charging/seal injection and letdown lines in the Chemical and Volume Control System and the auxiliary steam line to the liquid waste concentrator. Given the limited number of MAB high energy lines, Brown & Root decided to analyze all of them. Brown & Root's decision to analyze and seismically support all high energy lines in the IVC and MAB was based on Brown & Root's commitment to safety, with due regard for cost, accessibility and maintainability considerations.

Quadrex expresses concern, however, that the seismic supporting of all non-safety-related lines would compromise plant access and maintainability. The advantages of seismic support of nonseismic piping and equipment in seismic Category I buildings are discussed in the Brown & Root response to Quadrex Finding No. 4.7.3.2(o). As indicated there, to provide seismic support for all piping is the most suitable approach in light of the potential interaction of non-seismic piping and/or equipment with safety-related equipment. Quadrex would have realized this fact had it examined the total STP design rather than narrowly focusing on one particular area such as access. Moreover, Quadrex's allegation that Brown & Root's design philosophy compromises

plant accessibility or maintainability is not supported by the information provided to Quadrex during the review and is, in fact, inaccurate. See Brown & Root's response to Generic Finding No. 3.2(n).

Given the foregoing, it is clear that Brown & Root's plan to analyze all high energy lines in the IVC and MAB and to seismically support all non-safety-related lines, is both reasonable and cost effective and will not unreasonably compromise plant access or maintainability. Accordingly, the above Quadrex finding will not impact on the generation of reliable power by STP.

SECTION 2.8 - MECHANICAL ANALYSIS FINDINGS

Contained in this section are the Brown & Root responses to the Quadrex findings relating to Mechanical Analysis, which are contained in Section 4.6.4 of Volume I of the Quadrex Report. For the Mechanical Analysis Group there were sixteen (16) questions posed, from which Quadrex made three (3) "Most Serious" findings and no "Serious" findings. The following is a summary overview of the Quadrex findings in this area as well as the Brown & Root responses thereto.

SECTION 2.8.1 - SUMMARY OVERVIEW

Quadrex concerns, as expressed in Finding Nos. 4.6.4.1(a), (b) and (c) deal with single failure analyses, effects of pipe rupture in combination with single active component failure, and problems with a particular calculation.

Of these findings, two are related to Brown & Root's alleged failure to develop Failure Mode and Effects Analyses (FMEAs). (See Quadrex Finding Nos. 4.6.4.1(a) and (c)). As indicated in the Brown & Root responses to those findings, there is no regulatory requirement that FMEAs be conducted as a part of the STP design, and HL&P did not require that they be conducted. Nevertheless, FMEAs are contained in the FSAR. These FMEAs were not conducted for design purposes, but as confirmatory exercises to verify the adequacy of the design to meet the single failure criterion. Moreover, early in the STP design process, Brown & Root completed an Event System Analysis Program (ESAP) for selected systems. An ESAP produces similar results as an FMEA. This study was completed in 1977 and some design changes resulted. Later, as a result of increased industry emphasis on FMEAs as a design evaluation method, Brown & Root decided to utilize the System Design Assurance Group to complete additional FMEAs on key systems.

Quadrex Finding No. 4.6.4.1(c) also expresses some concern about the lack of Brown & Root procedures for addressing the single failure criterion. As indicated in the Brown & Root response to this finding, the single failure criterion is clearly defined in 10 CFR 50, Appendix A, and Brown & Root does not believe that it is necessary to repeat this definition in specific project documents. Rather, each individual Brown & Root discipline was responsible for incorporation of the single failure criterion into the designs it developed. Overall assurance that the single failure criterion is correctly incorporated by the individual disciplines is provided by the System Design Assurance Group. This is consistent with industry practice.

Quadrex Finding No. 4.6.4.1(b) identifies two insignificant errors which would have been detected and corrected during the review part of the "Design Freeze" effort.

Finally, in its assessment of the Mechanical Analysis Group, Quadrex states on page 4-64:

> "Work performed by the Mechanical Analysis Group appears to be adequate. There were a few numerical mistakes, minor judgment errors and improper assignment of verification levels noted. However, in general, a reasonable level of technical competence has been demonstrated by Mechanical Analysis."

Quadrex further states:

> "The Mechanical Group appeared knowledgeable and performed well in coordinating input from several sources (Nuclear Analysis, Heavy Civil, and Westinghouse.)"

Given these two statements, it is clear that the Quadrex findings contained in this section will not impact on plant licensability.

SECTION 2.8.2

RESPONSE TO MECHANICAL ANALYSIS FINDINGS

QUADREX FINDING NO. 4.6.4.1(a) - MECHANICAL ANALYSIS TECHNICAL ADEQUACY ASSESSMENT

The following findings may have an impact on plant licensability or deserve licensing attention:

(a) "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. 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."

BROWN & ROOT RESPONSE

Brown & Root disagrees that the above finding will have any impact on plant licensability and notes that the finding alleges no shortcoming in the Mechanical group's work. In fact, the overall Quadrex assessment of the work of the Mechanical Analysis group was "adequate," and Quadrex further stated that such work demonstrated a "reasonable level of technical competence."

Brown & Root also believes that the questions referenced in the finding demonstrate the adequacy of the Brown & Root design, and agrees with the statement in the first two sentences of the finding: "The ECW and CCW systems and their components appear to be well designed...All modes of operation have been accounted for...." The two concerns expressed in the finding regarding Failure Mode and Effects Analyses (FMEAs) and the effects of pipe rupture in combination with single active component failure have been addressed in several other Brown & Root responses including those to Quadrex Generic Finding No. 3.1(e) and Quadrex Finding Nos. 4.5.3.1(a) and (c), and 4.7.3.1(a).

With regard to the Quadrex concern about FMEAs, there is no regulatory requirement that FMEAs be conducted as part of a nuclear power plant design, and HL&P did not require that they be conducted. Nevertheless, FMEAs are contained in the FSAR. These FMEAs were not conducted for

design purposes, but as confirmatory exercises to verify the adequacy of the design to meet the single failure criterion. Moreover, early in the STP design process, Brown & Root completed an Event System Analysis Program (ESAP) for selected systems. An ESAP produces findings similar to an FMEA. This study was completed in 1977, and some design changes resulted from it.

As a result of increased industry emphasis on FMEAs as a design evaluation method Brown & Root had planned to have the System Design Assurance Group complete additional FMEAs on key systems, including ECW and CCW. FMEAs would have been performed on the components of each selected system, the system itself, and all interfacing systems, using written procedures reflecting present day FMEA practices. The System Design Assurance Group, which was established in 1980, would have provided uniform project-wide applications and systems level integration of the FMEAs. Performance of FMEAs as the design becomes finalized is normal industry practice.

The Quadrex concern regarding the effects of postulated pipe ruptures outside of containment was addressed in the Brown & Root responses to Finding Nos. 4.5.3.1(a) and (c). As indicated in those responses, Quadrex misunderstood the design philosophy employed at STP with respect to the analysis of postulated pipe rupture effects. Quadrex overlooked the fact that the majority of all high energy systems at STP were purposely concentrated within containment or in the IVC. This philosophy minimizes the need to consider rupture effects in the other areas of the plant (i.e., outside of containment) and, in turn, allows the evaluation of such effects (for the few instances in which they occur) to be more efficiently performed when detailed system response information becomes available.

Given the foregoing, it is evident that the above Quadrex finding will not impact on plant licensability.

QUADREX FINDING NO. 4.6.4.1(b) - MECHANICAL ANALYSIS TECHNICAL ADEQUACY ASSESSMENT

The following findings may have an impact on plant licensability or deserve licensing attention:

* * * *

(b) "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 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. The second exception was use of a 7 level designation (verification not required) rather than a safety related verified calculation."

BROWN & ROOT RESPONSE

Brown & Root agrees with the above finding, but disagrees that it will have any impact on plant licensability.

The first exception to the suitability of the analysis referred to in the finding was an arithmetic error made in calculating the break of a 6" HHSI pipe line. This error has been corrected in accordance with Brown & Root procedures and, as noted by Quadrex, was not significant and will not affect the actual design or change the conclusions of the flooding analysis.

The second exception referred to in the above finding was Brown & Root's use of a 7 level designation for a calculation involved in the analysis of the ECCS pump room rather than assigning it a safety-level designation. Brown & Root agrees that the calculation should have been classified as safety-related. However, at the time of the Quadrex Review, Brown & Root was in the process of reviewing all calculations irrespective of safety classification as a part of a "Design Freeze" effort. During the review, the calculation discussed above would have been examined and the safety designation as well as the arithmetic error would have been corrected.

The seriousness attributed by Quadrex to this finding is inconsistent with the overall Mechanical Analysis Technical Adequacy Assessment, where

Quadrex states (Quadrex Report, Volume I, page 4-64):

> "Work performed by the Mechanical Analysis Group appears to be adequate. There were a few numerical mistakes, minor judgment errors, and improper assignment of verification levels noted. However, in general, a reasonable level of technical competence has been demonstrated by Mechanical Analysis."

Lastly, Quadrex suggests in this finding that verification of the ECCS pump room analysis may be necessary. This suggestion is puzzling. Given the limited nature of Quadrex's review, there can be no valid technical basis from which Quadrex could determine whether such verification would be necessary, much less indicate that there would be a resulting impact on plant licensability.

In sum, the ECCS pump room analysis is adequate. Accordingly, the above Quadrex finding will not impact on plant licensability.

QUADREX FINDING NO. 4.6.4.1(c) - MECHANICAL ANALYSIS TECHNICAL ADEQUACY ASSESSMENT

The following findings may have an impact on plant licensability or deserve licensing attention:

* * * *

(c) "Formal FMEA methodology and single failure analysis guidelines do not exist (see Question N-19)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

As discussed in Brown & Root's response to Quadrex Finding No. 4.6.4.1(a), Failure Mode and Effects Analyses (FMEAs) are contained in the FSAR; these FMEAs were not conducted for design purposes but as confirmatory exercises to show compliance with regulatory requirements. There is no regulatory requirement to conduct FMEAs as part of the design, and HL&P did not require that they be conducted. As a result, there are no formal guidelines establishing FMEA methodology. Nonetheless, early in the STP design process, Brown & Root completed an Event Systems Analysis Program (ESAP) for selected systems. An ESAP produces similar findings to an FMEA. The ESAP work was completed in 1977 and resulted in some design changes.

Brown & Root also does not have multi-disciplinary guidelines on how to apply the single failure criterion in controlled documentation. The single failure criterion is defined in 10 CFR 50 Appendix A, and in industry standards such as IEEE-308. Brown & Root believes these documents provide sufficient definition of the single failure criterion. Insofar as application of the criterion, multi-disciplinary guidelines are neither necessary nor required by the NRC, HL&P, or normal design practice. Rather, each individual Brown & Root discipline is responsible for incorporation of the single failure criterion into the designs developed by that discipline. Overall assurance that the single failure criterion is correctly incorporated by the individual disciplines is provided by the System Design Assurance Group. This procedure is consistent with industry practice.

Given the foregoing, it is evident that the above Quadrex finding will have no impact on plant licensability.

SECTION 2.9 - PIPING AND PIPE SUPPORT FINDINGS

Contained in this section are the Brown & Root responses to the Quadrex findings in Sections 4.7.2 and 4.7.3 of Volume I of the Quadrex Report, which address the area of piping and pipe supports. Quadrex divides these findings into those related to piping and supports inside containment and those related to piping and supports outside containment. As noted in the Summary Overview to the Pipe Rupture Section (see Section 2.5), the inside containment piping design was subcontracted to EDS Nuclear under Brown & Root's direction. Brown & Root retained responsibility for the design of outside containment piping. For the piping and pipe supports area, Quadrex posed thirty-eight (38) questions from which Quadrex made seventeen (17) "Most Serious" findings and four (4) "Serious" findings. The following is a summary overview of the Quadrex findings in the area of piping and pipe supports, and of Brown & Root's responses thereto.

SECTION 2.9.1 - SUMMARY OVERVIEW

With regard to the inside containment findings, there are six findings which Quadrex feels may seriously impact on plant licensability (there are no Quadrex findings that are expected to seriously impact on plant licensability, nor are there findings that pose a concern as to the plant's ability to generate reliable power in the future). Of the six findings, Finding No. 4.7.2.1(d) challenges the use by EDS of high support stiffness values which, as discussed in the Brown & Root response to that finding, are consistent with Brown & Root design criteria and exceed the minimum values specified in the applicable TRD. Finding No. 4.7.2.1(e) simply reflects the opinion of Quadrex that a draft NRC working paper should have been incorporated into the design, even though the NRC had not adopted a final position on the matter and HL&P had not approved utilization of the draft guidelines at STP. As seen in the Brown and Root responses to these two findings, Brown & Root's position in both cases has a proper analytical basis, is founded on sound engineering judgment, and is consistent with industry practices.

The remaining four findings relating to the inside containment piping design raise minor administrative questions as to FSAR consistency and the need to update the FSAR to reflect methodologies actually utilized by EDS. In none of these findings did Quadrex challenge the technical adequacy of the methodologies used or the results obtained. See Quadrex Finding Nos. 4.7.2.1(a), (b), (c), and (f). Thus, it is difficult to understand how Quadrex could seriously conclude that these findings, which reflect mere administrative matters, would impact on plant licensability. The impact attributed by Quadrex to the findings is particularly puzzling because Quadrex itself stated on page 4-74 of Volume I of the Quadrex Report: "In general, EDS in-containment design analysis appears to be technically adequate."

There are fifteen Quadrex findings related to piping design outside containment. Six of those findings again reflect a disagreement between Quadrex and Brown & Root as to the adequacy of a design approach or mode of analysis utilized by Brown & Root. (See Quadrex Finding Nos. 4.7.3.1(d), (h), (i), (k), (l) and (o)). In all cases, the design approach or mode of analysis utilized by Brown & Root had a proper analytical basis, was based on sound engineering practice, and was consistent with NRC regulations and/or industry standards.

In three of the remaining findings, Quadrex is simply wrong. (See Quadrex Finding Nos. 4.7.3.1(c) and (j), and 4.7.3.2(m)). For example, Quadrex Finding No. 4.7.3.1(c) indicates that the Brown & Root criteria governing utilization of simplified methods of analyses versus response spectra methods were inconsistent with an FSAR commitment. In fact, the Brown & Root criteria were not only consistent with the FSAR commitment, but provided a more detailed and rigorous specification of when a particular method of analysis must be used than called for in the FSAR.

In two other findings, Quadrex evidences a failure to comprehend the Brown & Root design philosophy as it relates to the analysis of pipe rupture effects. (See Quadrex Finding Nos. 4.7.3.1(a) and 4.7.3.2(n)). A complete description of the Brown & Root philosophy as well as a critique of the Quadrex failure to comprehend that philosophy are found in the Brown & Root response to Finding No. 4.5.3.1(a).

The remaining three findings relate to work which was not within Brown & Root's scope of responsibility (see Quadrex Finding No. 4.7.3.1(e)), to a difference of opinion on the applicability to STP of a NRC working paper (see Quadrex Finding No. 4.7.3.1(f)), and to an administrative FSAR inconsistency (see Quadrex Finding No. 4.7.3.1(g)). As such, they are insignificant.

In sum, the Quadrex findings with regard to both the EDS piping and support work inside containment and the Brown & Root piping and support work outside containment are either factually erroneous, based on a misunderstanding of the STP design, or insignificant. None of the findings will impact on plant licensability.

SECTION 2.9.2

RESPONSE TO PIPING AND PIPE SUPPORT FINDINGS

QUADREX FINDING NO. 4.7.2.1(a) - PIPING AND SUPPORTS TECHNICAL ADEQUACY ASSESSMENT (INSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

(a) "The FSAR should be corrected since no modal analysis is done (see Question P-7)."

BROWN & ROOT RESPONSE

Brown & Root agrees with the above finding, but disagrees that it will have any impact on plant licensability.

Sections 3.7.3.8 and 3.7.3.9 of the FSAR should be updated to delete reference to mode-by-mode analysis and also to clarify Brown & Root's use of the worst possible differential displacements between supports. The method utilized by both Brown & Root and EDS to evaluate differential displacement between supports in piping analysis is consistent with industry practice, as Quadrex acknowledged in its assessment of Brown & Root's response to Question P-7.

Brown & Root agrees that the FSAR should be clarified to reflect the actual methodology employed by Brown & Root. However, since this methodology is consistent with industry practice, the sole concern expressed in the above finding is of an administrative rather than a technical nature. Thus, this finding clearly will not have any impact on plant licensability.

QUADREX FINDING NO. 4.7.2.1(b) - PIPING AND SUPPORTS TECHNICAL ADEQUACY ASSESSMENT (INSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(b) "EDS stated that they do not review the FSAR for changes or accuracy; this interface may present licensing problems (see Question P-7)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

EDS worked on STP as a consultant to Brown & Root with responsibility for performing stress and rupture analyses for piping inside the Reactor Containment Building. EDS' scope of work was for engineering design services, not licensing services. Brown & Root, not EDS, was responsible for the content and accuracy of the FSAR sections which relate to the EDS work. In many instances, however, Brown & Root solicited and received EDS input on FSAR sections related to its scope of work.

Given the foregoing, it is evident that the absence of an EDS review of the FSAR will have no impact on plant licensability.

QUADREX FINDING NO. 4.7.2.1(c) - PIPING AND SUPPORTS TECHNICAL ADEQUACY ASSESSMENT (INSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(c) "The FSAR needs to address EDS's methodology for Class 1 components (see Question P-9)."

BROWN & ROOT RESPONSE

Brown & Root agrees with the above finding, but disagrees that it will have any impact on plant licensability.

Section 3.9.3.3 of the FSAR should be clarified to include the methodology used by EDS in the analysis of Class 1 components. This clarification will simply describe an EDS methodology which, as acknowledged by Quadrex, was adequate and consistent with industry practice.

Because this finding represents an administrative concern on Quadrex's part with FSAR clarity and not a technical concern, this finding will not have any impact on plant licensability.

QUADREX FINDING NO. 4.7.2.1(d) - PIPING AND SUPPORTS TECHNICAL ADEQUACY ASSESSMENT (INSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(d) "EDS's use of high stiffness (default values) for pipe supports gives unconservative results compared to actual stiffness values (see Question P-12)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

It is common practice in the industry to decouple the piping supports from the actual piping analysis model when performing piping system analyses. Thus, in order to account in a conservative fashion for the effects of the supports on the piping system, minimum support stiffness values are established and applied to the piping system analyses. These minimum stiffness values ensure that pipe supports are of sufficient rigidity so that they do not amplify the dynamic responses of the supported piping system.

At STP, pipe supports were designed to the minimum stiffness values given in Technical Reference Document (TRD) 1L369RQ006, "Criteria for Design of Pipe Supports." These minimum values were derived from industry experience and test results. Industry experience, as well as parametric studies conducted by Brown & Root, demonstrate that utilization of stiffness values in excess of these minimum values has a negligible effect on the overall piping system response. Therefore, utilization by EDS of stiffness values in excess of the minimum values in the TRD has no measurable effect on system response and is not "unconservative".

