GRAND GULF UNIT 1

Independent Design Review

The following paragraphs describe Cygna's independent design review of Grand Gulf Unit 1. This description incorporates the scope of work as presented and amended during the NRC meeting on March 11, 1982.

CYGNA QUALIFICATIONS

Cygna has provided a broad range of consulting services to the nuclear industry since 1974. Over 40 nuclear facilities have employed Cygna's expertise, including work on pipe stress analysis, pipe support design and quality assurance evaluation. More specific experience relative to this independent design review is listed below:

- Dynamic, static and inelastic pipe stress analyses.
- Pipe support/restraint design.
- Field as-built data collection.
- Evaluation of hydrodynamic loads on piping and equipment.
- Redesign of equipment support structures.
- Stress analysis of the MARK I torus support during a LOCA.
- Systematic Evaluation Program (SEP) consultant.
- Analysis of piping systems for conformance to IE Bulletins 79-02, 79-13 and 79-14.
- Evaluation of operations quality assurance (QA) plans and implementation procedures.

- Evaluation of the QA programs, both engineering and construction, of a major subcontractor.

- Evaluation of a vendor QA control program.

In addition to being highly qualified to perform this review, Cygna also qualifies as an independent reviewer on the Grand Gulf project, as stated in Attachment 1.

SUMMARY OF WORK

The overall objective of this independent design review is to evaluate how well the design and design control processes on Grand Gulf Unit 1 performed under adverse conditions, such as during a major redesign effort. It is felt that a performance review of the design control procedures and a portion of the design process under these adverse conditions is a good measure of the quality of the overall plant design. Should this review show satisfactory performance, then it can be reasonably inferred that the overall plant design is also satisfactory.

To accomplish this objective, Cygna will perform the review in two parts, which might be called "horizontal" and "vertical." These will be described in more detail later; but, in essence, the horizontal review concentrates on the design control program while the vertical review looks at the design of a selected piping system. Cygna will focus this horizontal and vertical review on the major redesign effort resulting from the requirements of the BWR New Loads Adequacy Evaluation Program (NLAEP) which emerged when the final design of Grand Gulf Unit 1 was nearly completed.

The NLAEP required that three new loadings be considered: loss of coolant accident (LOCA) loads, annulus pressurization (AP) loads and safety relief valve (SRV) discharge loads. SRV loadings combined with the safe shutdown earthquake (SSE) will be the subject of the independent design review.

Cygna developed the following criteria for selecting a representative piping system for the vertical review:

- The system shall be Seismic Category I.

- The system shall be safety-related.

- The system or portion of the system shall be part of the reactor coolant pressure boundary.

- The system shall be diverse in equipment content (i.e., it should have piping, branch piping connections, supports, pumps, valves, etc.).

- The system shall require a maximum number of design interfaces (e.g., MP&L, A/E, NSSS, and vendor).

- The system shall be located in more than one building. (This is to ensure that the design complexities of routing piping from one building to another are addressed.)

- The system shall be one of high interest to the NRC (as indicated during initial discussion between MP&L and the NRC).

Based on the above criteria, Cygna has selected for review the following portions of the Residual Heat Removal (RHR) System, train "A" (see Figure 1):

- Pump discharge from pump nozzle to containment flued head through the heat exchangers.

- Piping between heat exchangers.

- Piping between containment and drywell flued heads.

- Piping between drywell flued head and RPV nozzle.

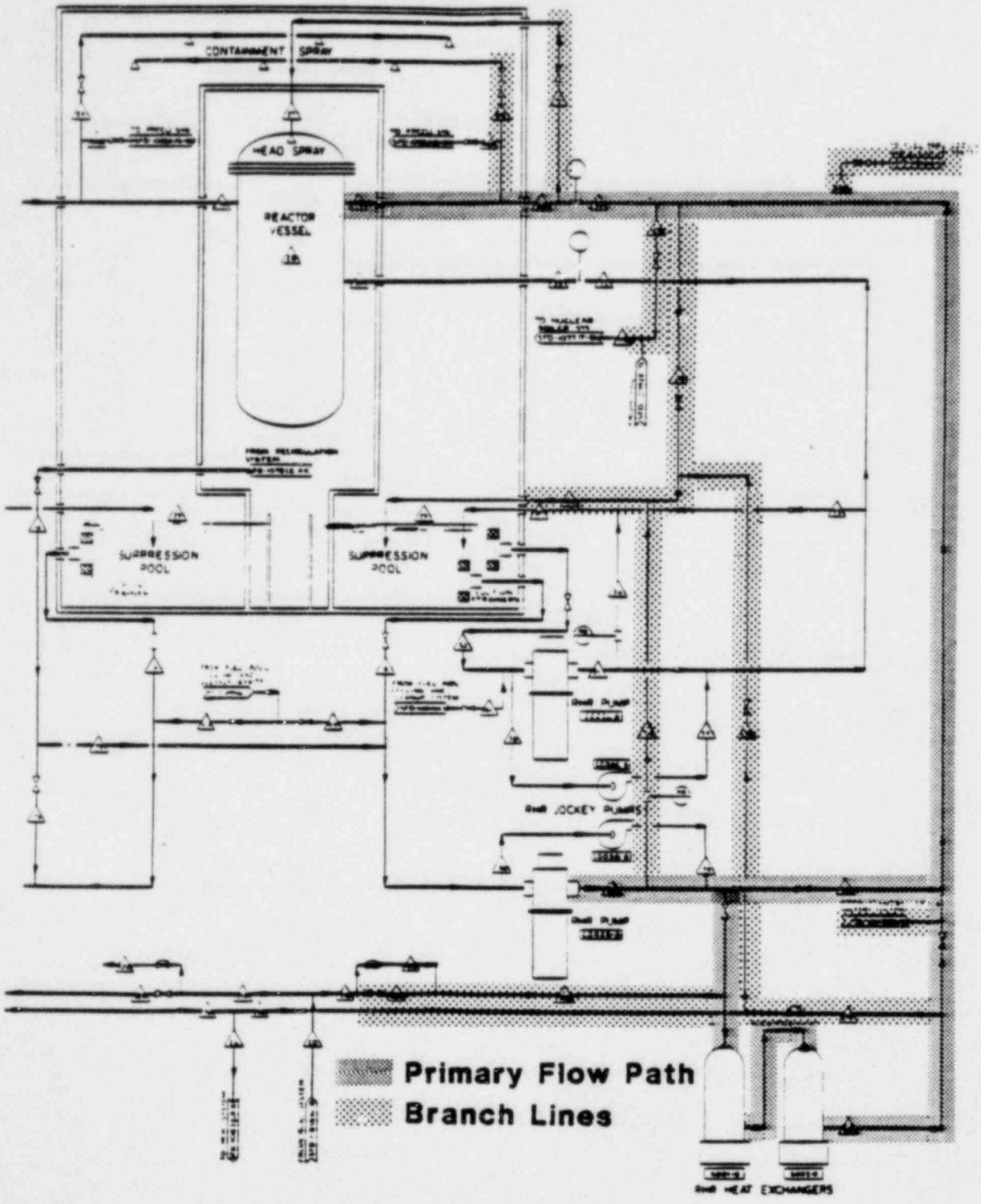


FIGURE 1

TRAIN "A" FLOW DIAGRAM

Having selected a major redesign effort, NLAEP, a specific loading combination, SRV & SSE, and a representative piping system, PHR train "A," the work process to be reviewed is as shown in Figure 2. That process is as follows:

- GE develops a New Loads definition report which is transmitted to Bechtel. This report contains loadings due to a loss-of-coolant accident (LOCA), various combinations of safety relief valve (SRV) loadings and annulus pressurization (AP) loadings.

- Bechtel distributes the load definition report to the various engineering groups for their use.

- The Civil/Structural Group develops a mathematical model of the containment building structures to which the SRV loadings are applied.

- This mathematical model is used to attenuate the loads throughout the structure, thus creating amplified response spectra (ARS) and displacements which are used for system designs.

- The ARS and displacements are transmitted to the Plant Design Group.

- The Plant Design Group performs pipe stress analyses and develops pipe support designs.

- The results from the pipe stress analyses and pipe support design are reflected on system drawings and support drawings. System loadings are transmitted to vendors (via specifications) and to the NSSS supplier.