For the foregoing reasons, the above finding is erroneous and will have no impact on plant licensability.

QUADREX FINDING NO. 4.7.2.1(e) - PIPING AND SUPPORTS TECHNICAL ADEQUACY ASSESSMENT (INSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(e) "Applicability of MEB-6 to STP vintage plants needs to be determined (see Question P-16)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

NRC Branch Technical Position MEB-6, "Acceptable Component Operating Conditions Under Combination of Plant Abnormal Events, and Plant Operating Conditions for Essential System-ASME Class 1, 2, 3 Components and Supports," was issued by the NRC only as a working paper. This document articulates the NRC position that the operability and functional capability for essential systems during abnormal events should be assured. When originally issued, MEB-6 was reviewed by Brown & Root. Brown & Root subsequently monitored the document through three drafts.

In December, 1976, Brown & Root noted that the NRC seemed no closer to finalizing MEB-6 than it was when the original draft of the document was issued. Brown & Root, therefore, recommended to HL&P in ST-BR-HL-6183, dated December 28, 1976, that no additional work be undertaken to meet what was then understood as the intent of MEB-6. This recommendation was based on Brown & Root's belief that it was not prudent or efficient to design in accordance with uncertain, informal regulatory positions.

HL&P concurred with Brown & Root's position on MEB-6 and directed Brown & Root in ST-HL-BR-2009, dated February 22, 1977, to perform no further work to comply with MEB-6 until such time as it was published as a formal document. MEB-6 has not been issued as a formal NRC Branch Technical Position. Moreover, the NRC has never requested Brown & Root or HL&P to address any of the concerns found in MEB-6. However, recognizing the NRC concern with the operability and the functional capability of certain active components, Brown & Root developed an operability program in the PSAR aimed at satisfying the NRC concern. This program is currently described in Section 3.9 of the FSAR. 1/

1/Guidelines similar to those in MEB-6 were included in July, 1981 in Appendix A to Standard Review Plan (SRP) 3.9.3 of NUREG-0800. If STP chooses to commit in the future to the guidance in the revised SRP, further evaluation of the requirements will be necessary and the extent of implementation work will be determined at that time.

Quadrex's assessment of Brown & Root's response to Question P-16 (which provides the basis for the above finding) appears to take contradictory positions. Quadrex recommends that Brown & Root evaluate incorporating MEB-6 into the STP design, in whole or in part. At the same time, Quadrex agrees that Code rules are adequate and that "MEB-6 is too conservative for design purposes." Moreover, the explicit ground for Quadrex's suggestion is that certain Boiling Water Reactor (BWR) plants have committed to complying with MEB-6. BWR experience, however, is not necessarily applicable to the Pressurized Water Reactor (PWR) design at STP. Brown & Root's position regarding MEB-6, as presented in its response to Question P-16, is supported by EDS, which has extensive experience in the licensing acceptability of both PWRs and BWRs.

For the above stated reasons, there is no need to consider any further at this time the applicability of MEB-6 to STP. Accordingly, the above finding will have no impact on plant licensability.

QUADREX FINDING NO. 4.7.2.1(f) - PIPING AND SUPPORTS TECHNICAL ADEQUACY ASSESSMENT (INSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(f) "The FSAR should be corrected to reflect EDS's modified spectra method used in the simplified method (see Question P-24)."

BROWN & ROOT RESPONSE

Brown & Root agrees with the above finding, but disagrees that it will have any impact on plant licensability.

Section 3.7.3.1.4 of the FSAR should be updated to reflect EDS' method of considering contributions of multi-modes in the seismic span generations for simplified stress analysis. However, this simplified method for seismic stress analysis is mcre rigorous than that described in the FSAR, and was acknowledged to be adequate by Quadrex. See Quadrex's assessment of EDS's response to Question P-24.

Accordingly, the concern expressed by Quadrex in this finding is administrative, not technical, and will have no impact on plant licensability.

QUADREX FINDING NO. 4.7.3.1(a) - PIPING AND SUPPORTS TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

The following finding is expected to seriously impact plant licensability:

> (a) "B&R has not yet developed a (sic) criteria for jet impingement protection on unbroken piping systems (see Question P-20). A future TRD is planned."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Referring to the Quadrex assessment of Brown & Root's response to Question P-20, cited above, it is clear that the Quadrex concern in this finding revolves once again around Brown & Root's consideration of postulated pipe rupture outside of containment. As indicated in Brown & Root's responses to Quadrex Finding Nos. 4.5.3.1(a) and (c), Quadrex totally misunderstood the design philosophy employed at STP with respect to pipe rupture. Specifically, Quadrex overlooked that the majority of high energy piping systems at STP were purposely placed within containment (including the IVC). As a result, the potential effects from pipe rupture in other areas of the plant (i.e., outside containment) are minimal. This deliberate design choice allowed Brown & Root to complete the pipe rupture analyses in areas outside containment at a later date, when more detailed system response information was available. The above philosophy is based on a thorough Brown & Root understanding of pipe rupture design requirements and demonstrates that a significant degree of planning was undertaken in order to optimize plant design with respect to the mitigation of pipe rupture effects.

Quadrex recognizes in this finding that at the time of its review a TRD was being developed for use in the pipe rupture analysis. This TRD is consistent with the criteria, procedures and methods utilized in the analysis of pipe ruptures inside containment. Therefore, Quadrex is incorrect in implying that prior to its review no efforts had been made to develop criteria for pipe rupture outside containment analyses; in fact, the outside of containment rupture criteria were known throughout the project evolution and are the same as those utilized in the analyses of pipe ruptures inside containment. It is well to note that, subsequent to the Quadrex review, the aforementioned TRD was issued for review and comment and portions of the criteria it contains are being implemented into the STP design.

Given the foregoing, it is clear that the above Quadrex finding will not have an impact on plant licensability.

QUADREX FINDING NO. 4.7.3.1(b) - PIPING AND SUPPORT TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE OF CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

(b) "Approximately 50% of the reviewed SDDs do not yet contain system operating temperatures (see Question P-1)."

BROWN & ROOT RESPONSE

Brown & Root agrees with the above finding, but disagrees that it will have any impact on plant licensability.

The system operating temperatures for each piping system are computed and documented in calculations within the Mechanical Discipline. This information has in turn been incorporated into certain SDDs, and more importantly, into the Project Line List, a single document. This document is being updated with the latest design information and will define the system operating temperatures for every line. This design information, coordinated with the system operating calculations, has provided a basis from which the STP stress analysis could conservatively be completed and, where necessary, has allowed the flexibility to evaluate each mode of operation.

In its assessment of Brown & Root's response to Question P-1, Quadrex agreed with the Brown & Root approach of using design information augmented by the system operating calculations generated by the Mechanical Discipline. Despite the recognized validity of Brown & Root's approach, Quadrex suggests that the lack of temperature information in SDDs could impact the validity of the piping analysis. Not only is this suggestion erroneous, but in fact, Brown & Root's analysis, if anything, has used data more conservative than the operating temperature data which could have been in the SDDs. Thus, the fact that 50% of the SDDs did not contain system operating temperatures will have no impact on plant licensability.

QUADREX FINDING NO. 4.7.3.1(c) - PIPING AND SUPPORTS TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

The following finding may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(c) "FSAR paragraph (sic) 3.7-17 is inconsistent with the B&R stated basis for separation of simplified method versus response spectra method (see Question P-1)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Brown & Root criteria specify when simplified methods and when response spectra methods are to be used. These criteria are set forth in TRD RQ001 and are, not only consistent with FSAR Page 3.7-17 (Section 3.7.3.1), but also provide a more detailed specification of when the various analytical methods should be utilized. For example, for ASME Class 1 piping systems 2" in diameter and under, the FSAR permits the utilization of either simplified or response spectra methods. However, TRD RQ001 does not allow such a choice unless the piping system is 1" or less in diameter. For all larger systems, TRD RQ001 requires utilization of the more rigorous response spectra methods. This more detailed specification of when particular analytical methods must be used results in a more rigorous evaluation of the design and is consistent with the aforementioned FSAR commitment. It should be noted that Quadrex's assessment of Brown & Root's response to Question P-11 acknowledges that Brown & Root had an adequate basis for the separation of simplified methods versus response spectra, and that the Brown & Root methodology was consistent with industry practice.

Given the foregoing, it is evident that the above Quadrex finding is erroneous and will not have any impact on plant licensability.

QUADREX FINDING NO. 4.7.3.1(d) - PIPING AND SUPPORTS TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Questions P-1 and P-3, cited in the finding, relate to the requirements of safety-related piping systems and the method to be utilized for ensuring the coordination of these requirements into the system design. In Brown & Root's view the requirements associated with complex safety-related piping systems are so numerous that the responsibility for overseeing that these requirements are met should not be vested upon a single individual, i.e. a "system engineer." Accordingly, STP procedures require that documents involving safety-related piping equipment, systems, and/or components be subjected to an extensive interdisciplinary review, which in many cases involves interdisciplinary meetings. The review process was completed for the initial STP piping design as well as for all subsequent design changes. This extensive review ensured that the requirements of each discipline were incorporated into the design.

The above multi-discipline integration of system requirements has been in effect throughout the STP design process and continues today. However, to ensure that the above project-wide system integration was being effectively accomplished, the System Design Assurance Group was formed in early 1980. This group provided a project overview for all system designs including piping systems, and ensured that the functions and requirements of each system were being appropriately considered. It was this group that was to provide the system "freeze" information necessary to finalize the STP design. (See Brown & Root's response to Quadrex Generic Finding No. 3.1(a)). Unfortunately, Quadrex did not understand the multi-discipline approach in effect at STP, and ignored the efforts of the System Design Assurance Group.

Given the foregoing, it is evident that the above Quadrex finding is erroneous and will not have any impact on plant licensability.

QUADREX FINDING NO. 4.7.3.1(e) - PIPING AND SUPPORTS TECHNICAL ADEQUACY ASSESSMENT (INSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root agrees with the above finding, but disagrees that it will have any impact on licensability.

The Westinghouse Nuclear Energy Systems ("WNES") program for environmental qualification of electrical equipment is presented in topical report WCAP-8587, which is a generic document applicable to many Westinghouse plants including STP. The environmental conditions stated in the WCAP are intended to be bounding conditions. Should plant-specific environments exceed these bounding conditions, Westinghouse has asserted that affected equipment must be qualified on a case-by-case basis. The responsibility for administering the WNES interface at STP has always been assumed by HL&P.

Review and comment on the WCAP would have been an out-of-scope activity for Brown & Root for which work was not authorized by HL&P to be performed. Indeed, HL&P expressly assumed responsibility in this specific area in letter ST-HL-BR-19691. This specific interest on the part of HL&P was the result of commercial concerns with the Westinghouse program. These commercial concerns are outlined in letter ST-WH-HL-206 dated July 15, 1980. To date, HL&P has not notified Brown & Root that any changes are required in Brown & Root's environmental qualification program in order to meet any Westinghouse interface requirements.

For the above stated reasons, this finding will have no impact on plant licensability.

QUADREX FINDING NO. 4.7.3.1(f) - PIPING AND SUPPORTS TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(f) "The decision not to 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."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding, which is virtually identical to Finding No. 4.7.2.1(e).

As a general matter, newly issued regulatory positions need to be followed throughout the entire design phase of a plant. However, Brown & Root disagrees that failure to incorporate into the design a draft regulatory position such as NRC Branch Technical Position MEB-6 will impact licensability.

MEB-6 "Acceptable Component Operating Conditions Under Combination of Plant Abnormal Events, and Plant Operating Conditions for Essential System-ASME Class 1, 2, 3, Components and Supports," issued as a working paper only, defines the NRC philosophy of assuring the operability and functional capability for essential systems during abnormal events. When originally issued, MEB-6 was reviewed by Brown & Root. Brown & Root subsequently monitored the document through three drafts.

In December 1976, Brown & Root noted that the NRC seemed no closer to a formal position than they were when the original draft of MEB-6 was issued. Brown & Root, therefore, recommended to HL&P in ST-BR-HL-6183, dated December 28, 1976, that no additional work be undertaken to meet what was then understood as the intent of MEB-6. This recommendation was based on Brown & Root's belief that it is not prudent or efficient to design to uncertain, informal regulatory positions.

HL&P concurred with the Brown & Root assessment of MEB-6 and directed in ST-HL-BR-2009, dated February 22, 1977 that no futher work be performed to meet the provisions of MEB-6 until such time as it was published as a formal document. To date, MEB-6 has not been issued as a formal Branch Technical Position, and Brown & Root has never been

required by the NRC to address it. It is noted, however, that similar guidelines to those in MEB-6 are presented in Appendix A to Standard Review Plan (SRP) 3.9.3 of NUREG-0800 issued in July 1981. The extent to which HL&P wishes to commit STP to the new regulatory positions and acceptance criteria of the revised SRPs will govern the degree of study and implementation to be given to these regulatory guidelines. However, recognizing the NRC's concern with operability and functional capability of certain active components, Brown & Root had developed an operability program in the PSAR aimed at satisfying the NRC concern. This program is currently described in section 3.9 of the FSAR.

To date, commitments made within the industry to the provisions of MEB-6 have been limited to Boiling Water Reactors (BWRs) and not to Pressurized Water Reactors (PWRs) such as STP.

Brown & Root also notes that, in its assessment of Brown & Root's response to Question P-16, Quadrex appears to take contradictory positions. Quadrex recommends that STP study incorporating into design the guidance of MEB-6, in whole or in part, and criticizes STP for not complying with this informal regulatory position. At the same time, however, Quadrex agrees that Code rules are adequate and that "MEB-6 is too conservative for design purposes." Brown & Root believes that the practice of attempting to comply with draft regulations is impractical and inefficient. Indeed, the Brown & Root position regarding MEB-6, as presented in Question P-16, is supported by EDS which has had extensive experience beyond STP.

In summary, MEB-6 has already received all the attention it currently warrants, and failure to commit to it will have no impact on plant licensability.

QUADREX FINDING NO. 4.7.3.1(g) - PIPING AND SUPPORTS TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(g) "The FSAR should be corrected to delete the reference to mode-by-mode analysis and enveloping of response spectra (see Question P-7)."

BROWN & ROOT RESPONSE

Brown & Root agrees that the FSAR should be corrected as specified in the above finding, but does not agree that this finding, which is virtually identical to Finding No. 4.7.2.1(a), will have any impact on plant licensability.

Sections 3.7.3.8 and 3.7.3.9 of the FSAR should be updated to delete reference to the mode-by-mode analysis and to explain Brown & Root's alternate use of the worst possible differential displacements between supports analysis, as well as to add a reference to enveloping of response spectra. While clarification of the FSAR is appropriate, the actual methodology employed by Brown & Root and EDS was acknowledged by Quadrex as acceptable and consistent with industry practice. (See Quadrex's assessment of Brown & Root's response to Question P-7). There is, therefore, no technical issue involved in this finding, but rather a minor administrative concern with FSAR consistency.

Given the foregoing, it is evident that the above Quadrex finding will not impact on plant licensability.

QUADREX FINDING NO. 4.7.3.1(h) - PIPING AND SUPPORTS TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(h) "The decision to ignore SSE SAM loads as a primary load on pipe supports should be re-examined (see Question P-7)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The consideration of SSE SAM (Safe Shutdown Earthquake-Seismic Anchor Movement) loadings as either primary or secondary loads on pipe supports has been and continues to be a subject of considerable controversy. For example, in early 1981, both the ASME NF Working Group and the ASME Subgroup on Design approved a Code change specifically excluding SSE SAM loadings from any primary consideration. This action was rejected by the NRC representative on the ASME main committee and returned to the working group for further evaluation. Recently, the ASME main committee decided that SSE SAM loadings should be considered as a primary load on pipe supports. However, the corresponding primary allowable stresses for this SSE condition were also increased, so that the increase in load was balanced by a corresponding increase in allowable stresses.

The current ASME view on SSE SAM loads is therefore one of either classifying them as secondary loads, not to be considered in a faulted load evaluation of pipe supports, or classifying them as primary loads in conjunction with increased allowable stresses which offset the increased loads. The first viewpoint is consistent with the design philosophy taken by Brown & Root which, as stated in Paragraph NF 3231.1(c) of the ASME Code of Record for STP is:

> "Constrained free end displacement and differential support motion effects and bearing type stresses need not be considered for the faulted condition."

Nevertheless, the Quadrex assessment of Brown & Root's response to Question P-7 infers that "significant re-analysis and potential backfitting" could occur if, contrary to the ASME position, SSE SAM loads have to be included in the pipe support analyses. This inference, based on conjecture, indicates that Quadrex has a general lack of understanding of the STP support design. The faulted load combination, even with added SSE SAM loadings, is not the limiting support design factor

at STP. Moreover, the conservatism built into the piping support design would vastly overshadow the insignificant loading increase that could result due to SSE SAM. Conservatisms, such as considering a full friction load during earthquake loadings as well as factoring up all loads by 30% to account for future unknowns, are only some of the elements incorporated into the support designs to ensure a conservative configuration. Indeed, because Brown & Root limited the increase of allowable stress for faulted conditions to only 1.33, instead of a permissible value as high as 2.0, the load increase which could potentially occur by considering SSE SAM would be insignificant.

In the event that changes in Code or regulatory requirements are issued and adopted by HL&P for STP, it can be easily shown that the increase in load due to SSE SAM is well within the conservative margins of the design. Therefore, the support design for faulted conditions need not be re-examined, and this decision not to re-examine it will not impact plant licensability.

QUADREX FINDING NO. 4.7.3.1(i) - PIPING AND SUPPORTS TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(i) "The lack of consideration of FW water hammer is not adequate (see Question P-21)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The potential for water hammer effects within feedwater systems has been long known by Brown & Root and by the nuclear industry as a whole and was under evaluation by Brown & Root for the STP design prior to and during the Quadrex review. The considerations of the potential for water hammer were factored into the feedwater system design early in the project. For example, design features such as a series of check valves between the Steam Generator and the Condensate Storage Tank have been included in the design to reduce the possibility of air pocketing within the system, thereby reducing the potential for water hammer. Other nuclear facilities have incorporated these features into their design of feedwater systems and have met with successful system operation without a water hammer event.

In addition to these design features which will mitigate water hammer effects, Brown & Root engaged a consultant from Rice University to investigate further the water hammer potential at STP. This investigation was underway prior to the Quadrex review and, as expected, resulted in the conclusion that the water hammer hazard at STP is insignificant.

Although it was clear that the probability of experiencing a water hammer event in the STP feedwater system was low, Brown & Root also discussed with HL&P the possibility of extending the NUS thermal-hydraulic analysis of the feedwater system to consider the potential of water hammer and to develop hypothetical systems loads. These loads could then be imposed on the system design in the event additional conservatism was deemed appropriate.