Figure 2 also defines the boundaries of the horizontal and vertical reviews. The horizontal review, which is described in more detail in the QA Activities section, covers the review of the Bechtel Quality Assurance Program in the area of design control and the implementation of the design control procedures. Included in this horizontal review is a confirmation that the correct (final) loading data was utilized in the piping analysis. To confirm this, a technical reviewer will accompany the QA reviewer during their implementation audit of internal and external interface procedures. The vertical review is discussed

later in the Technical Activites section. It is a detailed technical review of one piping system for SRV loadings to ensure conformance with the project design criteria and normal industry practice. An as-built verification of the piping supports along the main flow path is a part of the vertical review.

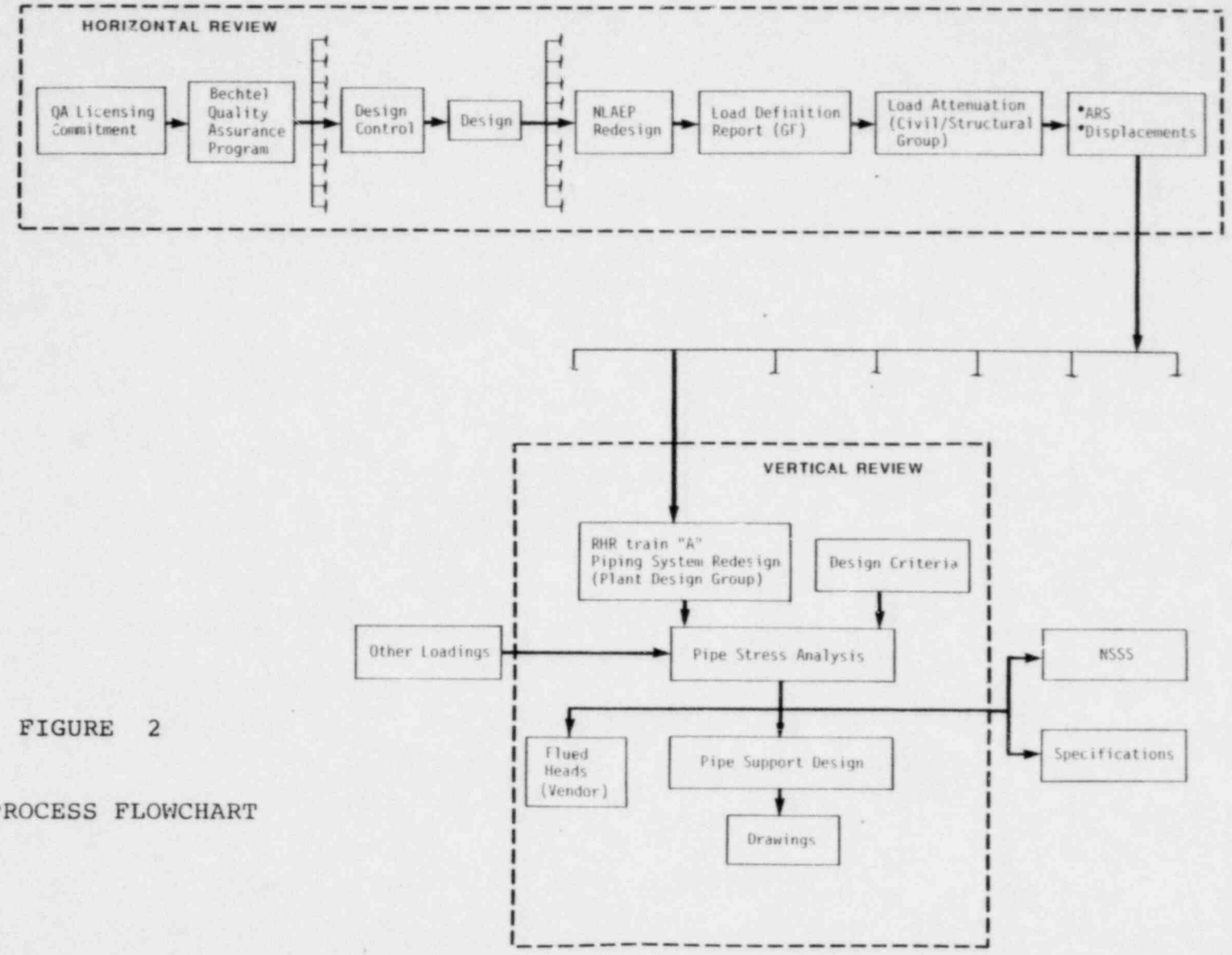


FIGURE 2

WORK PROCESS FLOWCHART

PROJECT APPROACH

Figure 3 shows Cygna's organization for this project. This organization is divided into three functional tiers consisting of the project team, the senior review team and in-house consultants. The project team is composed of the principal-in-charge, project manager and lead engineers in the areas of quality assurance, technical review and as-built verification. This team, which will draw upon the in-house consultants as necessary, is responsible for the day-to-day work performance. The senior review team consists of Cygna executives with extensive experience in areas directly applicable to this independent design review. Mr. Kacyra, President of Cygna Corporation, brings to bear experience in structural design and dynamic analysis. Mr. Ward, Chief Executive Officer of Cygna Energy Services, provides a knowledge of systems design and regulatory evolution. Mr. Trainor, Vice President, Quality Assurance, offers extensive experience in the quality assurance arena. This team, with as-needed assistance from the in-house consultants listed, will review the work performed by the project team and will pass final judgement on the impact of any potential findings.

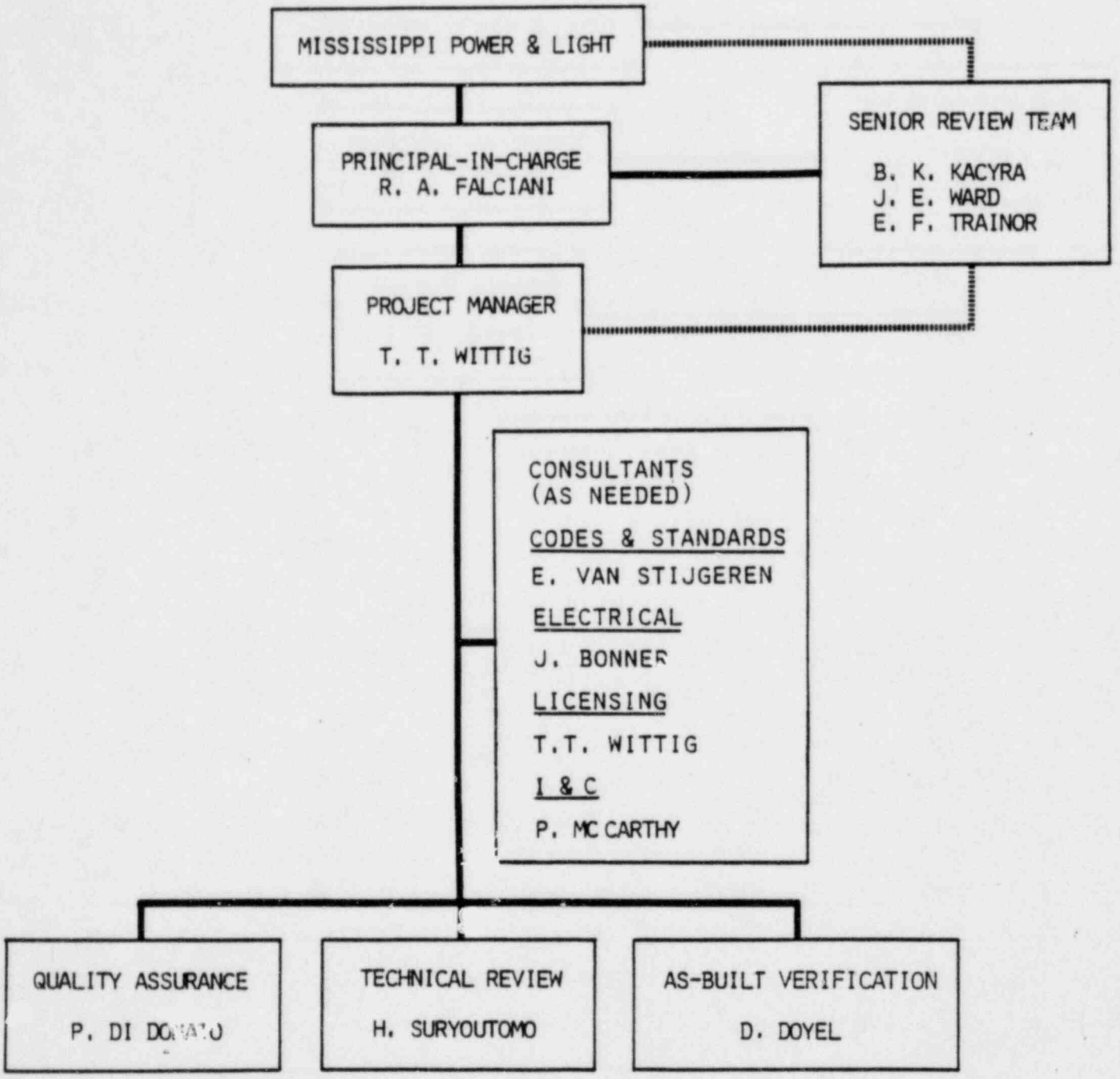


FIGURE 3

PROJECT ORGANIZATION

The review process, showing the three-tier approach and an overview of the decision process, is flowcharted in Figure 4. Throughout this review process, items identified by the project team as having potential impact on plant safety will be brought to the immediate attention of the senior review team. This is to ensure that Mississippi Power and Light will receive timely notification of those items concluded to have a definite potential for impacting plant safety.