Quadrex evidently overlooked the design features incorporated in the STP feedwater system to minimize water hammer effects, and failed to realize how the STP system is analogous to other PWR systems that have shown successful operation. Quadrex also ignored Brown & Root's efforts, as described above, to evaluate the water hammer potential. Thus,

Quadrex's allegation that there has been a lack of consideration of water hammer effects is erroneous. Accordingly, the above finding will have no impact on plant licensability.

Brown & Root notes, however, that the potential for water hammer in feedwater systems is an ongoing generic concern and, therefore, is expected to receive close NRC review prior to issuance of the operating license, even though there is every indication that Brown & Root's design is conservative.

QUADREX FINDING NO. 4.7.3.1(j) - PIPING AND SUPPORTS TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

As an initial matter, it should be noted that Quadrex did not interview any members of the Site Change Review Board (SCRB), and also failed to review any of the decisions made by the SCRB. Given these facts, it is difficult to understand how Quadrex can have an adequate basis for questioning the adequacy of the SCRB's procedures and the qualifications of its members.

In fact, the SCRB procedures and the qualifications of its members are more than adequate. The primary function of the SCRB is to provide a mechanism for ensuring that proper design reviews have been conducted. Brown & Root procedure STP-DC-029 establishes the SCRB's methods of operation and provides for the participation of senior level engineering management personnel (Assistant Enginering Project Manager, Discipline Project Engineers and Quality Engineers). There can be no question as to the qualifications of these individuals.

In its assessment of Brown & Root's response to Question P-26, Quadrex concluded, based on its conversations with the Stress Analysis Group, that changes to piping were not submitted by SCRB to Brown & Root Engineering in Houston for approval, even if the changes related to piping greater than 2.5 inches in diameter. Quadrex inferred from this erroneous conclusion that the SCRB was not operating effectively.

The above inference denotes a lack of understanding by Quadrex of the STP design process. Contrary to Quadrex's conclusion, any piping changes (outside the design tolerance range) originating in the field are examined by the SCRB, which determines whether they can be resolved by site engineering or need to be transmitted to the Piping Design Discipline in Houston for resolution. Whether resolved at the site or by the Piping Design Discipline, all approved piping changes are incorporated by the Piping Design Discipline into the piping drawings.

The Piping Design Discipline then transmits the revised piping drawings to the Stress Analysis Discipline for review and reanalysis, if required. The Stress Analysis Discipline, accordingly, would not normally be aware of whether the piping change originated in the Home Office or was sent from the field by the SCRB. Thus, instead of asking the Stress Analysis Discipline, Quadrex should have gone to the Piping Design Discipline if it wanted examples of field initiated design changes to piping referred to the Home Office by the SCRB. (See, e.g., PCN#1 to 3M361P-CC-1109 SHT 2 REV 1 DATED 2/16/81).

Finally, Brown & Root agrees with the following statement made in the Quadrex assessment to Brown & Root's response to Question P-26:

> "The concept of a qualified Site Review Board to make sound engineering decisions to reduce construction delays should be beneficial to the overall plant construction schedule and should not reduce the engineering quality."

That is precisely the role of the SCRB at STP.

Given the foregoing, it is evident that the SCRB procedures as well as the qualifications of its members are adequate. Thus, this finding will not impact on plant licensability.

QUADREX FINDING NO. 4.7.3.1(k) - PIPING AND SUPPORTS TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(k) "B&R assumptions for seismic to non-seismic boundary anchors are probably unconservative and difficult to technically justify as adequate (see Question P-29)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

When considering the potential interactions between seismic and non-seismic pipe within the same piping system, there are two possible methods for dealing with the problem: (a) design an anchor at the interface between the seismic and non-seismic piping; or (b) seismically support all piping, whether seismic or not. The decision as to which method to utilize in a given area of a nuclear power plant must take into account the effective implementation of all design requirements as well as general plant arrangements.

In many instances, anchors are used within seismic Category I buildings to separate seismic from non-seismic piping. However, this approach can result in a major concern that the non-seismic piping within the Category I building may fall on, or otherwise interact with, other safety related equipment. In addition, the estimated load on this separation anchor from the non-seismic side is of concern because the non-seismic side is not analyzed for load input to the anchor. This seismic to non-seismic anchor design is obviously the subject of Quadrex's concern in the above finding.

However, this seismic to non-seismic anchor design question is of little concern at STP, since the Brown & Root design philosophy required the seismic supporting of all piping and equipment within Category I buildings whether the piping and equipment are classified as seismic or not. Under this philosophy, the non-seismic piping within Category I buildings has been evaluated for seismic conditions and the resulting loads from the non-seismic side are, therefore, accurately determined and addressed. Moreover, this philosophy also provides for an accurate design of the intermediate anchors, if any, as well as eliminating the potential for seismically induced interactions between the non-seismic piping and safety-related equipment within the building.

Because of the above design philosophy, the number of seismic to non-seismic anchors at STP is extremely limited. In fact, these anchors are limited to those lines which penetrate Category I buildings (e.g., seismic piping from MEAB to Yard and IVC to TGB). In these cases, the anchor is typically at the building wall, and the load from the non-seismic side (outside the building) on the anchor is estimated in accordance with criteria customarily used in the nuclear industry. The criteria for these isolated anchors are presented in the Brown & Root response to Question P-29 and basically consist of:

1) For piping analyzed by response spectra, the load from the seismically analyzed side of the anchor is multiplied by four and added to the other operational loads from both sides of the anchor.

2) For piping analyzed by the static seismic method using the peak seismic response, the load from the seismically analyzed side of the anchor is multiplied by two and added to the other operational loads from both sides of the anchor.

Both of these methods are conservative and in accordance with procedures used on similar nuclear plants. If one were to incorporate the ultra-conservative techniques suggested by Quadrex of designing anchors using plastic hinge loads, the design of these anchors would be similar to the massive whip restraints utilized on large piping systems. Such overconservative design is not necessary.

Given the foregoing, it is clear that the Brown & Root design philosophy provided for appropriate load determinations for all piping systems inside Category I buildings, and that the loads on those limited number of anchors which are needed to separate seismic from non-seismic piping at STP have been adequately addressed. Accordingly, the above finding is erroneous, and will not impact on plant licensability.

QUADREX FINDING NO. 4.7.3.2(I) - PIPING AND SUPPORTS TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

The following findings pose a concern for the plant to generate reliable power:

> (I) "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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

All static and dynamic loads for the STP systems and components, including those supplied by Westinghouse, have been either reviewed or developed by Brown & Root. For the Balance of Plant (BOP) systems, and in particular those that interface with the Westinghouse systems, the impact of transient loads on the systems was a major design consideration, since the impact from such loads affects both plant availability and economical operation. During the design evaluation of STP, there have been a series of analytical assessments conducted to avoid fatigue failures and to ensure that the transient operation (i.e., the plant's "cyclic duty") would not adversely affect plant operation. In various situations, this effort involved the control of the balance of plant transients, while in others it resulted in increased component margins to handle this duty.

The design and economic factors of each system were considered and a balance was sought between increased component design margins and a desire not to design to conditions more severe than individual components could be expected to encounter. As typical examples, the CCW Heat Exchangers have been designed with titanium tubes to ensure their availability; the safety related valves specifications require a minimum duty cycle of 50 cycles/yr; and the CCW pumps include design margins in the sizing calculations to ensure conservative flow rates. Additionally, such items as the mechanical penetrations have been designed using detailed stress and fatigue analysis procedures instead of acceptable simplified rules because of their duty cycles and importance to the safety of the plant.

As this Quadrex finding is worded broadly and is not supported by the information in Question P-2 (or elsewhere), it can only be concluded that Quadrex has extrapolated from a previous finding addressing the Westinghouse Startup and Shutdown cycles (Quadrex Finding No. 4.5.5.2(i)). In responding to that finding, Brown & Root discussed

the concern and indicated that the interface in this area is between Westinghouse and HL&P. (See also Brown & Root response to Quadrex Finding No. 4.3.2.1(I)). If Quadrex indeed extrapolated from this previous concern and inferred a lack of Brown & Root consideration of applicable duty cycles for all other equipment in the plant, to do so was grossly erroneous.

Brown & Root has provided adequate design margins in the components of the plant to meet the best estimate of the actual duty cycles and, where applicable, has factored in the operating experience of other similar plants. Accordingly, the above Quadrex finding is erroneous and will not impact on the reliable generation of power by STP.

QUADREX FINDING NO. 4.7.3.2(m) - PIPING AND SUPPORTS TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

The following findings pose a concern for the plant to generate reliable power:

* * * *

(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."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

As indicated in the Brown & Root response to Question P-6, the design of the rupture restraint discussed in the above Quadrex finding, which involved the use of "snubbers," was under re-evaluation prior to the Quadrex review. This re-evaluation was being completed in light of industry data which indicated that the potential for snubber lockup should be addressed as a loading condition of the system. Accordingly, the snubber design of the restraint was being re-evaluated in light of the additional loadings that it would impose on the system, and the question of whether a more effective restraint design could be incorporated was being considered.

Several different restraint designs were considered and evaluated not only from a standpoint of ability to function technically, but also from a standpoint of cost, fabrication, and material lead time. Brown & Root presented one of the most cost and fabrication-effective design alternatives to Quadrex during its review. Although the design presented during the review was not the one eventually chosen, it has been demonstrated that the design which was selected will perform its intended function satisfactorily.

The redesign of the above restraint mechanisms was part of a normal design evolution process which accounts for new information as it becomes available. Since this design evolution process was underway prior to the Quadrex review and was scheduled for a timely completion commensurate with the construction schedule, the above Quadrex finding will clearly not impact on the reliable generation of power at STP.

QUADREX FINDING NO. 4.7.3.2(n) - PIPING AND SUPPORTS TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

The following findings pose a concern for the plant to generate reliable power:

* * * *

(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 too close to straight pipe 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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The design of pipe whip restraints at STP did consider the requirements of maintenance access; further, as indicated in the Brown & Root Response to Quadrex Finding No. 4.5.3.1(a), that design included specific consideration of such factors as space, personnel access, system function, equipment layout, and plant availability. In addition, the STP design philosophy of locating the majority of high energy lines inside containment resulted in the vast majority of restraints also being concentrated inside containment; the restraint designs in some instances involved multi-system restraints. This design philosophy led to more congestion inside containment than would ordinarily be desirable. However, such concentration of high energy lines and restraint mechanisms inside containment is by far preferable to locating those lines and mechanisms throughout the entire facility. In addition, where necessary, removable mechanisms have been provided to facilitate access.

Quadrex's review of the restraints inside containment appears to have been made from the narrowly focused perspective of ISI, and failed to evaluate the situation in light of the entire plant layout. Consequently, Quadrex failed to consider the trade-offs between access and total system design adequacy.

With regard to Quadrex's criticism of the use of the minimum yield strength values to define pipe bending behavior, use of those values is a typical industry practice in the initial design of restraints. By utilizing the minimum yield strength values, the verification of actual yield strengths after the fact is ensured. On the other hand, if higher yield strength values were used in the design, the actual yield strengths would have to be confirmed when the pipe was fabricated. If it was found that the fabricated strengths were not of sufficient magnitude when measured against the restraint design, a backfit would be necessary with a potential scrapping of material. Therefore, the prudent approach is to design the restraints using the published minimum strengths and, on a case-by-case basis, factor in the actual material strengths once known. This approach allows the engineer to address access problems after the design is completed without jeopardizing the overall design itself.

Quadrex also criticizes Brown & Root's alleged failure to utilize available documented guidance on ISI. Actually, this ISI document, along with numerous other criteria documents, has been factored into the total STP design.

Finally, as Quadrex acknowledged in its assessment of Brown & Root's response to Question P-17, the Quadrex judgment and opinions were based on a limited review of the STP design. As a result, in this as in many other instances, Quadrex ignored or overlooked the entire STP design philosophy in reaching its findings. (See, e.g., Brown & Root responses to Quadrex Finding Nos. 4.5.3.1(a) and 4.7.3.1(k)). Without understanding the entire design of STP, it is inappropriate to take a piecemeal look at one isolated parameter and not consider all of the other parameters which may have influenced that particular design.

Given the foregoing, it is evident that the above Quadrex finding does not pose a concern for the plant to generate reliable power.

QUADREX FINDING NO. 4.7.3.2(o) - PIPING AND SUPPORTS TECHNICAL ADEQUACY ASSESSMENT (OUTSIDE CONTAINMENT)

The following findings pose a concern for the plant to generate reliable power:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The design philosophy of seismically supporting the non-seismic equipment and piping inside seismic Category I buildings is discussed in the Brown & Root response to Quadrex Finding No. 4.7.3.1(k). This philosophy potentially resulted in some increase in the size of and, in some cases, the number of supports for non-seismic equipment and piping. However, this design decision is clearly preferable to, and more likely to enhance safety and avoid licensing concerns in this area, than the alternative of performing the extensive analyses which would have been required to evaluate the effects of postulated interactions between non-seismic equipment and safety-related equipment in the event the support for the non-seismic equipment failed. Such analyses would have not only led to the construction of barriers or other protective devices, but future plant modifications involving safety-related equipment would have been complicated by the fact that seismic interaction between that equipment and non-seismic piping would have to have been considered each time the plant design was modified.

As previously indicated in the Brown & Root response to Quadrex Finding No. 4.7.3.2(n), one cannot isolate and evaluate one aspect of a particular design, such as access, without considering all aspects of the design. When one considers all aspects of the Brown & Root approach to dealing with support for non-seismic piping and equipment, it is clear that this approach is the preferred method for dealing with the problem. Accordingly, the above Quadrex finding is erroneous, and will not adversely affect the generation of reliable power at STP.

SECTION 2.10 - RADIOLOGICAL CONTROL FINDINGS

Contained in this section are the Brown & Root responses to the Quadrex findings in the area of radiological control, which are presented in Section 4.8.2 of Volume I of the Quadrex Report. In the area of radiological control, Quadrex posed 32 questions, which resulted in one (1) "Most Serious" finding and fifteen (15) "Serious" findings. The following is a summary overview of these findings as well as the Brown & Root responses thereto.

SECTION 2.10.1 - SUMMARY OVERVIEW

The "Most Serious" finding related to a system (the common instrument air line in the HVAC exhaust subsystem in the Fuel Handling Building) whose design allegedly does not meet the single failure criterion of 10 CFR 50. (See Quadrex Finding No. 4.8.2.1(a)). As indicated in Brown & Root's response to Quadrex Finding No. 4.3.2.1(a), the NRC agreed that a design such as that for the system in question would meet regulatory requirements provided certain design features were incorporated. Those features are indeed part of the design of the system which is the subject of this finding, and Brown & Root believes that the system would meet regulatory requirements. In any event, the design could be modified with a minimum of cost to eliminate any potential licensing concern, and such a modification has been initiated.

Three of the fifteen "Serious" findings are unsupported statements concerning the adequacy of the STP shielding calculations, analysis and design. (See Quadrex Finding Nos. 4.8.2.1(d), (e), and (g)). For example, Quadrex Finding No. 4.8.2.1(d) criticizes the classification of shielding calculations as non-safety-related. However, as noted in Brown & Root's response to that finding, the present Brown & Root classification meets NRC requirements, and even Quadrex acknowledges that there is no NRC plan to upgrade that classification. Equally unsupported and erroneous is Quadrex Finding No. 4.8.2.1(e), where Quadrex states that Brown & Root has not correlated radiation zones to the shielding design. As noted in Brown & Root's response to that finding, there is a shielding TRD that establishes radiation levels and specifies maximum dose rates for each radiation zone; these specified dose rates translate into shielding design limits.

Four of the remaining findings are critical of the STP ALARA program. Quadrex alleges there is a lack of minimum qualifications for ALARA reviewers (see Quadrex Finding No. 4.8.2.1(b)), an inadequacy in the ALARA review procedures and in the ALARA review of plant design (see Quadrex Finding Nos. 4.8.2.2(h) and (i)), and a failure to incorporate ALARA concerns into the maintenance, test and inspection activities. (See Quadrex Finding No. 4.8.2.2(j)). Contrary to the assertions in those findings, Brown & Root has adequate procedures

for defining the ALARA reviewers' qualifications and for making certain that qualified ALARA reviewers are hired and remain competent. Similarly, Brown & Root's procedures specify appropriately which documents are to receive ALARA review, and in fact adequate ALARA reviews of the STP design have been conducted throughout the life of the project by both Brown & Root and HL&P as stated in FSAR page 12.1-2. Finally, as indicated in the Brown & Root response to Quadrex Finding No. 4.8.2.2(j), ALARA considerations were addressed when designing the plant to meet maintenance, test and inspection requirements; the instances of restrictions on equipment access for maintenance identified by Quadrex are, in many cases, access limitations required by other overriding design considerations. The entire ALARA program, including radiation protection design features, has been presented to the NRC in FSAR Chapter 12.

Quadrex Finding No. 4.8.2.1(c) criticizes the decision to eliminate certain filtration systems from the MAB HVAC design. As noted in the Brown & Root response to this finding, Brown & Root had initially included these filtration systems into the design, but they were removed at HL&P's direction.

The remaining five findings are both erroneous and insignificant. Two of them express Quadrex's opinion as to the need to document the design basis for, or define, the location of items such as electric outlets, lighting, and removable shielding. See Quadrex Finding Nos. 4.8.2.2(k) and (l). As noted in the Brown & Root responses to those findings, there is no requirement, nor is it practical, to specify by procedure the location of such items. Finally, the last three findings allege that measures for verifying radioactive pipe routing, preventing radiation streaming through pipe penetrations, and minimizing crud build-up in equipment have not been implemented. See Quadrex Finding Nos. 4.8.2.2(m), (n) and (o). As noted in Brown & Root's responses to those findings, the actions whose absence is identified by Quadrex have in fact been implemented.

In summary, the Quadrex findings in this section do not demonstrate any significant deficiency in Brown & Root radiological control program. Accordingly, these findings will not have an impact on plant licensability.

SECTION 2.10.2

RESPONSE TO RADIOLOGICAL CONTROL FINDINGS

QUADREX FINDING NO. 4.8.2.1(a) - RADIOLOGICAL CONTROL TECHNICAL ADEQUACY ASSESSMENT

The following finding is expected to seriously impact plant licensability:

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

This finding is identical to Finding No. 4.3.2.1(a); it is discussed in detail in Brown & Root's response to that finding.

For the reasons presented in Brown & Root's response to Finding No. 4.3.2.1(a), this finding will have no impact on plant licensability.

QUADREX FINDING NO. 4.8.2.1(b) - RADIOLOGICAL CONTROL TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

(b) "No procedures exist that define the minimum qualification requirements for ALARA reviewers. 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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Section 2.2.1 of Brown & Root's ALARA Review Procedure STP-DC-016 directs the Engineering Project Manager (EPM) to designate in writing a Responsible Engineer or specialist who is qualified by training and experience in the principles of radiation protection to conduct the ALARA review. Other provisions of this same procedure assure that qualified ALARA reviewers are hired by Brown & Root. The Brown & Root ALARA reviewers monitor industry and regulatory developments affecting their activities in order to maintain their competence to conduct ALARA reviews. Thus, Quadrex's criticism of Brown & Root's qualification requirements for ALARA reviewers is unfounded.

The Quadrex statement that "some design drawings have been reviewed and such review signed off for ALARA ...(without) proper follow-up... to verify incorporation of ALARA specified design" is incorrect. The fact is that those design drawings requiring ALARA review have received it. Such drawings are identified in Procedure STP-DC-016. Additional ALARA reviews are also performed during the drawing revision process, as well as during the design change process. Design drawings are also being reviewed as a part of a comprehensive project-wide ALARA re-review.

ALARA review Form 200.40A and the drawing signoff procedures specified in Procedure STP-DC-016 constitute sufficient verification that the comments of ALARA reviewers have been properly considered and, where appropriate, incorporated into the design documents. In the event there is a disagreement about a particular ALARA comment, the EPM is called on to resolve the problem. To provide additional ALARA follow-up, two status/action reports have been developed: one for the ALARA review activities discussed above and the other as part of the ongoing design change process.

In summary, Brown & Root's ALARA review process of design drawings is adequate. The finding, therefore, will not have any impact on plant licensability.

QUADREX FINDING NO. 4.8.2.1(c) - RADIOLOGICAL CONTROL TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(c) "Modification of the MAB HVAC system to eliminate filter media needs to be re-examined (see Questions R-5 and R-29)."

BROWN & ROOT RESPONSE

Brown & Root agrees with the above finding.

HVAC exhaust filtration systems were initially specified by Brown & Root. However, HL&P directed deletion of such systems. Current nuclear industry practice is to provide, at a minimum, a particulate air cleanup in the exhaust system to minimize the risk of releasing radioactive particles to the site boundary. As a result of HL&P's deletion, only the Radiochemistry Lab and Sample Room have such filtration systems at the present time.

HL&P should re-examine the MAB HVAC system for reinclusion of exhaust filtration systems as originally recommended by Brown & Root. Brown & Root takes no position with respect to the impact, if any, of this finding on plant licensability.

QUADREX FINDING NO. 4.8.2.1(d) - RADIOLOGICAL CONTROL TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Quadrex initially recommends that Brown & Root re-examine the safety classification of its shielding calculations. However, Brown & Root's non-safety-related classification of these calculations meets the current NRC requirements and, as Quadrex indicated in its assessment of Brown & Root's response to Question R-7, there is no established NRC plan to upgrade that classification. Although it has been Brown & Root's position that most shielding calculations are not safety related, safety related documentation and verification requirements were imposed on the initial design basis analyses, with special emphasis on those associated with the control room evaluations.

Quadrex also alleges in the above finding that Brown & Root lacks familiarity with the standard models and codes used in shielding analyses. However, nowhere in the Quadrex Report is there any evidence supporting this allegation. To the contrary, Quadrex stated in its assessment of the Brown & Root response to Question R-11 that the shielding analyses supplied by Brown & Root and NUS were "appropriate for shield design and reflect similar methods and approaches to that accepted in the nuclear industry." The analyses referred to above are Brown & Root shielding calculations that use the QAD code, an accepted industry tool. Thus, this portion of the finding is without basis.

BROWN & ROOT RESPONSE 4.8.2.1(d) - CONT.

With regard to the NUS shielding calculations, Brown & Root was, at the time of the Quadrex review, in the process of updating those calculations as part of a previously initiated "as-built" shielding review. This as-built program also included, as necessary, a re-review and re-analysis effort on shielding.

In sum, Brown & Root's efforts in the area of shielding calculations were adequate and consistent with industry practices and regulatory requirements. Accordingly, the above finding is erroneous and will have no impact on plant licensability.

QUADREX FINDING NO. 4.8.2.1(e) - RADIOLOGICAL CONTROL TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The above finding makes three allegations. Quadrex first alleges that Brown & Root has not correlated radiation zones to the shielding design. This allegation is erroneous. Shielding design TRD A509NQ005B not only establishes the radiation level for each radiation zone, but also specifies a maximum dose rate which is equivalent to the maximum radiation level for that zone. For example, Section 3.3.1 of the TRD specifies that the primary shield wall will be designed such that the radiation level outside the secondary shield wall will not exceed 25 millirem (mrem) per hour, which is the maximum radiation level for that zone. In addition, the requirements for shielding in areas containing equipment necessary for the safe shutdown of the plant in the event of a design base accident specify that accident source terms will be utilized to determine the required shielding. Source term information and radiation zones have been presented to the NRC in Chapter 12 of the FSAR.

The second allegation in this finding is that the Brown & Root shielding design did not adequately consider ISI requirements. This statement is misleading. Many major plant components requiring ISI are located in the reactor coolant pressure boundary, which is a high radiation area both during operation and shutdown. Accordingly, it does not make sense to factor ISI requirements in the establishment of radiation zones, for ISI requirements would not change the definition of those zones. Instead, the ISI plan considers the radiation levels, the equipment to be used and the access required given the existing conditions.

Quadrex finally alleges that the Brown & Root shielding design did not adequately consider potential locations for temporary shielding. This allegation is erroneous. Shielding design criteria A509NQ005B clearly states that consideration should be given to provisions for temporary shielding for major sources of radiation during ISI to allow access

and minimize radiation exposure to personnel. The characteristics of this temporary shielding will depend on the equipment to be used, the component to be inspected and the accessible area. These characteristics are addressed in the ISI plan prepared for HL&P by Southwest Research Institute.

Given the foregoing, it is evident that Brown & Root has correlated radiation zones to the shielding design and has adequately considered both ISI requirements and temporary shielding in developing that design. Accordingly, the above Quadrex finding is erroneous and will not impact on plant licensability.

QUADREX FINDING NO. 4.8.2.1(f) - RADIOLOGICAL CONTROL TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(f) "Radiation zone drawings based on accident conditions have not been prepared (see Question R-30)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Prior to the TMI accident, the onsite accident dose limit for the main control room was established in 10CFR50. Brown & Root incorporated this limit in the FSAR and in TRD A509NQ005.

As a result of TMI, the NRC established additional guidelines and limits for accident conditions. These guidelines identify other "vital area" locations in addition to the control room for which accident dose limits have been established. Brown & Root had planned to develop zoning maps to identify and specify such "vital area" locations at STP for a TMI-type accident. However, this effort was part of the post-TMI activities which were not to be considered in Quadrex's review. Therefore, basing this finding on post-TMI requirements was inappropriate.

Given the above facts, it is evident that the above Quadrex finding is erroneous and will have no impact on plant licensability.

QUADREX FINDING NO. 4.8.2.1(g) - RADIOLOGICAL CONTROL TECHNICAL ADEQUACY ASSESSMENT

The following findings may have a serious impact on plant licensability or deserve licensing attention:

* * * *

(g) "A design basis governing removable concrete walls was not evident (see Question R-11)."

BROWN & RESPONSE

Brown & Root disagrees with the above finding.

Given the placement of this finding in Section 4.8 of the Quadrex Report, it is assumed that Quadrex is stating that Brown & Root did not have a design basis governing shielding requirements for removable concrete walls. This statement is erroneous because the Brown & Root General Structural Design Criteria, which were in place at the time of the Quadrex review, include such a design basis and require consideration of shielding requirements when removable concrete walls are used. Section 4.5.1 of the General Structural Design Criteria 5A369SD001-D contains the design requirements for materials to be used in removable walls. The Brown & Root shielding personnel provided input to the Structural Discipline during development of these requirements. The masonry block density was considered in the shielding calculations to determine the required thickness of the removable walls. Section 7.3 of the above referenced criteria document contains the requirements for seismic restraints of removable walls.

Quadrex seems to have based this finding on the Radiation Shielding TRD A509NQ005. However, that TRD is not the appropriate design basis document for structural criteria; the above referenced General Structural Design Criteria document is the one that controls design in this area.

Given these facts, it is evident that the above finding is erroneous and will have no impact on plant licensability.

QUADREX FINDING NO. 4.8.2.2(h) - RADIOLOGICAL CONTROL TECHNICAL ADEQUACY ASSESSMENT

The following findings are expected to have an impact on the generation of reliable power by STP:

> (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."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Section 2.1 of Brown & Root Procedure STP-DC-016-C provides the requirement that:

> "designated design documents for systems that process, convey, indicate or record levels of radiation of radioactive material and facilities containing such systems shall receive an ALARA review."

Specific plant features where additional emphasis is required are identified in the Procedure. The specific design documents to be reviewed are also identified in Appendix A of the Procedure. Moreover, most of the pertinent ALARA review items listed in the HL&P ALARA Design Manual are included in the Procedure. Indeed, the Procedure had been reviewed by Brown & Root and HL&P and had been the subject of audits by Brown & Root and HL&P without significant findings.

In addition, prior to the Quadrex review, Brown & Root had decided to upgrade the ALARA program, including STP-DC-016-C, and had set up a new organization to perform this upgrade. The upgraded program would have included utilization of the HL&P Manual where appropriate.

Thus, Brown & Root has adequately addressed development and implementation of ALARA review procedures. Accordingly, the above Quadrex finding is erroneous and will have no impact on the generation of reliable power by STP.

QUADREX FINDING NO. 4.8.2.2(i) - RADIOLOGICAL CONTROL TECHNICAL ADEQUACY ASSESSMENT

The following findings are expected to have an impact on the generation of reliable power by STP:

* * * *

(i) "B&R reviews of plant design from an ALARA viewpoint have not been adequate (See Questions R-1 and R-2)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

This finding purports to be based on the Quadrex assessments of the Brown & Root responses to Questions R-1 and R-2. Those assessments are erroneous and do not support the finding.

The Quadrex assessment of Brown & Root's response to Question R-1 stated that there is "little evidence" that the pertinent ALARA review items, contained in the "check list" distributed to the design disciplines, had been implemented. The ALARA "check list" was distributed by Brown & Root in the early stages of the plant design but was intended to serve merely as a guideline. Indeed, utilization of a form check list for ALARA review activities was discussed with the HL&P Health Physics Group on several occasions and, by mutual agreement, was not implemented.

Nonetheless, it can be easily shown that adequate ALARA reviews have been conducted throughout the design. HL&P recognized that to be the case when it conducted a design audit on March 20, 1976. The HL&P auditors stated that "Brown & Root was able to quickly retrieve all necessary documentation to demonstrate that an ALARA review had been conducted, that modifications had been considered, and that they had been implemented when feasible."

The Quadrex asssessment of Brown & Root's response to Question R-1 also states that the ALARA review procedure STP-DC-016 issued in November 1978, is very "general in nature" and that Appendix A should be upgraded to include P&IDs and construction drawings. It further stated that "no guidelines or procedures exist on how to develop the document list." As discussed in Brown & Root's response to Quadrex Finding No. 4.8.2.2(h), the ALARA review procedure adequately specifies the plant features and design documents to be reviewed.

The Quadrex assessment of Brown & Root's response to Question R-1 also states that no documented evidence was provided to show that the ALARA review program was implemented from December, 1975 to December, 1977. Project records amply document the ALARA review program during the period in question. Attached to this response is a sample listing of the ALARA review forms on file for the period between October 1975, and March 1976. In addition, the results of the HL&P audits of the ALARA review program conducted on March 10, 1976 and on October 5, 1977 confirm the implementation of the ALARA review program. Thus, Quadrex's assessment of Brown & Root's response to Question R-1 is totally erroneous.

The Quadrex assessment of Brown & Root's response to Question R-2 states that review of SDDs, TRDs and specifications "in no way ensures that ALARA design features will be properly incorporated;" Quadrex would have more emphasis placed in P&IDs, construction type drawings, and vendor documentation. As a matter of fact, many of the drawings cited by Quadrex are reviewed for ALARA requirements, and so are other drawings such as composite piping and general arrangement drawings. However, the SDDs, TRDs and specifications are the design documents which provide the basis for the ALARA group to assess the degree of ALARA implementation in the design. During the ALARA review, the reviewer makes recommendations as to potential ALARA design features. Whether or not these recommendations are incorporated depend on many factors, such as: technical feasibility; economics; schedule; scope of responsibility between the design organization and the owner, and overall reasonableness. Thus, the incorporation of ALARA features into the design does not hinge upon the kinds of documents given to the ALARA reviewer, but on the appropriateness of the recommended ALARA features.

Finally, the Quadrex assessment of Brown & Root's response to Question R-2 states that no documentation exists which references inspection of the STP model as part of the ALARA review program. The STP model was not systematically inspected as part of the ALARA review because the model was used primarily for detection of physical interference and identification of other concerns of the physical layout of the plant. An ALARA re-review of the project has been conducted since the Quadrex review. This re-review, which was conducted by a joint task force comprised of HL&P, NUS, and Brown & Root personnel, included use of the STP model and uncovered no significant deficiencies in the ALARA program.

Given the foregoing, it is evident that the Quadrex finding is erroneous and will have no impact on the generation of reliable power by STP.

SAMPLING OF ALARA REVIEW COMMENT FORMS ON FILE

DATE	SUBJECT/SYSTEMS/SDD/SPEC/ETC.
10/07/75	LWPS P&IDs
10/02/75	HVAC P&IDs
10/30/75	GWPS SDD R319ND015
10/30/75	GWPS SPEC. R319NS058
11/05/75	LWPS SDD R309ND024
11/05/75	Architectural Door Schedules
11/12/75	SWPS SDD R329ND002
11/20/75	SWPS Spec. R329NS048
12/21/75	Waste Evap. Spec R309NS046
01/07/76	GA Drawings MEAB
01/07/76	Plant Labs. SDD Q289ND026
01/28/76	GA Drawing MEAB
01/12/76	GA Drawings RCB
02/02/76	Architectural SDDs A490AD001 and D003
02/02/76	RCB H_2 Monitoring SDD 2Z169ZD009
02/02/76	Piping Design Criteria 1L019PD002
02/02/76	Concrete Supply Spec. 2A010CS001
02/09/76	RCB Penetration SDD C099ND009
02/27/76	Concrete Inspection Procedures 2A010CS027
02/24/76	Floor Grating Spec. 9A010SS011
02/26/76	Concrete Drawings
03/05/76	Concrete Construction Spec. 2A010CS028
03/05/76	Shop Fab. Pressure Vessel Spec. 7R019NS027

QUADREX FINDING NO. 4.8.2.2(j) - RADIOLOGICAL CONTROL TECHNICAL ADEQUACY ASSESSMENT

The following findings are expected to have an impact on the generation of reliable power by STP:

* * * *

(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. (se Questions R-2 and R-9)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The finding is largely based on a Quadrex inspection of the STP model. During this inspection, Quadrex noted that eleven (11) of the valves in the Reactor Containment Building were mounted in locations or positions which, in Quadrex's opinion, could compromise ALARA principles during repair and maintenance. Quadrex also noted what it considered to be restrictive access for maintenance on a manway at the bottom of the steam generator and on "several valves" in the Radioactive Pipe Tunnel; a potential crud trap on one of the Reactor Containment Building valves; and lack of offsets in piping through shielded room and cubicle walls to minimize radiation streaming.

It is worthy of note, however, that there are on the order of one thousand valves in the Reactor Containment Building. Even if, as Quadrex contends, some access restrictions exist with respect to one percent (i.e., eleven) of those valves, it would be unreasonable to conclude that maintenance, test and inspection activities in that building will be significantly compromised. The same observation applies to the problems said to exist in the other buildings. Moreover, in most cases listed by Quadrex in its assessment of Brown & Root's response to Question R-9, the access restriction noted, if existing, was the result of the need to accommodate other

important design considerations, such as providing adequate pipe restraints, flow requirements, and constructability. For these reasons, Quadrex's conclusion that maintenance, test, and inspection requirements have not been incorporated from an ALARA standpoint is erroneous.

With respect to the other problems alleged in the finding, the potential of crud traps in piping and valves was considered by Brown & Root, as discussed in the Brown & Root response to Quadrex Finding No. 4.8.2.2(o). Similarly, Brown & Root's appropriate handling of radiation streaming considerations is demonstrated in the Brown & Root response to Quadrex Finding No. 4.8.2.2(n).

Finally, it should be emphasized that in the design process, the first item that has to be considered is the building arrangement. The arrangement and placement of the equipment within the finite space provided in each building takes place subsequently. It is no violation of the ALARA principle that equipment has to be located sometimes in areas of relatively restricted access due to space limitations dictated by structural design considerations. Consequently, it is erroneous to focus, as Quadrex did, on a few equipment items or isolated areas of the plant and draw general conclusions on ALARA without taking into account the entire design intent.

Given the foregoing, it is evident that the above finding is erroneous and, accordingly, will not impact on the generation of reliable power by STP.

QUADREX FINDING NO. 4.8.2.2(k) - RADIOLOGICAL CONTROL TECHNICAL ADEQUACY ASSESSMENT

The following findings are expected to have an impact on the generation of reliable power by STP:

* * * *

(k) "There is no documented basis for locating electrical outlets, breathing air connections or lighting (see Questions R-9)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

There is no regulatory requirement to document the design basis for locating electrical outlets, breathing air connections or lighting. Brown & Root located the electrical outlets and lighting in accordance with standard industry practice. All locations of electrical outlets were reviewed by HL&P and revised as a result of its comments. The location of lighting is sufficient to provide adequate light for maintenance. However, if necessary, portable lighting may be used for local maintenance activities requiring high intensity lighting.

Given the foregoing, it is evident that the above Quadrex finding will not impact on the generation of reliable power by STP.

QUADREX FINDING NO. 4.8.2.2(I) - RADIOLOGICAL CONTROL TECHNICAL ADEQUACY ASSESSMENT

The following findings are expected to have an impact on the generation of reliable power by STP:

* * * *

(I) "The radiation shielding TRD does not address the use of removable shielding (see Question R-11)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The Radiation Shielding TRD A509NQ005 does not specify where removable shielding (concrete block walls) is to be used, because this determination is to be made by the designers and shielding personnel, with maintenance access to equipment being the primary objective in the use of removable shielding.

With respect to the design requirements for removable shielding, Section 7.3 of the General Structural Design Criteria 5A369SD001-D contains the design requirements for seismic restraint of removable walls. The design requirements for such walls also include material density specifications for shielding effectiveness. These are set forth in Section 4.5.1 of the design criteria document.

From the foregoing, it is evident that the above finding will not impact the generation of reliable power by STP.

QUADREX FINDING NO. 4.8.2.2(m) - RADIOLOGICAL CONTROL TECHNICAL ADEQUACY ASSESSMENT

The following findings are expected to have an impact on the generation of reliable power by STP:

* * * *

(m) "An identification of radioactive piping outside containment was not evident (see Question R-12). Verification that radioactive piping is properly routed through pipe chases is necessary (see Question R-10)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

With respect to the first part of the finding, it should be noted that all STP piping systems are identified by line numbers. Each line number consists of a group of numbers and letters that identify the size, system, number, piping material and quality level of the piping system. The system indicator included in the identification indicates the pipe contents and relative radioactivity levels. Use of such a system indicator was consistent with NRC requirements and industry practice at the time of the Brown & Root identification of its piping systems.