The basic steps involved in the review process are as follows:

Step 1: Collect Documents.

Step 2: Develop Work Instructions. These instructions will include standard forms, design criteria and checklists to aid and guide the reviewers.

Step 3: Perform QA and Technical Reviews. During this step, the review teams will record the documents reviewed and identify significant conservatisms.

Step 4: Identify Potential Findings. The technical and QA review teams will identify potential findings in the design or design control process and record the finding. This preliminary record will contain the following (as a minimum):

- Potential finding number (QA - 1000 to 1999, technical - 2000 to 2999).
- Description of potential finding.
- Documents reviewed (relative to the finding).
- Extent of potential finding.
- Evaluation of impact on design.

Step 5: Project Team Review. Lead members of the project team will review the finding for accuracy and completeness, and then evaluate the potential safety

impact. In order to complete this evaluation, the project team may gather more data to either clarify a question or better assess the extent of the finding. Simplified analyses may also be performed.

Step 6: Record Project Team Evaluation. Upon completing their review of the potential finding, the project team will record the following:

- Description of additional work done, if any, to supplement the initial review.
- Assessment of extent (qualitatively on a 1 to 4 scale, plus a narrative).
- Evaluation of impact on plant safety (qualitatively on a 1 to 4 scale, plus a narrative).
- Considering the extent and safety impact, assess the significance of the potential finding to the overall plant design (qualitatively on a 1 to 4 scale plus a narrative).

The result of this review will be a preliminary review package for each finding, which will be presented to the senior review team.

Step 7: Senior Review Team. The senior review team, assisted by the team of in-house consultants, will check the preliminary review package for all potential findings. This review will concentrate on completeness, accuracy and potential impact on plant safety. Based on their assessment of the preliminary review package, the senior review team may do <u>one</u> of the following:

- Direct the project review team to perform more work, such as clarifying data, extending the review or performing limited independent analyses.

- Determine that the potential finding has insignificant impact on plant safety.

- Notify MP&L that a finding may have potential impact on plant but requires extensive review, beyond the current work scope and budget, to reach a conclusion.

- Notify MP&L and the NRC that a finding has a definite potential impact on plant safety.

The result of this senior level review will be a final review package for each finding which will be included in the draft report.

The senior review team will also evaluate the collective impact of potential findings that are concluded to have insignificant safety consequences.

Step 8: Draft Report. The results of the three-tier review will be recorded in the draft report, which will be sent to both MP&L and the NRC. As a minimum, the report will contain the following:

- Record of the documents reviewed.

- Review checklists.

- Description of significant conservatisms identified.

- Final review package for each potential finding, including a description of the finding and its final disposition.

- Overall assessment of Bechtel's QA Program in the area of design control.

- Assessment of Bechtel's implementation of design control procedures for the selected scope of review.

- Assessment of the quality of the overall plant design as inferred by the results of this independent design review.

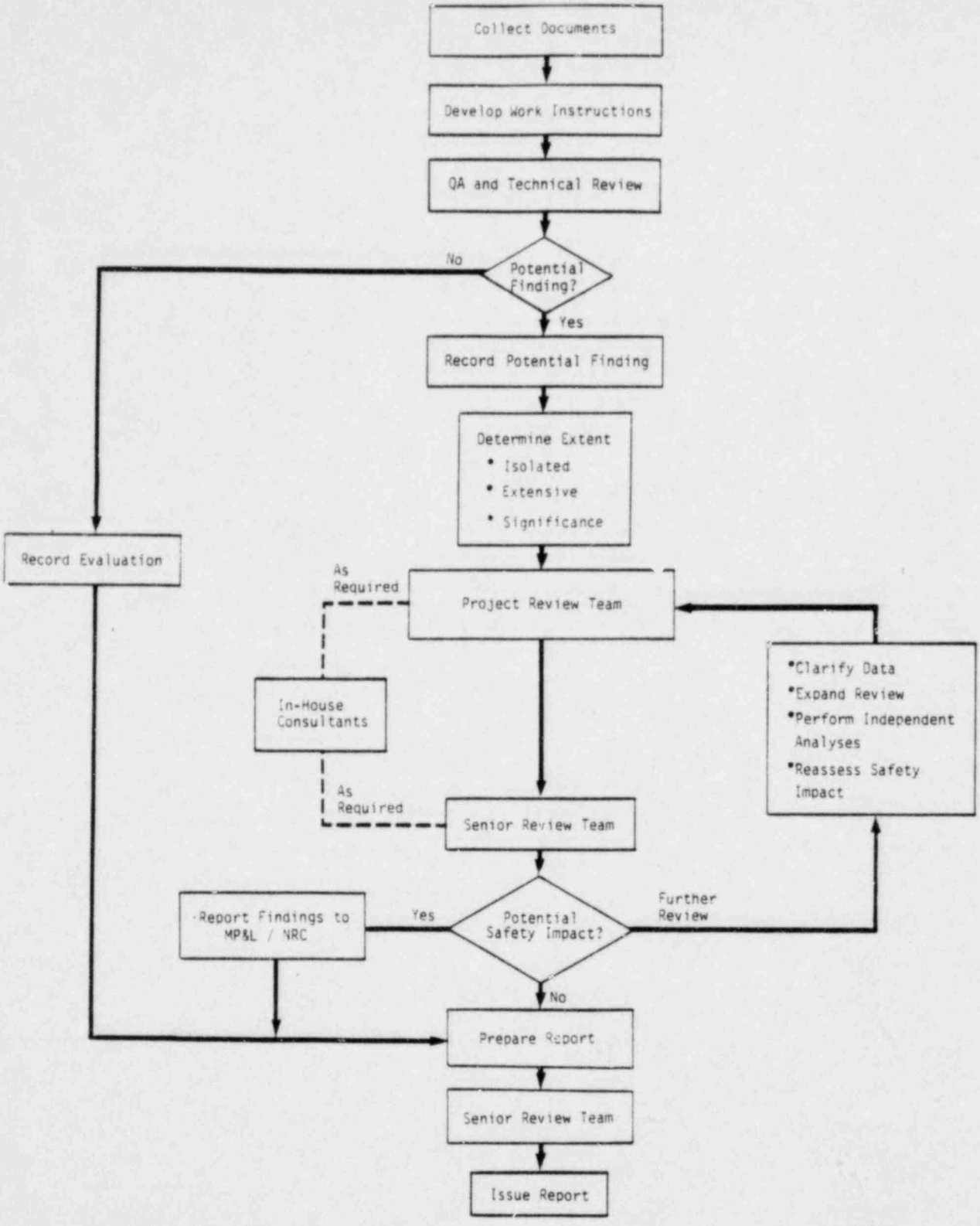


FIGURE 4

PROJECT REVIEW FLOWCHART

QUALITY ASSURANCE REVIEW

The Quality Assurance review is the horizontal look at the design control process. This QA review will be of Bechtel's Quality Assurance Program as related to the design of piping systems. Key elements to be reviewed are:

- Design input documents.
- Design analyses control.
- Drawing control.
- Specification control.
- Internal and external interface control.
- Design verification.
- Document control (controlled documents), including revisions.
- Design change control.
- Corrective action.
- Internal audits and surveillances.

In addition to reviewing Bechtel's QA program for adequacy as compared to industry standards, Cygna will assess the implementation of the design control procedures by auditing the documentation related to the redesign of the RHR system, train "A," due to the BWR New Loads Adequacy Evaluation Program requirements.

The program evaluation and implementation audit are described further in the following paragraphs.

A. Quality Assurance Program Evaluation

The Bechtel QA Program documentation will be reviewed to assess how well it satisfies the Grand Gulf Unit 1 licensing commitments. It will also be compared to industry standards, such as the Standard Review Plan. This evaluation will be accomplished by first obtaining all the necessary quality

program/procedural documents from Bechtel and then developing a matrix cross-referencing the key control elements to the Bechtel design control procedural system. Based upon a preliminary assessment of the Bechtel Quality Assurance Program appropriate portions of the following Bechtel documents will be used to develop the matrix:

- Nuclear Quality Assurance Manual
- Bechtel Quality Assurance Manual - ASME III, Division 1
- Project Engineering and Procedures Manual
- Quality Assurance Department Procedures Manual

Other applicable documentation will also be utilized to guide this review of the quality assurance program, such as the QA portion of reports developed during the ongoing Independent Design Review of the San Onofre Project and the NRC LCVIP inspection reports on Grand Gulf Unit 1.

B. Implementation Evaluation

An integral part of the independent quality assurance evaluation is a review of the implementation of design control procedures. This will be done by auditing selected documentation throughout the horizontal and vertical pathways shown in Figure 2. As a minimum, the following design documentation will be reviewed:

- The transfer of applicable load definition data from GE to Bechtel and within Bechtel. The purpose of this task is to ensure that the final load data was utilized in the design of the RHR, train "A," piping system.
- A sampling of the load attenuation calculations performed by Bechtel's Civil/Structural Group to also ensure that the final load data was utilized.
- Ensure that computer codes utilized by the Civil/ Structural Group have been verified in accordance with QA procedures.

- A sampling of design documentation in the Plant Design Group.

- A sampling of specifications to ensure that the final load data developed by the Plant Design Group was incorporated in the specification.

Cygna will develop a plan to ensure that the Bechtel program for controlling the key design control elements has been satisfactorily implemented. This plan will include a review of the documentation discussed above. Specific activities involved in the implementation evaluation are as follows:

1. Develop an implementation audit checklist. The checklist is designed to focus the audit activities towards key areas of the implementation process. The checklist will contain key design control element attributes (questions derived from Bechtel procedural commitments to be reviewed during the audit). Emphasis will be placed on developing attributes pertaining to activities where, if not properly implemented, would result in the greatest impact on quality. A checklist will serve the purpose of ensuring depth and comprehensive coverage of the audit. It is intended to be utilized only as a guide during the audit and will not restrict the audit investigation. To provide further audit continuity, the checklist will be prepared by an individual who will also participate in the audit. This will ensure that the audit is performed in accordance with both the content and intent of the checklist.

2. Conduct an implementation audit at the Bechtel offices in Gaithersburg, Maryland. This audit will concentrate on the items contained in the audit checklist and will be structured to identify weaknesses, assess their extent and evaluate their impact on plant safety. During this phase, the quality assurance team will be accompanied by a technical representative who will review the design flow with respect to the transfer of data across interfaces. The audit will be performed by qualified QA personnel who will:

   a. verify by examination and evaluation of objective evidence that the established design control program has been implemented;

b. assess the degree of implementation;

c. identify the impact of failures to implement the quality program.

Cygna will identify any findings during the course of the QA program review and implementation evaluation efforts which may have occurred due to the following conditions:

- Omissions in the quality program with respect to the key design control elements identified earlier.

- Implementation is not in accordance with the documented quality assurance program.

The findings will be reported in sufficient detail to assure that corrective action can be effectively implemented.

All findings will be reviewed by both the project team and the senior review team to assess their accuracy and completeness. As a part of their overview process, findings which individually have no impact on plant safety are assessed collectively to evaluate their cumulative effect on plant safety.

TECHNICAL REVIEW

The vertical portion of the independent design review involves a technical review of the design of a selected system. As discussed previously, the selected system is the RHR, train "A," piping from the RHR pump to the reactor vessel nozzle (i.e., four piping calculations).

The objective of the technical portion of this review is to perform an assessment of pipe stress and support calculations to insure correctness with respect to applicable code requirements and industry standards. The vertical review will also concentrate on one loading combination containing SRV(ADS) plus SSE load cases. Other loading combinations will be reviewed only for their reasonableness. In addition, an as-built review will be performed to insure pipe supports are installed in accordance with the intent of the design drawings. This review applies to large pipe only (2-1/2" and up) and excludes instrumentation tubing.

The vertical review includes a detailed review of criteria documents, a pipe stress analysis review, a pipe support design review and an as-built verification of pipe supports.

A. Detailed Review of Criteria Documents

In order to obtain an independe t assessment of the methodologies and approaches implemented in the piping analyses performed by Bechtel, the Cygna team will review the applicable design criteria documents. Based on Cygna's own expertise in piping design and analysis, we will then determine the validity of the criteria encountered. As a minimum, the appropriate sections of the following documents will be reviewed:

- Design Specification for Nuclear Piping Systems (9645-M-220.0)
- Design Specification for Hangers and Supports, Nuclear Service (9645-M-300.2)
- Field Fabrication and Installation of Nuclear Service Piping (9645-M-204.0)
- Criteria for Hanger Installation (9645-MS-16)
- Compensation Allowances for Piping Misalignment (9645-MS-21)

The above documents will form a basis for the development of checklists to guide the technical reviewers. These checklists will contain key design elements derived both from the design criteria documents and from normal practice, such as, loading combinations, stress allowables, code classifications, system requirements, operating conditions, verified codes, input loadings, damping values, required stiffnesses, allowable component accelerations and system boundaries. The use of these checklists will permit a qualitative, comprehensive evaluation of the technical adequacy.

B. Pipe Stress Analysis Review Activities

The technical review of the four stress problems will consist of the following activities:

1. Input data check;

2. Piping model check;

3. Review of all stress related calculations performed;

4. Review of reports and conclusions.

Each of the above four piping review activities are described in detail below.

1. Input Data Check

Cygna will perform a check of the piping analysis to ensure that data was properly input. The development of the input data itself will not be checked; however, the Cygna review team will check the input for general conformity to industry standards. As a minimum the following input data will be considered:

- Internal piping pressure
- Thermal load cases
- System operations modes
- Seismic spectra and anchor movements
- SRV spectra and anchor movements
- Other applicable SRV loading conditions

2. Piping Model Check

Using the criteria and operating conditions established above, the Cygna review team will obtain the applicable piping isometrics (latest revisions) and will perform the detailed check of the piping models developed by the Bechtel stress group. During this effort Cygna will pay

particular attention to the following items as a minimum:

- Piping geometry
- Piping section properties
- Support and restraint types and location
- Fittings, nozzles and valves
- Operating conditions
- System boundaries and classification
- Other considerations such as modal spacing and support stiffness

3. Review of Stress Related Calculations

During the stress analysis effort, numerous related calculations are performed. These calculations will be subject to a detailed review by the Cygna team. Some of these calculations are identified below:

- Stress intensification factors for weldolets
- Flow impact loads at elbows
- Pool swell impact loading on piping
- Seismic anchor movements
- Valve natural frequency check
- Support, restraint and penetration load summaries
- Flued head reports (by vendor)

4. Review of Reports and Conclusions

Upon completion of the reviews of the above indicated areas, the Cygna team will perform a detailed review of

the results and conclusions made by the Bechtel stress group. The basis for this evaluation will be a careful study of design and stress reports issued to date. As a minimum, particular attention will be given to the following items:

- Load cases considered in analyses
- Load combinations summarized
- Pipe stress code check
- Nozzle reactions and valve acceleration check

C. Pipe Support Design Activities

The technical review of selected pipe supports and restraints for the four stress calculations will consist of the following activities:

1. Review of the input data and load combinations considered.

2. Review of all design calculations performed.

3. Review of drawings issued.

This review applies only to supports and restraints on the primary flow path (as identified under the piping scope) from the RHR pump to the RPV nozzle. Each of the pipe support review activities are described in detail below.