Regarding the second part of Quadrex's finding, the routing of lines conveying radioactive materials was reviewed by Brown & Root during the ALARA review of composite piping drawings to ensure that the lines were properly routed. Further verification of radioactive pipe routing is not necessary.

It should also be noted that the STP piping layout was completed prior to the accident at Three Mile Island. The NRC "Lessons Learned" regulations issued after that accident established, among other things, more stringent requirements with regard to radioactivity levels in piping. Accordingly, in late 1979, Brown & Root began reviewing and updating its radiation shielding zones. This effort, which provides additional assurance of the proper identification of radioactive piping, was in progress at the time of the Quadrex review.

Given the foregoing, it is evident that Brown & Root has adequately addressed the identification of radioactive piping outside containment and the routing for that piping. Accordingly, the above finding is erroneous and will not impact on the generation of reliable power by STP.

QUADREX FINDING NO. 4.8.2.2(n) - RADIOLOGICAL CONTROL TECHNICAL ADEQUACY ASSESSMENT

The following findings are expected to have an impact on the generation of reliable power at STP:

* * * *

(n) "Criteria for streaming through shield penetrations do not appear to have been implemented (see Questions R-7 and R-13)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Quadrex's assessments of Brown & Root's responses to Questions R-7 and R-13 assume that the STP design intends to use offset shield penetrations as a means to prevent streaming for all systems and concludes that criteria for streaming through such offset shield penetrations have not been implemented. Both the assumption and the conclusion are incorrect. At STP, all penetration sleeves for fluid systems are designed straight, and not offset. Separate cubicles are the primary design mechanism utilized by Brown & Root to prevent streaming through those penetrations. Several examples of these cubicles were presented to Quadrex during its review. By utilizing separate cubicles for tanks, pumps, valve rooms and valve operating areas, the streaming from the primary source is reduced through proper alignment of the penetration. In addition, the requirements to provide shielding material in the annular spaces between process piping and penetration sleeves were pointed out to Quadrex.

It should also be noted that the STP design basis has been to reduce streaming from major components so that the radiation exposure in normal access areas is as low as reasonably achievable. When maintenance is required within cubicles adjacent to a high activity source, the source can be flushed and drained, or temporary shielding can be utilized.

With respect to the HVAC penetration discussed in Question R-7, it has been known for some time that additional shielding would be required to reduce streaming through the large HVAC penetrations. An extensive review of this streaming was initiated in 1980 prior to the Quadrex review.

Given the foregoing, it is evident that the above Quadrex finding is erroneous and will, accordingly, not impact on the reliable generation of power by STP.

QUADREX FINDING NO. 4.8.2.2(o) - RADIOLOGICAL CONTROL TECHNICAL ADEQUACY ASSESSMENT

The following findings are expected to have an impact on the generation of reliable power by STP:

* * * *

(o) "There is no evidence that a thorough design review relative to crud buildup has been conducted (see Question R-15)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

A design review exclusively directed at crud build-up has not been performed because it was not regarded as necessary. Crud build-up, however, has been considered during the ALARA review of plant systems. Review comments on file document the ALARA reviewers' examination of potential crud build-up. These comments address such features as weld joint design, material selection, valve design and piping arrangements.

Criteria documents include many system design features for precluding trapping and build-up of crud in piping and valves. This was acknowledged by Quadrex in its assessment of the Brown & Root's response to Question R-15. Quadrex stated, however, that during a review of the STP model it was observed "particularly in the pipe chase," that routing of piping, orientation of valves, etc. could pose crud trap problems. Whether or not that observation is accurate, the radioactive pipe chase contains no components requiring frequent maintenance and is provided with sufficient shielding so that radiation levels in the pipe chase do not affect operations in adjacent areas. Therefore, crud build-up in that area, if ocurring, would be inconsequential.

For these reasons, it is evident that the above finding is erroneous and will have no impact on the generation of reliable power at STP.

QUADREX GENERIC FINDING NO. 3.1(a) - MOST SERIOUS FINDING

The following generic findings are expected to impact plant licensability:

(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 in 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."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Quadrex's first paragraph faults Brown & Root for not having an effective system integration and overview function within the Brown & Root design process. The fact is that Brown & Root has employed a system integration process since the inception of the project. Brown & Root developed System Design Descriptions (SDDs) for each system, which describe the system's design and functional requirements. An SDD details the system functions, design requirements, design descriptions, system limitations, component descriptions, operation descriptions, casualty events, recovery procedures and maintenance. The SDD for each system is prepared by the discipline designing the system. This lead discipline obtains input, review, and concurrence for each SDD from each of the other disciplines, as documented in the Brown & Root Document Control Center (DCC) files. Thus, responsibility for coordinating preparation of the SDDs was placed in the discipline most qualified to perform this function.

Also, various interdisciplinary meetings were held throughout the design of the project to review work underway and to resolve interdisciplinary concerns on a timely basis. This design process is consistent with industry practice.

As the design and construction progressed, it became desirable to establish a more formal project-wide process to confirm systems integration. A Systems Design Assurance Group (DAG) was created in early 1980. The purpose of this Group was to review each system on a multi-discipline basis to ensure that it was effectively integrated into the overall plant design. Quadrex did not include this group in its review.

Earlier, Brown & Root had formed the Physical Design Assurance Group (PDAG) to ensure that interferences and other physical concerns relative to equipment layout were adequately addressed. This group has been evaluating the major plant areas with regard to interference between systems and basic components and where appropriate, considered various requirements of accessibility for maintenance and inservice inspection (ISI). This group's effort, augmented by the independent ISI and ALARA groups, were to provide a project overview function for these specific activities. Brown & Root has been involved in a variety of other systems integration activities. For example, a series of systems hazards review drawings have been initiated which identify the interaction of all physical areas and safety equipment with such hazards as fires, missiles, pipe breaks, etc. In short, Brown & Root believes that its design process at STP provided for adequate systems integration.

Brown & Root also notes that Quadrex's comment in the second paragraph of the above finding is simply not correct. The fact is that STP plant arrangements and equipment layouts do take into account such factors as physical separations, system and equipment performance compatibility, access for maintenance and ISI. Taking these factors into account has been the specific responsibility of the Mechanical and Piping Disciplines. The Electrical and I&C Disciplines develop their arrangements, layouts, wiring, cable tray routing, etc., based on, and consistent with, the work already done by the Mechanical Discipline. There are, of course, isolated instances in which access limitations may have existed which required further evaluation prior to the final "design freeze" of the plant layout. This evaluation of potential access restrictions had been initiated by Brown & Root at the time of the Quadrex review and was scheduled for timely completion commensurate with the overall project schedule.

Quadrex's third paragraph in this finding asserts that there is inadequate coordination of design among disciplines and further suggests that there was confusion as to the role Mechanical Engineering was to play in the Brown & Root systems integration process. In fact, the Mechanical Discipline is fully aware of its responsibilities for systems integration. The Mechanical Discipline is required to review, and has reviewed, logic diagrams throughout the STP design process. Documented evidence of this review is found throughout DCC files. As noted above, coordination of design is accomplished through the SDD process, interdisciplinary meetings, and through such formal groups as the PDAG and DAG.

The fourth paragraph in this finding, which expresses a concern regarding internal consistency among various design documents and the maintenance of that consistency, does not recognize the function of the DAG. In addition, the concern ignores the fact that criteria documents were in preparation at the time of the Quadrex review, i.e., Criteria for Electrical System Independence, 3E570EQ006, and Criteria for Prevention of Interaction Between Safety-Related and Non-Safety-Related Systems, A320GQ005. Also, as noted previously, Brown & Root had in place a safety systems hazards analysis program which defined the separation requirements for each plant area in relation to the safety related equipment in that area. The program included a comprehensive computer-based Fire Hazards Analysis (FHA) report. This report was issued in December, 1981, and included the criteria contained in above referenced TRD A320GQ005.

Quadrex's last paragraph in this finding states that "a multidisciplinary interpretation of the single failure criterion does not exist in controlled documentation." Brown & Root does not have such a

document because it is neither necessary nor required by the NRC, HL&P, or industry practice (see Brown & Root response to Quadrex Generic Finding No. 3.1(c)). The single failure criterion is clearly defined in 10 CFR 50, Appendix A. Brown & Root does not consider it necessary to repeat this definition in specific project documents.

Given the foregoing, it is clear that the above Quadrex finding will have no impact on plant licensability.

3.0 RESPONSES TO GENERIC FINDINGS

Contained in this section are the Brown & Root responses to each of the Generic findings 1/ in Section 3.0 of Volume I of the Quadrex Report. These Brown & Root responses are presented in the same order as the findings appear in Volume No. I of the Quadrex Report. Although the Brown & Root section numbers differ from those used by Quadrex, the responses identify the Quadrex finding number at the top of each response. Each Quadrex finding is reproduced verbatim with Brown & Root's response directly following.

The following Generic findings and responses are contained in this section:

GENERIC FINDINGS	QUADREX FINDING NUMBER
Most Serious	Findings 3.1(a) thru 3.1(j)
Serious	Findings 3.2(k) thru 3.2(q)

1/ When reference is made to Quadrex "Findings", "Questions" and "Assessments", "Findings" means the evaluations contained in Volume 1 of the Quadrex Report; "Questions" are the detailed technical questions asked by Quadrex to Brown & Root during the review; and "Assessments" refer to the assessments by individual Quadrex reviewers of Brown & Root's responses to the "Questions". The "Questions" and "Assessments" are set forth in Volumes II and III of the Quadrex Report.

SECTION 3.1

RESPONSE TO GENERIC FINDINGS

QUADREX GENERIC FINDING NO. 3.1(b) - MOST SERIOUS FINDING

The following generic findings are expected to impact plant licensability:

* * * *

(b) "Brown & Root Review of Engineering Data

The generic concern is in three parts; namely,

(1) Input data to a technical group does (sic) 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 (sic) 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) Brown & Root 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, N-1). No documented criteria exists (sic) governing the evaluation process for vendor reports.

Brown & 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 & 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."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

With regard to Item 1, the Quadrex finding is in error. Engineering procedures require a controlled design document to be used in transferring data from one discipline to another. These procedures also require such documents to be submitted to interfacing disciplines for review and comment prior to their issuance. The "reasonableness" of input values is evaluated during this review process. Indeed, Engineering records contain examples of design parameters that were questioned by interfacing disciplines during this review process. Moreover, Engineering Procedures also require the design verifier to ascertain the adequacy and reasonableness of input data. Finally, contrary to the implication in this finding, it is not an industry practice to require one discipline to be responsible for the manner in which others use its output data. However, both the Brown & Root design verification process and the review process act to ensure that output data are correctly utilized. Additional information on this review process is contained in the Brown & Root response to Quadrex Finding No. 4.1.2.1(a).

With regard to Item 2 of the finding, the questions cited by Quadrex in its finding do not support the finding's conclusion that "calculation errors" appear with a higher frequency than should be encountered. For example, in the Quadrex assessment of Brown & Root's response to Question C-16, Quadrex states:

> "Brown & Root's design verification procedure appears to be adequate or above industry standards on paper."

Moreover, although Quadrex expresses a concern about the effective implementation of the referenced procedure and states that there was evidence that a significant number of mistakes had passed through the verification process, no specific reference to any calculation mistake or calculation number was given.

BROWN & ROOT RESPONSE 3.1(b) - CONT.

Similarly, Item 2 is not supported by Brown & Root's response to Question H-15. In the assessment of Brown & Root's response to that question, Quadrex states that effects of restriction of air flow in the reactor cavity area were not taken into account. In fact, this restriction had been identified by Brown & Root prior to the Quadrex review, and was under evaluation at the time of review. Subsequently, it was determined that the original design was adequate. In any event, the existence of such a restriction does not in and of itself indicate that calculation errors were committed.

Item 2 is also not supported by Quadrex's assessment of the Brown & Root response to Question N-1. This assessment discusses among other things, an alleged large temperature error in the MSLB analysis. However, the alleged error did not in fact exist. See Brown & Root's response to Finding No. 4.6.[illegible].1(b). Even if the error had occurred, the Quadrex assessment of Brown & Root's response to Question N-1 acknowledges that the "occurrence of such an error is neither uncommon nor a sign of inadequacy." Further in this assessment, Quadrex stated that the calculations reviewed were well organized, as were the verifications.

Finally, in Question N-17, the Quadrex assessment indicates that there was either an error or an inconsistency with a calculation of the Emergency Cooling Pond temperatures evaluated by Nuclear Analysis and by Heavy Civil. As explained in the meeting with Quadrex, this was neither an error nor an inconsistency. The analyses developed by the two disciplines were used for different purposes and assumed totally different environmental and plant operating conditions. Apparently, Quadrex failed to understand these differences. See Brown & Root's response to Quadrex Finding No. 4.6.2.1(m). In sum, Quadrex's assessments of the Brown & Root responses to the Quadrex questions cited in Item 2 of this finding do not support the generic findings of a high frequency of errors in calculations.

With regard to Item 3 of the finding, Brown & Root does not agree with Quadrex's criticism of the Brown & Root review of vendor-submitted reports. See Brown & Root's response to Quadrex Finding No. 4.5.5.1(c). With regard to EDS, Quadrex states on page 4-74 of Volume I of its report that the EDS in-containment design analysis is technically adequate. Quadrex also made no findings related to the EDS scope that are expected to seriously impact plant licensability, (see page 4-74), or pose a concern for the plant to generate reliable power (see page 4-75). From such lack of findings from Quadrex, one would conclude that the interface between Brown & Root and EDS has been adequate.

Brown & Root's interface with Westinghouse (as directed by HL&P) was such that Brown & Root was only authorized to evaluate the technical adequacy of the interfaces between the NSSS and the rest of the plant. Brown & Root was neither responsible for, nor requested to, evaluate Westinghouse's internal analyses.

Given the foregoing, it is clear that this generic finding is erroneous and will have no impact on plant licensability.

QUADREX GENERIC FINDING NO. 3.1(c) - MOST SERIOUS FINDING

The following generic findings are expected to impact plant licensability:

* * * *

(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

QUADREX GENERIC FINDING NO. 3.1(c) - CONT.

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."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The first two paragraphs of this finding assert a concern about the lack of a top-level, overview-type document describing the project-wide bases for consideration of plant operating modes and environmental conditions. This type of document is not necessary nor required to design a nuclear facility. The degree of application of one criterion or another in each individual discipline varies and depends upon the extent to which it is applied by that discipline. The criteria applicable to a given design activity are adequately specified in the SDDs and/or TRDs governing the design. The SDD and/or TRD information is subject to a project-wide review and approval by all disciplines, project management, and HL&P to ensure a thorough and consistent treatment of each requirement.

The postulated top-level TRDs may have been deemed necessary by Quadrex to facilitate its understanding of the STP design. Indeed, as an outsider briefly looking in, this type of document would have eliminated the need to review in detail the many documents which together define the overall STP design philosophy. However, there is no need for such a document within the project itself, for there

is a thorough review of the design philosophy and criteria documents of each discipline. (For additional information, see the Brown & Root responses to Quadrex Finding Nos. 4.3.2.1(b), (c), (e) and (f), 4.5.3.1(a), 4.6.4.1(a) and 4.7.3.1(a)).

With respect to the Quadrex concern in the third paragraph of the finding about the consideration of degraded equipment performance, such a concern is without basis and stems from an insufficient design review by Quadrex of STP systems and/or components. The design and economic factors for each system were considered by Brown & Root, and a balance was established between increased component design margins and a desire not to design to conditions more severe than individual components could be expected to encounter. (See the Brown & Root responses to Quadrex Finding Nos. 4.5.5.2(h) and 4.7.3.2(l)).

The Quadrex concern in the same third paragraph about whether SDDs and TRDs address recent developments appears to be based on Quadrex Finding No. 4.3.2.1(k). However, prior to addressing this specific finding, it should be noted that the STP design is based on a 1975 construction permit and the degree of implementation of subsequent developments is dependent upon corresponding project commitments in these areas. Referring to Quadrex Finding No. 4.3.2.1(k), various erroneous conclusions were drawn by Quadrex in that finding. As indicated in Brown & Root's response to that finding, Quadrex failed to understand the applicability to STP of a certain IE Bulletin, and further misconstrued the applicability of certain industry standards to STP.

With regard to the discussion in the fourth paragraph of the above finding on off-normal conditions, Quadrex's concern appears to be primarily directed at the HVAC systems (see Quadrex Finding Nos. 4.4.2.1(a) and (b)). For the STP HVAC systems, the initial design was completed using assumed heat loads which were derived considering plant operating conditions such as full power operation and accident conditions. However, lacking exact heat load data during the initial design phase, Regulatory Guides and design experience played an important role in establishing the initial HVAC design bases. As more refined thermal load data became available (generally after major components had been purchased and large bore piping and high voltage conduits had been routed), additional analyses were performed to assess the appropriateness of the initial design assumptions.

These additional analyses were initiated prior to the Quadrex review and have now been completed. These analyses account for the specific operating data of various equipment and piping systems and consider the different (off-normal) modes of plant operation. This design

re-evaluation process has resulted in certain areas of the plant being identified as needing additional cooling, while in other areas certain HVAC equipment had to be upgraded to account for the layout of safety grade components in the areas. Although this design re-evaluation was discussed with Quadrex, Quadrex did not give it consideration in its findings.

In a similar design evolution process, the Essential Cooling Pond (ECP) was analyzed to demonstrate that it was capable of providing sufficient cooling capacity to effect a safe shutdown of the plant during off-normal and accident conditions. An equipment performance review to take into account the short-duration, high temperature conditions during off-normal operation of the plant had previously been underway and had indicated that the accident temperatures are within operating parameters for the equipment.

The example provided in the fifth paragraph of this finding concerning the door and hatch positions is supposed to illustrate Brown & Root's lack of understanding of off-normal plant operations. However, this example actually demonstrates that Quadrex failed to comprehend the STP design philosophy. As stated in Brown & Root's response to Quadrex Finding No. 4.4.2.2(h), radioactive areas of the plant are under administrative control and access to such areas is through doors and hatches which are normally closed. The HVAC systems in these areas have been designed for this condition and will maintain less pressure in the contaminated areas to ensure that contaminants do not migrate to the clean areas of the plant. If the ventilation systems were designed and balanced assuming open doors and hatches, a much larger system would be required. Such an overdesigned system would not only be expensive to build, operate and maintain, but could cause increased differential pressures across the doors under normal conditions making them difficult to open. Thus, Quadrex's statement that the Brown & Root assumptions regarding door and hatch positions "seem unrealistic based on plant operating experience" actually suggests that Quadrex lacks familiarity with plant operating experience.