1. Review of Input Data

The Cygna review team will take a close look at the support guidance generated by the Bechtel stress group for the pipe support group. Based on Cygna's own experience, it is felt that this interface requires attention. Some items to be reviewed in detail are:

- Support loads generated for all essential load cases
- Support types and locations

- Piping deflections for all essential load cases

2. Review of Design Calculations

Using the criteria and support guidance established above, the Cygna review team will review the calculations performed by the Bechtel pipe support group. For those supports and restraints on the primary flow path, Cygna will check the calculations in detail paying particular attention to:

- Support stiffness
- Weld calculations
- Stress allowables
- Vendor allowables for catalog hardware
- Proper modeling for computerized calculations
- Expansion bolt allowables and base plate flexibility

3. Review of Drawings

Since it is essential that correct drawings are forwarded to the site, Cygna will closely compare the analytical results of the overall piping design process with the support drawings produced. Consequently, the Cygna team will review the support drawings to insure that the intent of the stress analysis and pipe support design were met. Therefore, the following information will be checked on the drawings as a minimum:

- Proper type, orientation and location specified
- Proper clearances specified
- Proper structural and weld data
- Proper component sizes

D. As-Built Review of Pipe Supports

The purpose of this review is to insure the pipe supports and restraints will perform their intended functions in the installed condition. To accomplish this task, the Cygna review team will consider the overall assembly from a functionality vantage point rather than inspecting detailed individual parts and components. Therefore, the following review activities will be done as a minimum:

- Check approximate location and orientation with respect to the piping system
- Check the type, size and adjustment of components such as springs and snubbers
- Check approximate dimensions of critical members of the support assembly
- Check miscellaneous considerations such as clearance between pipe and restraint steel and gaps between baseplates and concrete surfaces.

PROJECT SCHEDULE

The project schedule is shown in Figure 5. It extends approximately ten weeks at which time a draft report will be issued concurrently to MP&L and the NRC. A status report will also be produced about one week prior to fuel load which is presently scheduled for April 23, 1982.

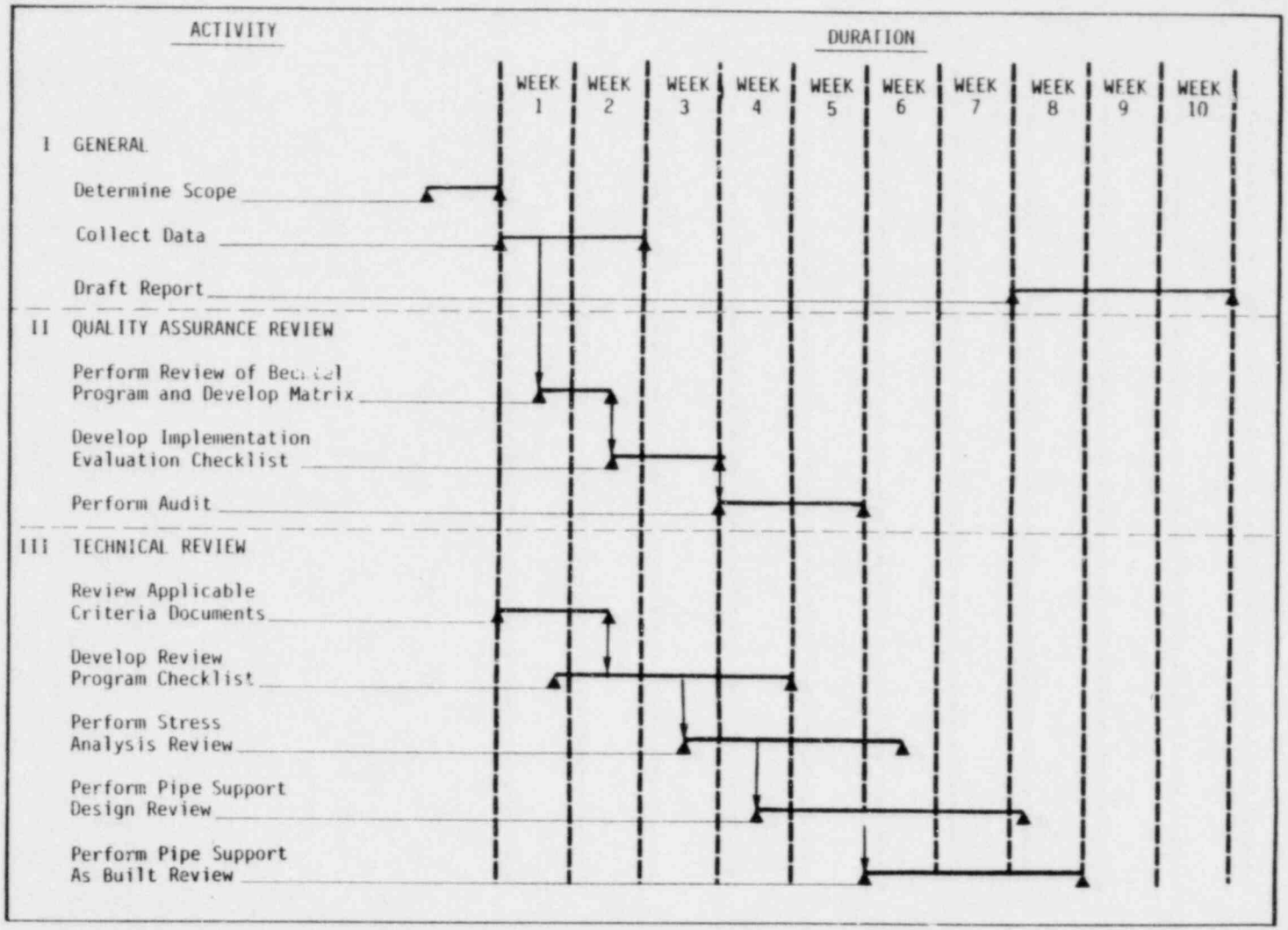


FIGURE 5 - PROJECT SCHEDULE

CYGNA

ENERGY SERVICES

GRAND GULF UNIT 1

INDEPENDENT DESIGN REVIEW

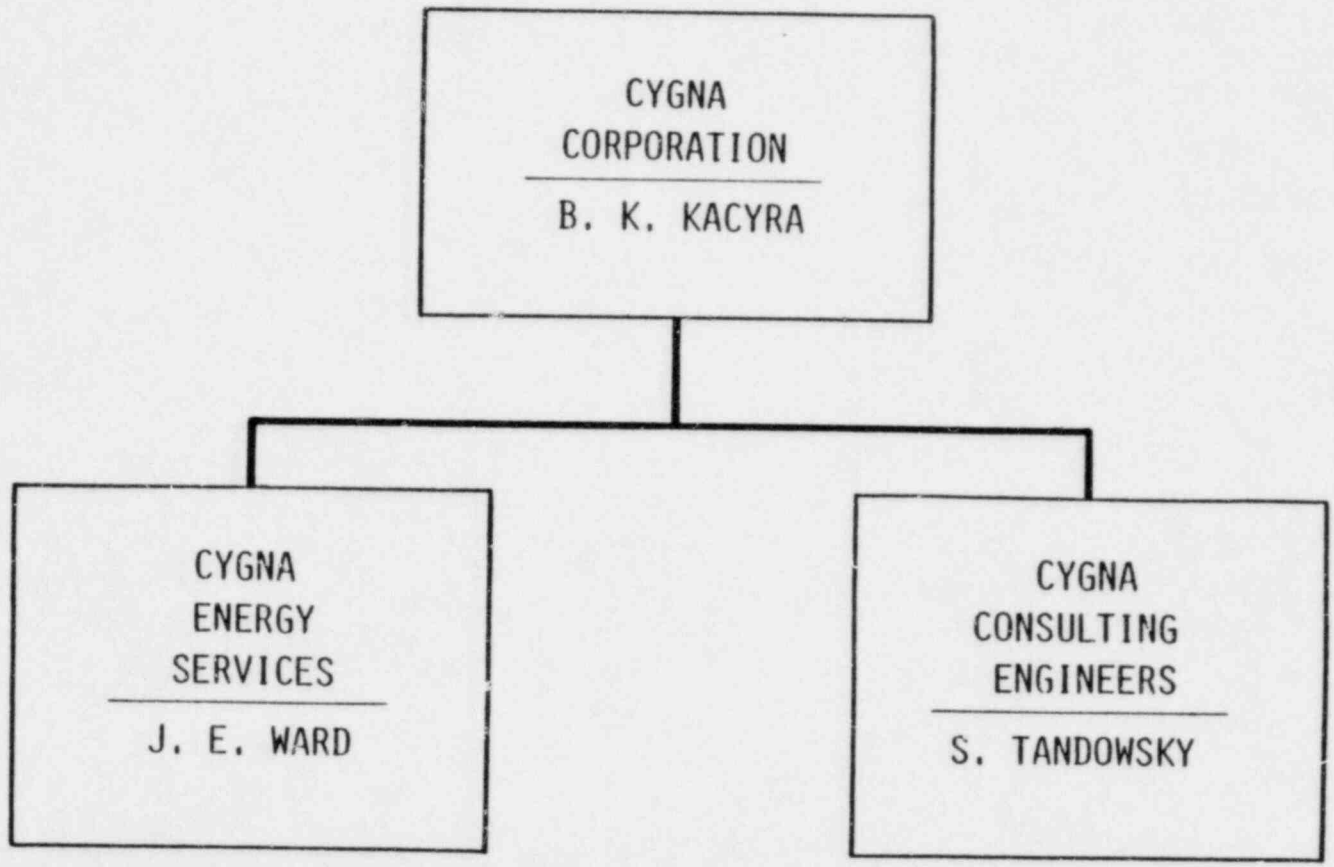
CYGNA ENERGY SERVICES

Cygna Presentation

• INTRODUCTION	J. WARD
– ORGANIZATION	
– QUALIFICATIONS	
• REVIEW ACTIVITIES	
– PROJECT OVERVIEW	R. FALCIANI
- QUALITY ASSURANCE EVALUATION	G. TRAINOR
- TECHNICAL REVIEW	E. VAN STIJGEREN
• SCHEDULE	T. WITTIG