Finally, the above finding questions the adequacy of the analyses of pipe ruptures outside containment. Quadrex's criticism overlooks a fundamental aspect of the STP design philosophy, under which the majority of all high energy systems were purposely concentrated within containment and in IVC. This philosophy minimized the need for early consideration of rupture effects in other areas of the plant (i.e., outside containment), and allowed their evaluation to be more effectively completed when more detailed system response

information was available. (See Brown & Root response to Quadrex Finding No. 4.5.3.1(a)). Additionally, the environmental temperatures used to qualify equipment in the outside containment area were appropriate, particularly since the equipment necessary for safe shutdown will be isolated from the few high energy lines in this area. (See Brown & Root response to Quadrex Finding No. 4.6.2.1(a)).

Given the foregoing, it is evident that the above generic finding is erroneous and will have no impact on plant licensability.

QUADREX GENERIC FINDING 3.1(d) - MOST SERIOUS FINDING

The following generic findings are expected to impact plant licensability:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Quadrex makes two allegations in this finding: (1) Brown & Root does not always properly determine whether a particular design is safety or non-safety-related; and (2) non-safety-related design is not reviewed, checked, or otherwise verified, thereby resulting in a potentially unsafe or inadequate design.

With respect to the first allegation, the systems, structures, and components designed by Brown & Root and the associated design documents, such as calculations, are classified as safety-related or non-safety-related. Brown & Root makes this classification based on the importance of the systems, structures, or components to the safety of the public and the safe operation of the plant. The safety functions which are performed by systems, structures, or components are defined in industry codes and standards such as ASME, IEEE, ANSI, ACI and NRC regulatory guides (R.G.s). These codes and standards are specified for use by the NRC regulations (e.g., 10 CFR 50.55a) for the design, manufacture, fabrication, erection, construction, testing, and inspection of nuclear components commensurate with the importance of the safety functions to be performed. These codes and standards are used throughout the nuclear industry for the determination of safety classification. Therefore, the bases for the safety classifications of equipment and calculations used by Brown & Root are appropriate.

With respect to the second allegation in the finding, all Brown & Root designs and calculations, both safety-related and non-safety-related, are reviewed and verified. The scope of the review and verification performed on safety-related and non-safety-related design is similar, except that in the former case, more rigid requirements for documentation of the review process are applied to demonstrate compliance with regulatory requirements set forth in 10 CFR 50, Appendix B; R.G. 1.64; and ANSI N45.2.11. Thus, the statement by Quadrex that non-safety-related design is not subject to design verification is factually inaccurate.

In the above finding, Quadrex observes that "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." Quadrex mischaracterizes Brown & Root's position. Brown & Root has consistently utilized regulatory documents to establish baseline design requirements. Many of these regulatory documents reference or endorse established industry codes and standards for use in specific design applications. While Brown & Root believes that NRC requirements often impose conservatisms in excess of non-nuclear industry practices, Brown & Root strives to comply with all regulatory requirements. Such compliance, however, is not (as Quadrex suggests) a thoughtless process, but the result of careful consideration and the exercise of technical judgement. Brown & Root also notes that the proper arena for contesting the accuracy or

reasonableness of NRC Staff requirements is before the NRC, at the time the requirements are issued or proposed. It is inappropriate for Quadrex to engage in a collateral attack on NRC requirements in the process of reviewing a design that does meet those requirements.

Quadrex's finding also theorizes that NRC requirements may not "even meet the intent of the regulations." Since no specific examples are given, Brown & Root can not answer this charge. However, Brown & Root does not understand on what basis Quadrex feels better qualified to interpret the intent of the regulations than the agency which prepared them. Regulatory requirements are established by the NRC Staff to implement the provisions and intent of 10 CFR regulations and the Atomic Energy Act of 1954, as amended.

The finding also claims that "there was no planned effort to review new NRC requirements (excluding TMI-2 concerns) to determine their impact on STP." This allegation by Quadrex is not supported by the Questions it cites, and is erroneous.

Baseline regulatory commitments were established for STP with the issuance of the Construction Permit on December 22, 1975. Since that time, Brown & Root has reviewed new or revised regulatory requirements for applicabililty and impact on STP. As part of this activity, Brown & Root performed value/impact assessments of new and revised regulatory guides. These numerous evaluations were provided to HL&P and are well documented. For example, Brown & Root provided its evaluation of R.G. 1.104, revision 0 in ST-BR-HL-6337 dated January 17, 1977 and R.G. 1.104, revision 1 in ST-BR-HL-11162 dated October 12, 1977. In view of these documented evaluations, the following Quadrex assessment of Brown & Root's response to Question C-3 is erroneous:

> ".....R.G. 1.104 or NUREG-0554, which present new NRC requirements, have not been reviewed for their potential impact on STP."

Also erroneous is Quadrex's overall assessment of Question C-3. R.G. 1.104, which as seen above was properly evaluated by Brown & Root, was withdrawn on August 22, 1979 and replaced by NUREG-0554. No further assessment of NUREG-0554 was considered necessary by Brown & Root since NUREG-0554 merely incorporates previous NRC staff positions. STP's design commitments to the provisions of those documents are stated in the FSAR.

Question C-5 asked what was the maximum allowable shear stress used for any load combination. Brown & Root's response was that it used acceptance criteria consistent with the NRC Staff's Standard Review Plan. Quadrex's assessment was that the Brown & Root answer was adequate but it pointed out "a possible lack of engineering judgment in cases where NRC criteria may not be appropriately conservative." This allegation has been addressed above. Question C-6 did not deal with NRC regulatory requirements, thus it is not relevant to the finding.

The Quadrex assessment of Brown & Root's response to Question C-35, which relates to NUREG-0577, implies that Brown & Root has not analyzed that document. The assessment is erroneous. NUREG-0577 was issued in October 1979, and deals with lamellar tearing in steel supports bolts. The same technical issue was the subject of NRC Inspection & Enforcement Bulletin 80-36, which references NUREG-0577. The Brown & Root position on NUREG-0577 and Bulletin 80-36 was presented to HL&P in ST-BR-HL-35382 dated December 23, 1980. In that correspondence, Brown & Root also addressed Westinghouse's scope of responsibility with respect to NUREG-0577.

Question H-6 and R-1 do not deal with NRC requirements, and thus do not support the finding. Question P-16 does not deal either with a "new NRC requirement", but with an NRC working paper that has never been issued as a regulation; see Brown & Root response to Quadrex Finding No. 4.7.2.1(e). Therefore, none of the questions cited support the above finding that "there has been no planned effort to review new NRC requirements."

Finally, Brown & Root disagrees with each of the seven numbered instances in the finding of cases where Brown & Root's position was said to be "either inaccurate or questionable." Those allegations are refuted in Brown & Root's responses to the corresponding specific findings. It is relevant to note, however, that for the vast majority of the questions cited in the finding, the Quadrex assesssment of Brown & Root's response to the question did not identify any technical inadequacy; for the few assessments in which inadequacies were identified, the inadequacies are in fact non-existing or insignificant.

For the above reasons, this finding is erroneous and will not impact on plant licensability.

QUADREX GENERIC FINDING NO. 3.1(e) - MOST SERIOUS FINDING

The following generic findings are expected to impact plant licensability:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The Failure Mode and Effects Analyses (FMEAs) contained in the FSAR were not conducted for design purposes, but as a method to show compliance with regulatory criteria. There are no regulatory requirements to conduct an FMEA as part of the design, and HL&P did not require that they be conducted. Early in the STP design process, Brown & Root completed an Event Systems Analysis Program for selected systems (which produces similar results as an FMEA) for HL&P. This study was completed in 1977 and some design changes resulted.

BROWN & ROOT RESPONSE 3.1(e) - CONT.

As a result of increased industry emphasis on the FMEA as a design evaluation method, Brown & Root planned to perform FMEAs on key systems. In order to provide uniform project-wide application and systems level integration of FMEAs, the System Design Assurance Group (DAG) was established in early 1980. As part of the Group's design review responsibilities, FMEAs were to be performed on the components of each system, the system itself, and all interfacing systems, using written procedures reflecting present day FMEA practices.

STP Procedure SD-002, "Engineering Procedure for System Design Descriptions" Appendix A, Section 9.3, requires that Section 4.3 of the SDD "Casualty Events and Recovery Procedures" include a "list of all casualty events considered in the design, such as:

Loss of offsite power
Loss of instrument air
Single failures
Operator errors, etc."

SDDs were being reviewed by all design disciplines and the DAG to ensure that a consistent approach was taken and that all failure modes had been appropriately considered. Therefore, these documents would have furnished guidelines on "...what types of failures should be considered for various types of equipment," and the DAG would have provided the consistent interpretation of failure analysis required.

The alleged "single failure criterion violation" cited in the finding refers to a common instrument air line which provides control air to dampers in the Fuel Handling Building (FHB) Exhaust Subsystem. In the event of a high radiation condition in the FHB, a radiation detector signal would actuate a three-way solenoid valve in the air line. This action both removes the control air supply to the dampers in the normal ventilation flow path and vents the control air line causing these dampers to close. At the same time, the radiation detector signal causes other dampers to open and divert the ventilation flow through two redundant banks of HEPA-charcoal filters. These latter dampers are closed during normal operation and the filter banks are bypassed. The dampers in the normal flow path are held open by instrument air pressure and "fail closed" upon loss of air.

The Quadrex contention is that the "common" instrument air line may become blocked thus disabling the system with a single failure. This design arrangement was the subject of discussion with the NRC during Construction Permit licensing. Brown & Root and HL&P agreed to incorporate certain features in the design of the instrument air system; the NRC had stated that, if these features were incorporated, its concerns with the instrument air system would be resolved.

Based on its previous discussions with the NRC, Brown & Root believes the design as reviewed by Quadrex meets all regulatory criteria. However, Brown & Root acknowledges that in the present fluid regulatory environment, this is an area that could be subject to further NRC clarification and that, with minimal cost, the design could be changed to eliminate any further licensing concerns. Therefore, Brown & Root has initiated a revision of the design to show redundant sets of solenoids. Brown & Root also performed a design review, which identified one other instance in the plant in which a similar concern existed. Appropriate design modifications were initiated in that case also.

Based on the foregoing information, Brown & Root does not believe this finding would impact plant licensability or is indicative of a generic design error. More detailed information is presented in Brown & Root's response to Finding No. 4.3.2.1(a).

Regarding Quadrex's concern with the treatment of the effects ("consequential failures") of postulated events, Quadrex does not state that any technical inadequacies do in fact exist. In this finding Quadrex states that "varied interpretation ... can be given" to the results of postulated events. This wording incorrectly infers that Brown & Root has misinterpreted regulatory criteria. Similarly incorrect is Quadrex's statement that "there is evidence that B&R does not fully understand" the implications of direct and consequential failures on single failure analyses.

Actually, various postulated plant events (e.g. pipe rupture, fire, missiles) and their resulting consequences have been analyzed by Brown & Root consistent with regulatory criteria. Depending upon the specific plant event being analyzed, the design must accommodate the most limiting single failure in coincidence with the event, or it must be shown that the event will not cause a common mode failure (e.g. failure of redundant safety-related trains or equipment). Brown & Root specified the regulatory criteria and the acceptable means to provide protection of equipment against the effects of pipe ruptures in such documents as L010RR064-A. Fire protection requirements were factored into plant design as they were promulgated by the NRC following the Browns Ferry fire of 1975. Compliance with NRC Branch Technical Position ASB (APCSB) 9.5.1 is stipulated in the applicable design documents in the STP Design Manual. The STP position on fire protection is presented in FSAR section 9.5.1.A.

Brown & Root analyzes events to define resulting conditions in specific plant areas from which identification of potentially affected equipment can be made. In other words, each specific event is analyzed and applicable regulatory criteria are factored into the design of the systems involved. It is not always practical or efficient to establish a generic criterion for equipment to account for the effects of all plant events, as Quadrex suggests in the above finding. For instance, there are significant differences between the requirements to protect against the effects of fire and

the effects of pipe rupture.

In its assessment of Brown & Root's response to Question H-6, which Quadrex cited in support of this portion of the finding, Quadrex suggests the establishment of a generic HVAC separation requirement. Physical separation, however, is only one means of protection and the actual separation distance varies depending on other design features.

Also in Question H-6, Quadrex implies that the Fire Hazard Analysis Report (FHAR), which is part of the Operating License application, should be converted into a controlled document governing plant design. The FHAR is a licensing document prepared to describe how the STP design complies with regulatory criteria, in accordance with the NRC's letter of September 30, 1976. The FHAR is not, and was never intended to be, a design document. More detailed information on separation requirements and the FHAR is presented in Brown & Root's response to Quadrex Finding No. 4.4.2.1(d).

Contrary to the Quadrex assessments of Brown & Root's response to Questions M-4 and P-20 (cited in support of the above finding) Brown & Root has considered the effects of pipe rupture in STP design consistent with regulatory criteria. See Brown & Root's response to Quadrex Finding Nos. 4.5.3.1(a) and (c). Despite the contrary statement by Quadrex in its Question M-4 assessment, environmental analyses have been performed, and their results are presented in TRD EQ004.

The last question used to substantiate this portion of the finding is Question E-2. In its assessment of Question E-2, Quadrex stated that TRDs EQ006 and ZQ003 do not provide inputs to other disciplines. This assertion is incorrect. EQ006 clearly states the electrical independence criteria and presents separation requirements in detail. Similarly, ZQ003 provides clear and detailed criteria for the routing and installation of instrument piping including separation requirements and protection criteria, considering postulated plant events and single failure criterion. Both TRDs are part of the project-wide controlled issue Design Manual used by all disciplines.

The last paragraph of this finding states that a number of Brown & Root disciplines were unable to provide a listing of postulated single failures. This portion of the finding is factually inaccurate. Four questions (H-6, P-20, N-19 and E-4) are listed by Quadrex as substantiating the allegation. For Question H-6, Brown & Root provided various HVAC layout drawings to show compliance with the single failure criterion. Brown & Root's response to Question P-20 referenced Report L010RR064-A, which Quadrex describes in the assessment of Question M-4 as "appropriate for selection of (pipe) break locations." (Pipe ruptures are considered passive single failures.)

Quadrex also acknowledges in its assessment of Brown & Root's response to Question N-19 that an FMEA is presented in the FSAR for the Component Cooling Water System (FSAR Table 9.2.2-3). Question E-4 does not address itself to single failures. Therefore, there is no support for this last part of the Quadrex finding in the referenced questions.

In summary, none of the concerns referred to in this generic finding, with the exception of Question R-6, raises questions as to the adequacy of Brown & Root's design. In the case of Question R-6 (the "common" instrument air line), sufficient justification for regulatory acceptability existed for this design and appropriate design modifications have been initiated by Brown & Root to eliminate any potential future licensing concerns.

For the foregoing reasons, it is evident that the above finding will have no impact on plant licensability.

QUADREX GENERIC FINDING NO. 3.1(f) - MOST SERIOUS FINDING

The following generic findings are expected to impact on plant licensability:

* * * *

(f) "FSAR Committment Tracking

There was no documented evidence for assuring that individual FSAR commitments for sytems, 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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The allegation in the first paragraph of the finding that individual FSAR commitments are not being systematically incorporated into the design is erroneous. The FSAR does not establish design requirements, but simply describes the design and how it complies with regulatory criteria. This subject is also addressed in Brown & Root's response to Quadrex Finding No. 4.3.2.1(g).

Brown & Root disagrees with the allegation in the second paragraph of the finding that there is no means to assure that design related changes are reflected in the FSAR. Brown & Root procedure STP-DC-012 sets forth requirements which govern the control of changes to the FSAR and the Environmental Report (ER). Quadrex expressly acknowledges STP-DC-012 in its assessment of Brown & Root's response to Question H-11. Brown & Root explained to Quadrex the FSAR change process and provided to Quadrex a copy of the procedure. Quadrex's concern with inconsistencies between the FSAR and EDS's practices is addressed in detail in Brown & Root's responses to Quadrex Finding Nos. 4.7.2.1(a), 4.7.2.1(c), and 4.7.2.1(f). Clarification of the FSAR to make it consistent with EDS's practices would be appropriate, but the cited inconsistencies could not have an impact on plant licensability. As stated in Brown & Root's responses to the above referenced findings, the design approaches and methodologies implemented by EDS were determined by Quadrex to be acceptable and consistent with industry practice, and to provide reliable results. Therefore, there is no technical inadequacy identified by Quadrex in the work of EDS. Rather, Quadrex identified an administrative concern with FSAR currency. This will not be a serious obstacle to licensability.

The statement in the third paragraph of the Quadrex finding that no apparent method exists for timely updating of the FSAR is factually incorrect. Brown & Root Procedure STP-DC-012 provides requirements for control and processing of changes to the FSAR and the ER. This procedure has governed FSAR and ER changes since issuance of the STP Construction Permit. As noted above, this Procedure was discussed with Quadrex and a copy of the procedure was given to it. As FSAR changes are approved by Brown & Root, they are transmitted to HL&P for execution. There is up to several months time lag between Brown & Root approval of a change and actual inclusion in the FSAR in the form of an amendment.

The Quadrex assertion in the fourth paragraph of the finding that STP site personnel are potentially unaware of FSAR commitments is not supported by any facts. The assertion apparently has its foundation in Quadrex Finding No. 4.7.3.1(j). As stated by Brown & Root in its response to that finding, Quadrex did not interview any site personnel and did not review any of the design decisions made by site personnel. Quadrex participated in no discussions concerning interaction

of site personnel relative to FSAR commitments or licensing information in general. This portion of the finding, therefore, is unsupported speculation on the part of Quadrex.

The absence of Brown & Root's Licensing Group during the Quadrex review noted in the fifth paragraph of the finding is not surprising, since Quadrex never stated an interest in Licensing or requested licensing participation during the review. If Quadrex had manifested interest in this area, Brown & Root would assuredly have provided substantial Licensing participation. Under these circumstances, it is clear that the statements in the finding concerning the Licensing Group are speculative and are without any factual basis.

In fact, contrary to Quadrex's finding, Licensing has routinely interfaced with other engineering disciplines and project organizations to identify and interpret licensing commitments and requirements to assure their consistent implementation. This activity is well documented in the STP files. For example, the distribution for review and comment of design documents such as specifications, SDDs, TRDs and changes thereto, has always included Licensing as an interfacing discipline. Licensing comments are documented on Form 200.40, in accordance with the requirements of the procedure for review and comment, STP-DC-014. New and revised licensing information such as NRC FSAR questions, I&E documents, rulemaking, and regulatory guides, are disseminated within Brown & Root by the Licensing Group. Any action or response that may be required is identified, scheduled, and monitored by Licensing. Distribution of such information is, again, well documented and is consistent with STP-DC-011, the Brown & Root procedure for document distribution.

The Quadrex assertion that Brown & Root has no effective means to secure timely NRC review and concurrence of alternate design approaches ignores the long-standing policy established by HL&P that Brown & Root cannot communicate directly with the NRC without prior HL&P authorization. Because of this policy, requests for NRC review of any STP information have been HL&P's responsibility, with Brown & Root acting in a support role. Indeed, on many instances, Brown & Root has recommended to HL&P that a "reading" from the NRC be obtained in order to reduce licensing uncertainty. In any event, there is no technical inadequacy identified in this finding.