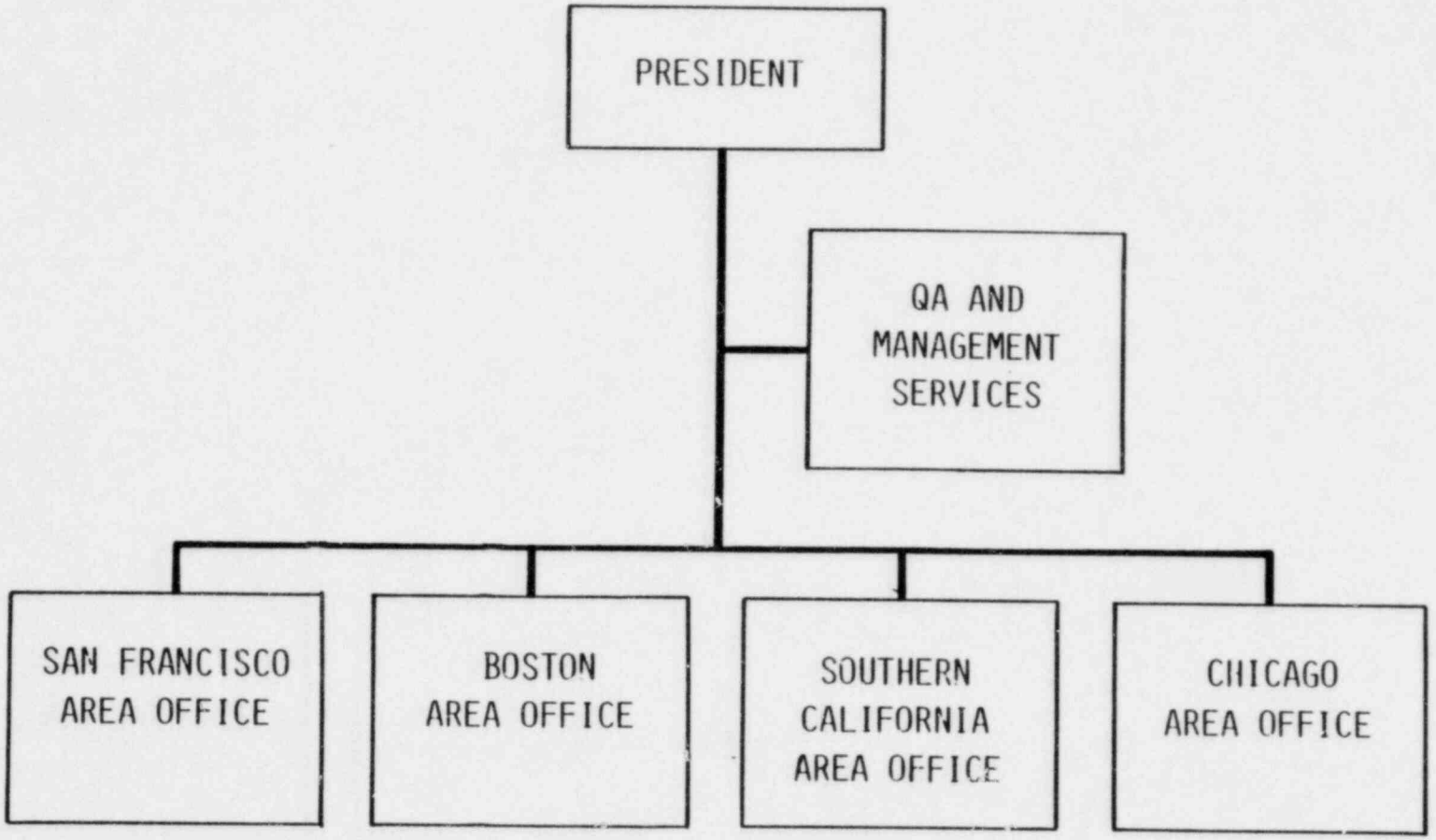
CYGNA ENERGY SERVICES

Company Organization



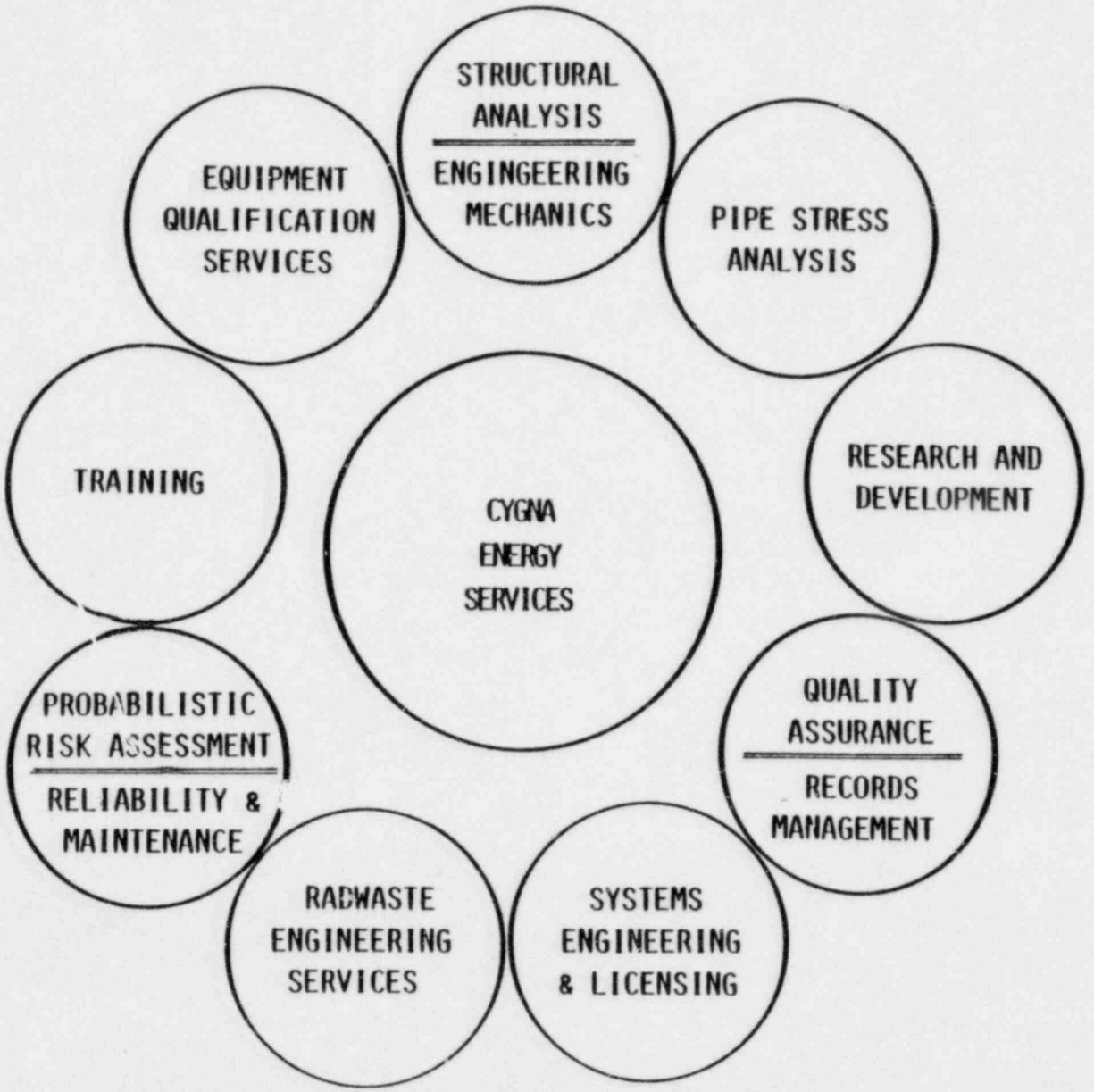
CYGNA ENERGY SERVICES

Cygna Energy Services Organization



CYGNA ENERGY SERVICES

Services Offered



CYGNA ENERGY SERVICES

Plants

PWR	BWR
• ARKANSAS UNITS 1 & 2	• HUMBOLDT BAY UNIT 3
• PILGRIM UNIT 2	• LA SALLE UNITS 1 & 2
• YANKEE ROWE	• SUSQUEHANNA UNITS 1 & 2
• TROJAN	• MILLSTONE UNIT 1
• MAINE YANKEE	• HATCH UNITS 1 & 2
• SURRY UNITS 1 & 2	• PEACH BOTTOM UNITS 2 & 3
• SOUTH TEXAS UNITS 1 & 2	• SHOREHAM
• PRAIRIE ISLAND UNITS 1 & 2	• HOPE CREEK UNITS 1 & 2
• PALO VERDE UNITS 1, 2, & 3	• VERMONT YANKEE
• KO-RI 5 & 6	• LIMERICK UNITS 1 & 2
• MAANSHAN 1 & 2	• KUOSHENG 1 & 2
• MIDLAND	• JAMES A. FITZPATRICK
• ROBERT E. GINNA	• PILGRIM UNIT 1

CYGNA ENERGY SERVICES

Pipe Stress Analysis & Pipe Support Design

HUMBOLDT BAY 3	YANKEE ROWE	SUSQUEHANNA 1 & 2
HOPE CREEK 1 & 2	LA SALLE 1 & 2	PEACH BOTTOM 2 & 3
LIMERICK 1 & 2	PILGRIM 1 & 2	ARKANSAS ONE 1 & 2
MAINE YANKEE	VERMONT YANKEE	

- DYNAMIC, STATIC AND INELASTIC PIPE STRESS ANALYSIS
- PIPE SUPPORT AND RESTRAINT DESIGN
- PIPE RUPTURE RESTRAINT DESIGN
- FIELD AS-BUILT DATA COLLECTION

CYGNA ENERGY SERVICES

Related BWR Experience(Hydrodynamic Loads)

LA SALLE

- PIPE STRESS ANALYSIS OF THE CRD SYSTEM
- PIPE SUPPORT DESIGN FOR THE CRD SYSTEM

SUSQUEHANNA

- EVALUATION OF HYDRODYNAMIC LOADS ON PIPING AND EQUIPMENT
- REDESIGN OF EQUIPMENT SUPPORT STRUCTURES

MARK I

STRESS ANALYSIS OF THE TORUS SUPPORT DURING LOCA

CYGNA ENERGY SERVICES

Evaluation Of Structures, Piping & Equipment

YANKEE ROWE

- SYSTEMATIC EVALUATION PROGRAM (SEP) CONSULTANT
- STRUCTURAL EVALUATION
  - REACTOR SUPPORT STRUCTURE
  - VAPOR CONTAINMENT
  - FUEL POOL REDESIGNS
  - PRIMARY PIPING LOOP
- ANALYSIS OF PIPING SYSTEMS FOR CONFORMANCE TO IE BULLETINS 79-02, 79-13, AND 79-14