As previously stated, changes to the FSAR are controlled by Procedure STP-DC-012. The statement that Brown & Root Licensing does not take the initiative to keep the FSAR current and accurate is incorrect. Brown & Root Licensing is the focal point within Brown & Root for the processing of all FSAR changes. FSAR changes are processed within Brown & Root consistent with STP-DC-012 and, when approved, the changes are forwarded to HL&P. The transmittal of FSAR amendments which effect these changes has been the responsibility of HL&P.

The last paragraph in the finding alleges the lack of a documented Brown & Root position on interpretation of codes and standards. This allegation is also without merit. The requirements of codes and standards are incorporated into Brown & Root equipment specifications in one of two ways: the requirements are either expressly stipulated in the body of the specification, or the applicable code or standard is referenced for compliance by the supplier. In either case, Brown & Root assures proper implementation of regulatory requirements and codes and standards by the vendor through the submission of its compliance program to Brown & Root for review and approval. This is consistent with industry practice. Further discussion of this topic is found in Brown & Root's response to Quadrex Finding No. 4.3.2.1(j). With respect to Question M-30, referenced in this finding, see Brown & Root response to Finding No. 4.5.5.1(c), and attachment thereto.

For the above stated reasons, the finding is erroneous and will have no impact on licensability.

QUADREX GENERIC FINDING NO. 3.1(g) - MOST SERIOUS FINDING

The following generic findings may have a serious impact on plant licensability:

(g) "Plant Design Basis

There was very little evidence of 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 the 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 (sic) 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.

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."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Regarding the alleged lack of evidence of a well-thought-out and consistent basis for design, it is assumed that Quadrex is referring to the lack of an overall (top-level) criteria document. While such a document would have been beneficial to Quadrex in reviewing the project in a brief time frame, its absence is no evidence that the design basis is not well thought out or consistent. (See Brown & Root response to Quadrex Generic Finding No. 3.1(c)). The plant design bases are contained in the STP Design Manual. These design bases were developed based on applicable codes, standards, and regulatory criteria.

The interface design information required by each discipline is identified in the STP Design Manual and the Westinghouse Plant Information Package (PIP). Information is conveyed to supporting disciplines by both formal and informal working sessions. Engineering procedures contain the requirements for design review meetings held for this purpose. In addition, the System Design Assurance Group's reviews specifically address interfaces between disciplines, and the Phase II Design Assurance Review would have ensured that all preliminary design data had been verified. Reference to the use of unverified data by the Civil/Structural discipline indicates a lack of understanding by Quadrex of the Civil/Structural design process. (See Brown & Root response to Quadrex Finding No. 4.1.2.1 (h)).

With respect to the number of key front end documents said by Quadrex to be missing, this is just a statement of Quadrex's opinion and lacks factual support. As indicated in the Brown & Root response to Generic Finding No. 3.1(c), had such "key" documents been available, Quadrex could have completed its review without needing to assimilate thousands of design documents. Lack of the kind of documentation desired by Quadrex constitutes no inadequacy in the design basis. Of the specific documents mentioned by Quadrex, the "Environmental Qualification" TRD and the "In-service Inspection Manual" are specific TRDs, not top level documents as defined by

Quadrex; in any event, they were prepared as early as 1976 and 1977. Due to changing philosophies and design procedures, it was considered beneficial to issue and revise these documents at the present time to clarify the design procedures in effect. With respect to a "Safety Related Classification TRD", the design criteria pertaining to safety-related classification are contained in the codes, standards, regulatory guides, etc., and were utilized in the design. The planned issuance of a TRD on this subject was meant to accommodate HL&P's request for a document that would assist in the field installation of equipment. (See Brown & Root's response to Quadrex Finding No. 4.3.2.1(f)).

Regarding the "significant quality variations" allegedly observed by Quadrex in the design review comments, this is again a statement of Quadrex's subjective opinion. The allegation that the Materials Group does not review subcontractor material selection is incorrect. The Materials Engineering Group reviews the material requirements contained in safety-related specifications prior to the subcontract; a normal engineering and quality assurance review of the subcontractor's material selection subsequently ensures that the specification requirements are met. Any deviations from the specification requirements after the material has been selected are reviewed again by the Materials Engineering Group. This group's comments, as well as any other discipline and client comments, are documented throughout the STP records and are indicative of an effective design review process.

Concerning the Westinghouse review of STP design, Westinghouse has received and reviewed piping composites and logic diagrams for all NSSS systems. Documentation of this review exists in project files. Westinghouse's position is that "no comment" responses are not transmitted to its clients. Therefore, documentation of Westinghouse's review consists of transmittal letters to Westinghouse and comments returned if they exist. The absence of documents evidencing Westinghouse's review of an item only indicates that Westinghouse had no comment on it. In any event, the review of STP design by Westinghouse was controlled by HL&P and not by Brown & Root. At the time of the Quadrex review, the Interface Agreement between Westinghouse, HL&P, and Brown & Root was being revised to provide for a direct Westinghouse to Brown & Root interface for the purpose of the final STP design review.

Changes to the Westinghouse PIP are submitted to HL&P with copies to Brown & Root. The changes received by Brown & Root are distributed by the Westinghouse Interface Engineer to the PIP manual holders and the affected design discipline is notified of significant changes. The aforementioned revisions to the Interface Agreement between Westinghouse, HL&P, and Brown & Root would have assured a more direct interface with Westinghouse, which in turn would have provided for a more effective review and indication of changes to the PIP.

Regarding EDS's review of Brown & Root drawings, the Brown & Root/EDS interface was reviewed by Quadrex in its assessment of the Brown & Root response to Question P-19. In that assessment, Quadrex determined that the procedures for transferring interface information from Brown & Root to EDS "are probably consistent with procedures followed by other A/Es." The EDS role is one of subcontractor, and as such it operates at the direction of Brown & Root. During EDS's initial design efforts (piping and supports inside of containment), EDS was on controlled distribution for all Brown & Root drawings and was required to ensure the adequacy of its design in accordance with these drawings. Following completion of the design efforts, the controlled distribution of drawings to EDS was discontinued, as Brown & Root assumed responsibility for activities following the initial design. Quadrex did not understand this arrangement and may have expected a continuing involvement by EDS throughout the life of the project.

Quadrex's interpretation of how Brown & Root applies Westinghouse criteria throughout the design is erroneous. Systems which interface with Westinghouse systems and which have interface criteria provided by Westinghouse were designed by Brown & Root to meet these criteria. It should be noted that Westinghouse provides balance-of-plant interface criteria on a generic basis, and these criteria were also implemented where applicable to STP. Other plant systems were designed to meet the presumed worst case conditions.

With respect to the use of design details from other PWR plants, the STP design engineers have been encouraged to utilize previous design experience. This has been construed by Quadrex to imply that "design details have been obtained from other PWR plants and used without confirming their applicability to the STP plant." It is assumed that the basis for this erroneous implication is Brown & Root's response to Question H-4, where Brown & Root said that the ambient conditions for different areas of the plant used at STP were in agreement with standard nuclear power plant design practice, citing the Virgil Summer Nuclear Station as an example. The Quadrex assessment of that response stated: "while the ambient conditions identified for the various plant areas in the SDDs appeared consistent with industry practice, their basis is not traceable to requirements of 'user systems'." This assessment clearly provides no justification for the above finding; there is absolutely no support for Quadrex's inference of an inadequate design basis taken without critical examination from other plants. All systems at STP have been designed considering the applicable technical and economic factors, to produce a configuration which balances all considerations. (See Brown & Root's response to Quadrex Finding No. 4.7.3.2(l)).

Quadrex also claims that Brown & Root has failed to adopt a consistent requirement for design margin to be achieved by each discipline. It should be noted, however, that design codes, standards, and regulatory criteria already include requirements for design margin. Thus, it can only be assumed that Quadrex is referring to additional margins placed on systems and components during the preliminary design stages beyond those required by codes, etc. These additional margins are not properly imposed on a project-wide basis, but should be specific to the particular design in question, taking into account factors such as the design's importancce to safety, any elements of uncertainty involved in it, the likelihood of future changes, etc. These margins were to be reviewed prior to the final design freeze process and again during preoperational tests.

Finally, regarding the allegations in the last paragraph of the finding, Brown & Root has prepared a Design Manual for STP. This manual contains documentation of the design (SDDs and TRDs), positions on Codes and Standards interpretation, and design criteria. In addition, each discipline keeps a regulatory manual containing Federal Regulations, NRC Regulatory Guides, NRC Standard Review Plans and Branch Technical Positions, IEEE Standards, and Standard Westinghouse Technical Specifications. In addition, the Mechanical, Electrical, and Instrumentation and Control disciplines are provided with the Westinghouse PIP. Design bases, assumptions, and other design details are required by project procedures to be documented in calculations, reports and system design descriptions, and controlled. No further documentation or additional information (in the form of engineering log books or design manuals, as suggested by Quadrex) is required, nor in any way necessary for an effective design. Quadrex's judgment that such log books or manuals "are especially critical for the first engineered nuclear plant by an A/E" rests on no technical bases and is merely a questionable expression of opinion on Quadrex's part.

Accordingly, the above Quadrex finding is erroneous and will have no impact on plant licensability.

QUADREX GENERIC FINDING NO. 3.1(h) - MOST SERIOUS FINDING

The following generic findings may have a serious impact on plant licensability:

* * * *

(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'."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The statement that specific reliability requirements, such as for the ESF Sequencer, have not been established, is incorrect and misleading. There is no regulatory requirement to establish specific reliability requirements (see Brown & Root's response to Quadrex Finding No. 4.3.2.1(j)). Nevertheless, the specification for the ESF Sequencer required the vendor to perform reliability analyses in accordance with IEEE-352, 1975.

It is worthy of note that the Quadrex assessment of the Brown & Root response to Question E-7 acknowledged that the ESF Sequencer location and design criteria were adequate. Similarly, the Quadrex assessment of Brown & Root's response to Question E-8 acknowledged that Brown & Root's response adequately described the automatic start, sequencing of loads, operation of auxiliary test equipment, and the test program. In fact, neither assessment raised any questions as to the adequacy of the ESF Sequencer design.

Regarding the possiblity of incompatibility hypothesized by Quadrex, the ESF Sequencer vendor is required to conform to the codes and standards cited in the specification. These requirements, plus the Brown & Root review of the vendor's design, ensures compatibility with the ESF equipment supplied by Westinghouse. The three-train design of the ESF power systems satisfies the single failure criterion; should one sequencer fail, the other two trains would be available. Thus, it is very unlikely that the ESF Sequencer reliability will be incompatible with that of the rest of the ESF equipment.

With regard to the absence of specific reliability requirements in equipment specifications, this is again not necessary for the design nor a regulatory requirement. Furthermore, there is no basis for the statement in the finding that:

> "the inability to produce a standard checklist of postulated failures to be considered casts doubts on the rigors of the safety-related evaluation process."

The absence of a standard checklist of postulated failures does not cast doubts on the safety-related evaluation process. Experienced engineers used industry codes, standards and regulatory documents to carry out the design of systems. Contrary to the Quadrex inference, the postulated failures to be considered in the design process are documented in STP Engineering Procedure STP-SD-002-B "System Design Description." These SDDs are reviewed by all design disciplines including the System Design Assurance Group to ensure that all failure modes have been appropriately considered in the design. In fact, it was one of the prime functions of the System Design Assurance Group to provide a project-wide review of all failure modes and to ensure that appropriate consideration would be given to each mode prior to the design freeze. Thus, whether a "standard checklist" exists is immaterial to the demonstrable adequacy of the safety-related evaluation process.

The last allegation in the above finding is that specifications to constrain spurious operation were absent. This allegation is assumed to again apply to the ESF Sequencer (see Quadrex assessment of Brown & Root's response to Question E-8). The ESF Sequencer and other safety-related control systems utilize the standard industry technique of coincidence logic. For the ESF Sequencer, this logic is as follows:

(a) For the undervoltage recognition (Mode II or III), the undervoltage condition must be recognized by two out of four sensor circuits. Therefore, the spurious failure of one component will not cause ESF initiation.

BROWN & ROOT RESPONSE 3.1(h) - CONT.

(b) For the safety injection recognition (Mode I or III), the safety injection signal must be recognized by four out of six sensors. Likewise, spurious signals from one circuit will not initiate safety injection.

Spurious valve movements have been considered as early as the PSAR stage. A review by Quadrex of the STP Safety Evaluation Report and the appropriate logic diagrams would have made this evident.

For the foregoing reasons, the above Quadrex finding is erroneous and will have no impact on plant licensability.

QUADREX GENERIC FINDING NO. 3.1(i) - MOST SERIOUS FINDING

The following generic findings may have a serious impact on plant licensability:

* * * *

(j) (sic) "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 & 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.

(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."

NOTE: This finding was incorrectly identified as Finding No. 3.1(j); it should be 3.1(i).

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The allegedly inadequate choice of analysis methods referred to in the first paragraph of this generic finding appears to be based solely on Quadrex Finding No. 4.6.2.1(e), in which the use of the RELAP 3 computer code is criticized. In Finding No. 4.6.2.1(e), Quadrex suggested that the results obtained using RELAP 3 were erroneous and alleged that the calculations should have been made using the more recent COMPARE code. Quadrex failed to realize that those calculations were performed prior to the time when use of COMPARE was being adopted by the industry. More importantly, the calculations have in no way been invalidated or questioned by the NRC. In fact, the RELAP 3 analysis completed for the annulus pressurization and IVC short term transients were submitted to and accepted by the NRC in a timely manner early in the project. These analyses, like many others, are being updated through the normal design process as more current data becomes available and, where appropriate, will utilize the COMPARE code to account for a more realistic modeling of certain areas. This normal evolution of design in no way supports Quadrex's broad assertion in this finding that Brown & Root's choice of analysis methods was inadequate.

Quadrex goes on to state that there was "an abnormally high error rate" in the nuclear analysis calculations. This is a statement of Quadrex's subjective opinion without basis in fact. Quadrex also alleges that additional analyses should have been completed at this

stage of construction. This claim is also erroneous. Not only have a large number of analyses been performed by Brown & Root as reported in the FSAR, but Brown & Root, in collaboration with NUS, had scheduled updates of these analyses to account for as-built and/or as-designed data and was performing other required environmental analyses. As indicated, this effort was to update these analyses to include final data and to remove any over-conservatisms utilized prior to final design information becoming available. This effort, more fully described in Brown & Root's responses to Quadrex Finding Nos. 4.6.2.1(b) and (c), may be the basis for Quadrex's assertions that the Brown & Root analyses contained errors or were insufficient. If so, the finding only denotes Quadrex's misunderstanding of the normal nuclear power plant design process.

Quadrex also claims in this finding that Brown & Root's use of consultants in the nuclear analysis area is "higher than a typical A/E practice". The main "consultant" utilized by Brown & Root is NUS, which is an unquestioned expert in this area; as a company affiliated with Brown & Root, NUS is in reality an extension of the Brown & Root engineering team. With regard to the allegedly insufficient guidance and review by Brown & Root of subcontracted analyses, the Quadrex assertion to that effect is also incorrect, as discussed in the Brown & Root responses to Finding Nos. 4.1.2.1(a), 4.5.5.1(c) and 4.7.3.1(e).

Finally, turning to specific examples presented in this finding:

The first example refers to the Brown & Root pipe rupture report provided to the NRC in 1976 and infers an inappropriate scheduling of the outside-of-containment effort. As indicated in the responses to Quadrex Findings Nos. 4.5.3.1(a) and (c), Quadrex failed to grasp the overall pipe break design philosophy employed on STP. This philosophy was to locate the majority of high energy systems inside either the Reactor Containment Building (RCB) or the Isolation Valve Cubicle (IVC), limiting the high energy systems outside containment to only three (3). This design philosophy provided the impetus for the early completion of pipe break evaluations inside containment and in the IVC. By the same token, it also allowed the consideration of pipe break effects outside containment to be completed at the present time, when more detailed information on the equipment and systems outside containment is known.

The second example suggests that the AFW pump motors may not meet qualification requirements in an accident environment. The example refers specifically to pumps located in one of the IVC compartments. The example has to assume an accident environment to exist in a compartment adjacent to that containing the pumps, resulting in a temperature at the pump higher than the pump's qualification temperature.

BROWN & ROOT RESPONSE 3.1(i) - CONT.

This scenario had been identified by Brown & Root prior to the Quadrex review and was under evaluation. The environmental qualification analysis was being undertaken at the time of the Quadrex review. This analysis has now been completed and it has been determined that the accident temperatures at the AFW pumps are within the pumps' qualification limits; thus, the accident does not pose a major concern with respect to the pump qualification.

In the same example, Quadrex refers again to the outside containment analysis discussed above and implies a lack of environmental information necessary to ensure equipment qualification. As discussed in the response to Quadrex Finding No. 4.6.2.1(a), the safety-related equipment necessary for the safe shutdown of the plant existing outside of containment and IVC has been isolated from the areas where high energy lines are routed. Consequently, the environmental qualification for this safety-related equipment is not based on potential harsh environments such as would be present during a postulated pipe rupture event.

The third Quadrex example in this finding discusses the operation time limit of HVAC equipment, and as such is not directly related to nuclear analysis. It implies that inappropriate closure rates may have been used in the design of HVAC equipment. This example is based on Quadrex Finding No. 4.4.2.4(w) 1/ concerning the operation of dampers during a tornado. The finding questions how quickly the dampers close to isolate the building. The dampers used at STP have a closure time of 0.25 seconds, which is adequate to isolate the building quickly and is typical of dampers used in other nuclear applications for similar service. In fact, the selection of these particular dampers was based on their previous qualification for this type of service.

The fourth example used by Quadrex in this finding reports that "inappropriate methods have been selected" but fails to identify any specific inadequacies. Therefore, it is impossible to respond to this example.

For the foregoing reaons, the above finding is erroneous and will not impact on plant licensability.

1/ Finding No. 4.4.2.4(w) was designated as presenting only a "Potential Problem" and thus is not addressed in this report.

QUADREX GENERIC FINDING NO. 3.1(j) - MOST SERIOUS FINDING

The following generic findings may have a serious impact on plant licensability:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

At STP, any design input which could not be verified as being the final value was identified as "preliminary." The preliminary status was maintained, for example, when the final verification required information from suppliers, qualification test results, operational test results, etc. Instead of being a deficiency, this process assured that any design input that could not be positively verified as being the final value was identified and carefully tracked until it achieved final status. On the other hand, a design input may have been finalized for a long time and still maintain a "preliminary" status because some documentation element has yet to be provided.

With regard to the Quadrex concerns about the Structural area expressed in the second paragraph of the finding, the Brown & Root procedure on design verification (STP-DC-015) permits the use of preliminary data up to the point just prior to STP fuel loading. This is an entirely acceptable procedural approach that is consistent with industry practice. Moreover, preliminary values were being finalized in the Structural area on a timely manner at the time of the Quadrex review.

It should also be noted that the practice of using assumed input loads in structural design is common, not only in the nuclear industry, but in other types of industrial design and construction. Construction planning dictates that the structure be erected as early as possible, and this necessitates the structural design being completed prior to a point where the remainder of the plant design has been fixed. Characteristically, conservative values are assumed for those loads that cannot be identified in their final form because such loads originate from a piece of electrical or mechanical equipment whose design parameters have not been fixed. ANSI N45.2.11 requires that a method be established to ensure that these assumptions are tracked and finalized at the appropriate time. This is accomplished in the Brown & Root system through the use of a specific form which is completed for each design document and which identifies the input sources. Input loads which have not been verified as being "final" are identified as "preliminary." By procedure, all of the design inputs classified as preliminary must be reclassified as being final at the earliest possible time, but no later than just prior to fuel loading. The Brown & Root system meets normal industry practice.

The contention in the third paragraph of the finding that final verification of equipment will occur after the equipment is delivered to the site is incorrect. Although in a few instances equipment has

been allowed to be supplied to the site without all the qualification documentation, this situation has occurred only in isolated cases and is not the normal procedure. Where this situation has occurred, the decision to allow the equipment on site was the result of an investigation of all aspects of the problem, such as potential construction delays, degree of confidence in the qualification, irreversibility of the decision, etc. These isolated instances have been reviewed. In each case, the decision to allow the equipment to be delivered was found to be preferable to holding shipment of the items.

With regard to the contention in the fourth paragraph of the finding that Brown & Root procedures do not contain standards for the minimum qualification of design verifiers, the procedures do state that a design verifier must be technically qualified to perform the review required. However, on some designs, only minimum knowledge and experience is required because of the simplicity of the design; in other cases, an extremely qualified and experienced individual with unique expertise is required because of the complexity of the subject. It would be virtually impossible, or at least extremely impractical, to draft qualification requirements for each level of design that requires verification. Instead, it is the responsibility of the Discipline Project Engineer to ensure that the person that is assigned as a design verifier is qualified for that task. Procedures require that each individual who performs as a design verifier must be nominated in writing to the Engineering Project Manager and the Design Quality Engineer, must have a resume of his technical qualifications in the project training records file for review, and must attend a training session for design verifiers. This training session emphasizes the professional responsibility that accompanies the design verifier assignment. Additionally, the design verifier, by procedure, is responsible to the Design Quality Engineer for the quality of his work. The verifier also signs a form which contains an endorsement by the Engineering Project Manager which ensures that the verifier is provided the proper amount of time and independence to complete the design verification process in an adequate fashion. The professional manner by which the design verification process is approached at Brown & Root obviates the necessity for specifically stating in procedures the minimum qualifications required for a design verifier.

The Quadrex finding also states that a higher error rate exists in the Brown & Root design verification than in other A/E firms. As discussed in the Brown & Root response to Finding No. 4.1.2.1(a), there is no evidence in support of this contention, and it is not true.

BROWN & ROOT RESPONSE 3.1(j) - CONT.

The Quadrex finding further states that the only evidence of a completed design verification is a signature, since Brown & Root does not require the use of design verification checklists. Apparently, Quadrex failed to review the procedure on design verification, or failed to understand the verification process. Engineering Procedure STP-DC-015 contains a list of the items which must be considered in verifying a design. The procedure also states that the signature of the design verifier on the review form is his professional certification that he has reviewed the design against the applicable items in the checklist and found them to be satisfied. At the time of the Quadrex review, the procedure did not require the design verifier to place a mark beside each item on a preprinted list to show that he had reviewed the item. Subsequent to the Quadrex review, however, such a checklist was included in the procedure to accommodate an HL&P request that this be done.

The last paragraph of the finding contends that evidence exists that errors have not been detected by the design verifier and cites Question C-16 as a reference. In the Quadrex assessment to the Brown & Root response to Question C-16, the same contention is made, but there is no supporting information offered. As discussed in the Brown & Root response to Finding No. 4.1.2.1(a), the Quadrex contention is erroneous.

Given the foregoing, it is evident that the above generic finding will not impact plant licensability.

QUADREX GENERIC FINDING NO. 3.2(k) - SERIOUS FINDING

The following generic findings appear to impact the generation of reliable power, but are not considered to be a serious threat to plant licensability:

(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."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The substantive allegations of this finding are contained in its last paragraph. They are: (1) that Brown & Root has not considered or assumed responsibility for HL&P power production needs in its design criteria; and (2) that the Quadrex observation of the plant model at Crestpark indicates that reliability, maintainability and similar considerations have been overlooked in the design, and appear to be compromising the maintainability and accessibility of the plant. Both allegations are erroneous.

The first allegation evidences a misunderstanding by Quadrex of the allocation of responsibilities between HL&P and Brown & Root with respect to the power production aspects of the design. HL&P has retained that responsibility, and Brown & Root could not assume it. Nevertheless, Brown & Root has kept as one of its prime design objectives that of enhancing the plant's ability to generate reliable power.

As an example of Brown & Root's dedication to enhancing reliability, in early 1975 Brown & Root and HL&P established the Nuclear Plant Reliability Data System and the Event System Analysis Program (ESAP). ESAP was conceived by Brown & Root as a multi-disciplinary effort that would analyze the plant systems beyond normal design review requirements. In the ESAP analyses, variations of possible equipment states were considered to determine the plant condition under both scheduled and abnormal events; ESAP had the capability of using Fault Tree analyses to postulate and analyze various failures. ESAP was used to analyze three events: loss of offsite power, plant startup/heat up, and plant shutdown/cooldown. Brown & Root was directed by HL&P to discontinue its work using ESAP in December 1977.

Brown & Root has continued to keep enhanced plant reliability as one of its primary design goals, and analyses of the type discussed above were scheduled to be extended to all major systems through Brown & Root's System Design Assurance Group. (See Brown & Root's response to Quadrex Generic Finding No. 3.1(e)). It should be noted, however, that enhancing the plant's ability to generate reliable power had to be balanced against all other objectives to arrive at a design that was an effective compromise between reliability, safety, and the other areas of technical concern. See Brown & Root's responses to Quadrex Finding Nos. 4.7.3.2(1) and 4.7.3.2(n). This balancing of the various design objectives was under the continuous review of HL&P power production, operation and engineering personnel.

With respect to the second allegation in the above finding, see Brown & Root responses to Quadrex Generic Finding Nos. 3.1(a), 3.1(c), 3.1(e), 3.1(g), 3.1(h) and 3.2(n) for discussions of how reliability, maintainability and similar considerations have been incorporated into the STP design.

From the foregoing, it is evident that the above finding is erroneous and will have no impact on the generation of reliable power by STP.

QUADREX GENERIC FINDING NO. 3.2(I) - SERIOUS FINDING

The following generic findings appear to impact the generation of reliable power, but are not considered to be a serious threat to plant licensability:

* * * *

(I) "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."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Plant symmetry is a desirable objective, and it was considered, and incorporated where possible, in the STP design. Although isolated examples of non-optimum arrangements (from a symmetry viewpoint) may be identified, those few instances do not indicate an ineffectual consideration of symmetry. Also, preservation of symmetry is only one of many objectives to be considered in the design.

With respect to the components cited in the finding, their arrangement was dictated by the Westinghouse TGX NSSS Standard Design Criteria, which establish requirements on the proximity of attachments to the primary system loops, the distances to valves, and the L/D ratios for accumulator piping. Therefore, any lack of symmetry on the arrangement of these components stems from Westinghouse's interface requirements and from physical and space limitations.

Accordingly, this finding is erroneous and the existence of non-symmetric arrangements of equipment will have no impact on the generation of reliable power.

QUADREX GENERIC FINDING NO. 3.2(m) - SERIOUS FINDING

The following generic findings appear to impact the generation of reliable power, but are not considered to be a serious threat to plant licensability:

* * * *

(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."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Quadrex makes two allegations in the finding. First, it claims that in some instances the valve design specifications did not specify closure rates; second, it alleges that transient analysis confirming valve opening and closing rates were not performed. Contrary to the first contention, all active mechanical valves have a closing rate specified. The generic identification number for each active mechanical valve includes a code letter that specifies that valve's closing rate. A simple review of the Valve Identificaton Guide reveals the closing rate for each mechanical valve. Furthermore, Paragraph 3.2.2.1(a) of the valve specifications for all motor operated valves also states the valve closing rate requirements. Those requirements were developed early in the project.

The second allegation that transient analyses were not performed to confirm the adequacy of the valve closing and opening rates is also incorrect. Brown & Root selected two critical systems, the Feedwater and the Circulating Water Systems, to perform transient analyses that verified valve closing rates. Brown & Root performed the analysis for the Circulating Water System, and NUS performed the analysis for the Feedwater System. Further confirmatory analyses were being planned at the time of the Quadrex review.

For these reasons, the above Quadrex finding is erroneous and will not impact the generation of reliable power at STP.

QUADREX GENERIC FINDING NO. 3.2(n) - SERIOUS FINDING

The following generic findings appear to impact the generation of reliable power, but are not considered to be a serious threat to plant licensability:

* * * *

(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 perform a system interaction analysis, has caused access space to be severely compromised."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Access provisions for maintenance, inspection and testing are based on the requirements provided by the Brown & Root SDDs, the NSSS vendor, other equipment vendors, and HL&P's directives. In addition, in 1975, Southwest Research Institute prepared for HL&P a document entitled: "Access and Design Considerations for In-Service Inspections." The criteria contained in this document were included and utilized in the preparation of the "In-Service Inspection Manual" U010MM001 issued in December 1976, and the In-Service Inspection TRD 4U010PQ007 effective August 1981. See also Brown & Root response to Quadrex Finding No. 4.8.2.2(j). Therefore, contrary to the above finding, there are established and documented requirements in the area of access provisions.

As indicated in the Brown & Root response to Quadrex Finding Nos. 4.5.2.2(e) and 4.7.3.2(n), the consideration of access for purposes of maintenance, in-service inspection and ALARA is one for which the total plant design must be taken into account so that the benefit of providing for access can be weighed against its impact on other design considerations. Indeed, the STP procedures require each design engineer not only to account for access in the initial design but also to consider the requirements of space, system function, equipment layout and plant availability. These requirements, balanced in each design, are subjected to a design review process which includes review by independent ISI and ALARA groups.

If one were to concentrate on a single design parameter, such as ISI or ALARA, in reviewing the design of a structure, it is very likely that one would determine that the design was not optimal with respect to that individual parameter. This is so because, as noted above, avery design must involve a compromise among a number of competing considerations. For each applicable design at STP, Brown & Root's ALARA and ISI groups have had an opportunity to express their concerns. Those concerns have been properly documented and are being appropriately resolved in light of all applicable design considerations.

Other Quadrex criticisms of ISI are contained in an extensive discussion at the end of Volume I of the Quadrex Report (see pages 4-92 through 4-104). Quadrex, however, made no findings in that section. With regard to the criticisms contained in that discussion, Brown & Root notes that until 1980, HL&P's ISI program was still under development and the access requirements for that program were not defined. Despite this lack of definition, from the early stages of the plant design, Brown & Root accounted for ISI access considerations through utilization of the Access Engineering Reference Manual. Access was provided (to the extent possible), by Brown & Root for those systems and components which were subject to the HL&P Pre-Service and In-Service Inspection (PSI and ISI) Programs, with HL&P responsible for the access program for the NSSS components and piping.

For welds within systems defined by the ASME Code, In-Service Inspection was required for a maximum of 50% of the non-exempt welds(except for 100% inspections on the welds in the Class 1 reactor coolant boundary). However, HL&P's program defining which 50% of the non-exempt welds were to be inspected was still under development. In late 1980, HL&P came to a working interface agreement with Brown & Root, pursuant to which access would be provided to 100% of the non-exempt welds, rather than the inspection requirement of 50%. In addition, this agreement led to the incorporation of revised ISI requirements, and set the stage for the issuance of the "In-Service Inspection" Technical Reference Document 4U010PQ007.

In the ISI discussions in Volume I of the Quadrex Report, several inferences are made to the lengthy access exception list contained in Appendix D of TRD 4U010PQ007. Although this list is lengthy, it is designed to be a comprehensive compilation of all exceptions to the TRD criteria.

These exceptions are largely the result of the following:

- The 1979 regulatory change which ended the exemptions from ISI requirements for certain systems (I&E. Bulletin No. 79-17).

- The aforementioned decision by HL&P to provide access to 100% of all non-exempt welds for the ISI systems instead of the inspection requirement of 50%.

- The STP pipe rupture design philosophy to concentrate the majority of all high energy systems inside containment.

- As noted below, the weld surface area requirement was increased in 1981 after much of the design and fabrication had been completed.

With regard to the Pipe Rupture Design factor listed above, reference should be made to the Brown & Root response to Quadrex Finding No. 4.5.3.1(a). In this response, Brown & Root describes the STP pipe rupture design philosophy of locating the majority of all high energy systems inside containment. This philosophy had many advantages, including:

1) allowing the early design of rupture restraints inside containment;

2) significantly reducing the need for rupture consideration outside of containment;

3) allowing the use of multi-system frames for rupture protection devices; and

4) allowing the system layout inside of containment to take place concurrent with the rupture evaluations.

The restraints placed inside containment to alleviate pipe rupture concerns do restrict somewhat ISI accessibility. To minimize this effect, Brown & Root, where necessary, provided for the inclusion of removable devices in various restraints. Utilization of these removable devices to increase accessibility while maintaining the majority of high energy lines inside containment was considered to be preferable to having high energy lines located throughout the plant.

Brown & Root further notes that the existence of a lengthy exception list to the ISI TRD does not mean that ISI cannot be performed. Rather, as a result of the exceptions, one simply cannot automatically assume that access in accordance with the TRD criteria has always been met and must take into account the fact that in certain areas access may be less than that called by by the ISI criteria. For

example, the weld area surface requirement was given to Brown & Root in 1975 by HL&P (based on a study by Southwest Research Institute) as 2T + 2 inches (where T is the pipe thickness). When the ISI TRD was issued in 1981, the weld area requirement was increased, at HL&P's request, to 2T + 4 inches or six inches, whichever is greater. Because much of the design and construction had already been completed at the time of this change, a number of welds could not meet the new access surface area requirements and had to be listed as exceptions to the new ISI TRD. However, the original surface area requirement should be sufficient to provide access for an ISI inspection, provided the exception is taken into consideration.

The Quadrex allegation about the access consequences of the decision to seismically support all equipment within the Mechanical-Electrical Auxiliary Building (MEAB) is discussed in the Brown & Root response to Quadrex Finding No. 4.7.3.2(o). As noted in Brown & Root's response to that finding, Quadrex's concern about this issue is a good example of the narrow review of a single design parameter without appreciation for the total design philosophy. At STP, the seismic support of all equipment in the MEAB makes it unnecessary to consider the interaction of non-seismic equipment with other safety related functions. The sacrifice in some access space is greatly outweighed by the advantages of a design that does not require interaction analysis at any point in the life of the plant, even if plant modifications are implemented in the future involving safety-related equipment.

From the foregoing, it is clear that the above finding is erroneous and will not impact on the reliable generation of power.

QUADREX GENERIC FINDING NO. 3.2(o) - SERIOUS FINDING

The following generic findings appear to impact the generation of reliable power, but are not considered to be a serious threat to plant licensability:

* * * *

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding to the extent that it is directed at Brown & Root. Neither pre-operational test requirements nor the resulting test provisions are within Brown & Root's scope of work; HL&P is wholly responsible for these areas.

Quadrex appears to consider a project level checklist or set of guidelines to be a "systematic" approach. Whether or not that view is correct, FSAR Section 14.1 establishes that it is HL&P, not Brown & Root, which is responsible for preparing the pre-operational and start-up test procedures which could have been used by Brown & Root to prepare checklists or project guidelines. Indeed, HL&P has undivided responsibility for the initial test program. Brown & Root's responsibility is for normal construction activities; this responsibility ceases when equipment and systems are released to the plant start-up test organization.

HL&P interfaced to some extent with Brown & Root in the pre-operational testing area through periodic meetings on start-up and pre-operational testing. Brown & Root supported HL&P's activities in these areas when and as requested by HL&P. Brown & Root's support activities in this area have been under the direct supervision of HL&P.

It is not incumbent upon Brown & Root to determine whether, as Quadrex alleges, there are shortcomings in the consideration and implementation of pre-operational test requirements and resultant test provisions. Nor is it Brown & Root's responsibility to ascertain whether such problems, if existing, will impact the generation of reliable power at STP.

QUADREX GENERIC FINDING NO. 3.2(p) - SERIOUS FINDING

The following generic findings appear to impact the generation of reliable power, but are not considered to be a serious threat to plant licensability:

* * * *

(p) "Local Temperature 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-31)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

Brown & Root had designed the plant with consideration for adequate ventilation in various cubicles to accommodate maintenance. HL&P, which will be responsible for carrying out maintenance activities, has approved all HVAC designs and the operational temperature conditions in which these temperatures are listed. Should the need arise to augment individual HVAC systems to facilitate maintenance in a particular area, the common industry practice is to use portable fans and, if necessary, temporary ducting to the affected area with appropriate filtration for contamination control.

Based on the above information, it is clear that the design of the HVAC systems is adequate to accommodate maintenance activities. Accordingly, the above finding will not impact the generation of reliable power at STP.

QUADREX GENERIC FINDING NO. 3.2(q) - SERIOUS FINDING

The following generic findings appear to impact the generation of reliable power, but are not considered to be a serious threat to plant licensability:

(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)."

BROWN & ROOT RESPONSE

Brown & Root disagrees with the above finding.

The above finding is premised on Quadrex's opinion that low allowable valve accelerations and end loads are a major factor in the number and size of piping supports. This opinion is incorrect. Brown & Root's analyses show that valve acceleration limits are rarely the limiting factor in the design of the STP piping systems. In those isolated instances where valve accelerations or end loads were found to be limiting conditions, Brown & Root initiated a review of the valve limits with the vendor, and, where feasible, increased the limits. However, because of the small number of these situations and due to the low seismic zone of STP, these limiting conditions were not a major factor in the design of piping systems.

The other Quadrex opinion in the finding is that seismic values used at STP were abnormally "low". This opinion is also mistaken, and is perhaps based on Quadrex's prior experience with higher seismic zone plants and/or plants utilizing a Boiling Water Reactor (BWR). For BWRs, sizeable hydrodynamic accelerations add to seismic accelerations, and thus present a major design consideration which results in higher valve acceleration values. These additional loads are not present in PWR plants such as STP. Consequently, the Brown & Root designation of acceleration values for valves and pumps for STP was correct and did not result in an overly restictive design.

For these reasons, the above finding is erroneous and will not impact the generation of reliable power at STP.