CYGNA ENERGY SERVICES

Quality Assurance

SOUTH TEXAS

- EVALUATED THE OPERATIONS QA PLAN AND IMPLEMENTATION PROCEDURES
- EVALUATED THE VENDOR CONTROL PROGRAM

SHOREHAM

- EVALUATED THE QA PROGRAMS, ENGINEERING AND CONSTRUCTION, OF A MAJOR SUBCONTRACTOR

PILGRIM 1

- DEVELOPED POTENTIAL COURSES OF ACTION ADDRESSING CONCERNS RAISED BY TMI
- EVALUATED OPERATIONS QA PROGRAM

PRAIRIE ISLAND

- EVALUATED OPERATIONS QA PROGRAM
- EVALUATED MATERIALS MANAGEMENT SYSTEM

ARKANSAS 1 & 2

- EVALUATED THE IMPLEMENTATION OF THE SUBCONTRACTORS QA PROGRAM AT THE SITE

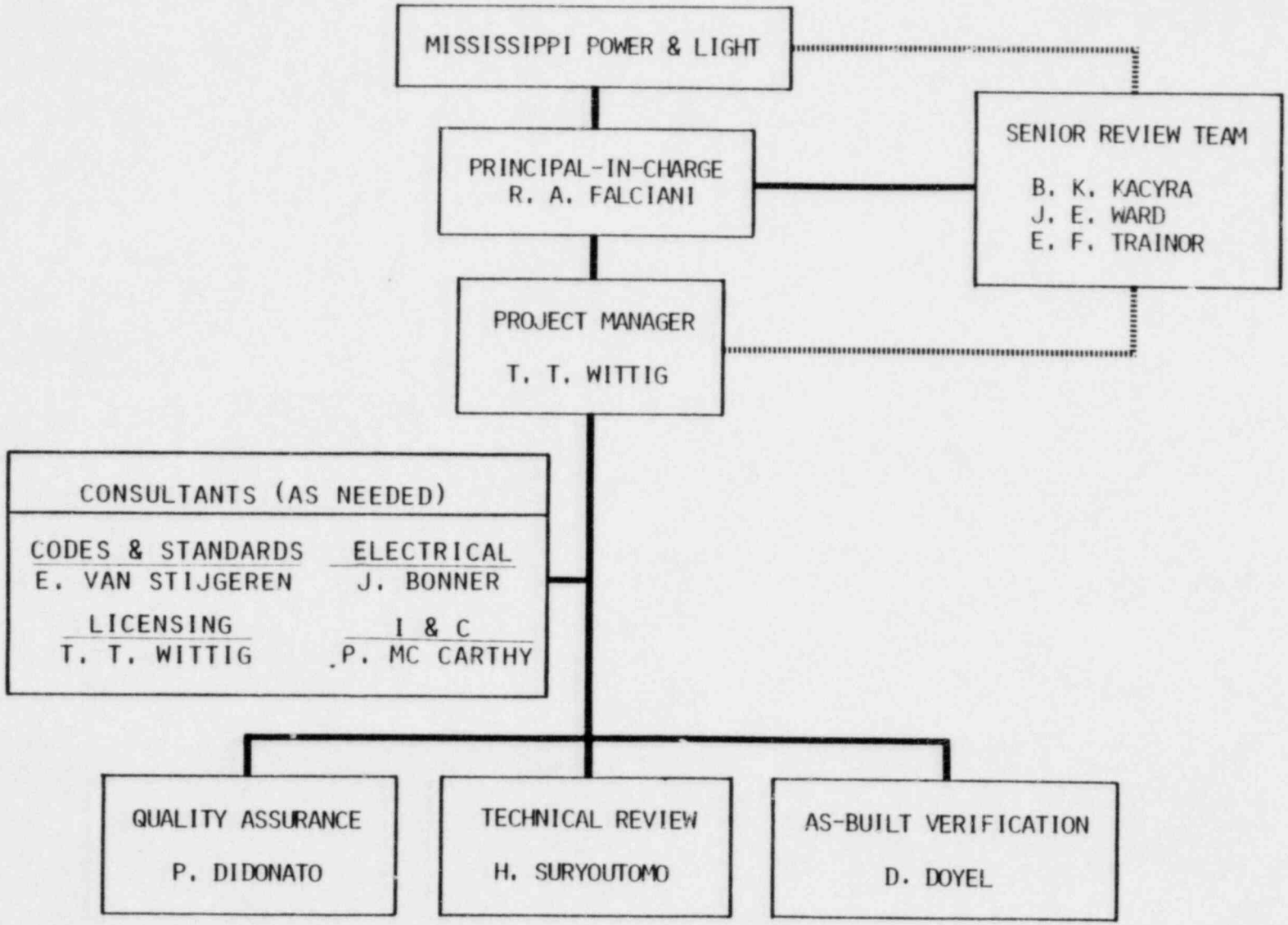
CYGNA ENERGY SERVICES

Project Overview

- OBJECTIVES
- PROJECT ORGANIZATION
- PROJECT APPROACH

CYGNA ENERGY SERVICES

Project Organization



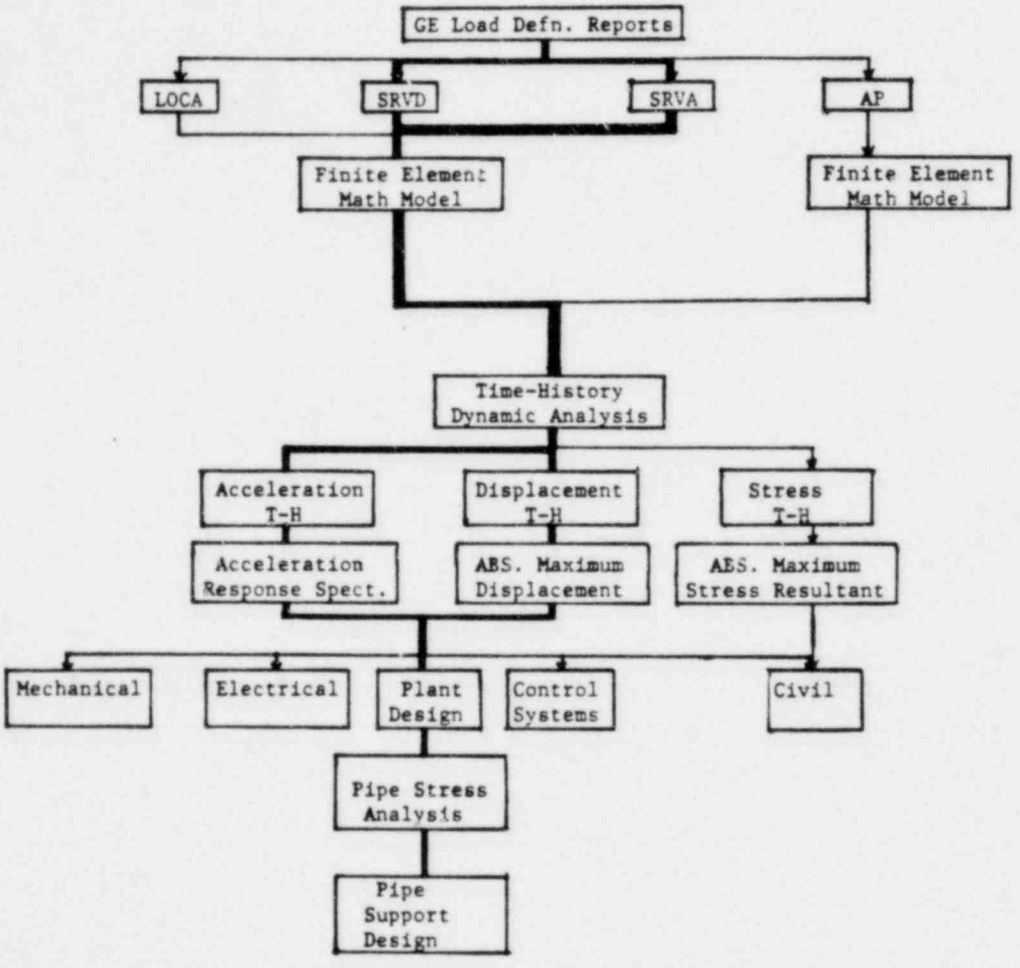
CYGNA ENERGY SERVICES

Objectives

- EVALUATE THE BECHTEL QUALITY ASSURANCE PROGRAM, AS RELATED TO DESIGN OF THE NEW LOADS ADEQUACY EVALUATION PROGRAM (HORIZONTAL)
- PERFORM AN INDEPENDENT DESIGN REVIEW OF A SELECTED GRAND GULF 1 PIPING SYSTEM (VERTICAL)

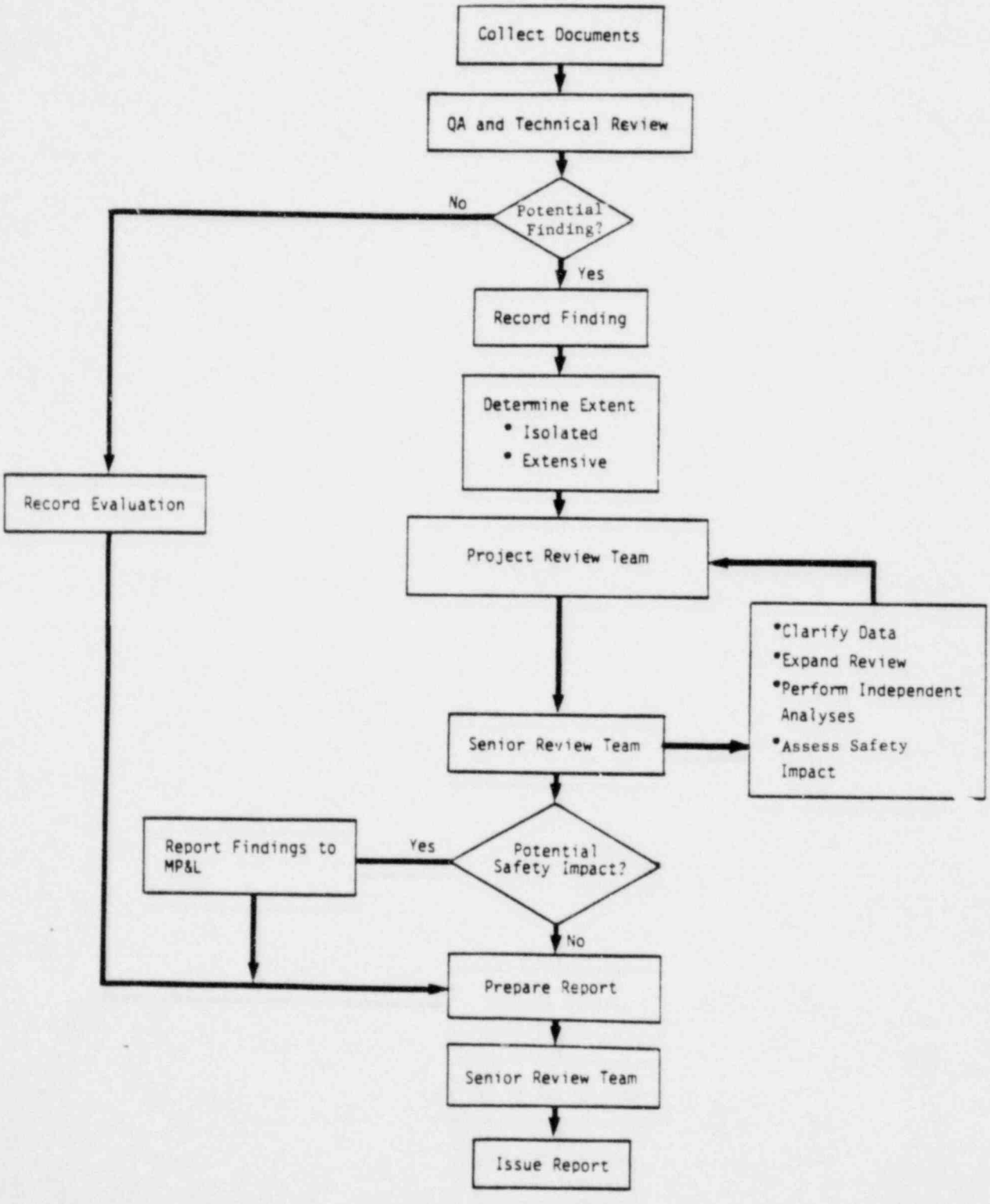
CYGNA ENERGY SERVICES

Hydrodynamic Loads Input Logic



CYGNA ENERGY SERVICES

Project Logic



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Quality Assurance Evaluation-Overview

- SCOPE
- OBJECTIVES
- APPROACH
- PROGRAM REVIEW
  - REVIEW PROGRAM DOCUMENTATION
  - DEVELOP CROSS REFERENCE MATRIX
- AUDIT
  - DEVELOP AUDIT PLAN
  - PERFORM AUDIT

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Quality Assurance Evaluation - Scope

EVALUATE THE BECHTEL QA PROGRAM FOR:

- CONTROL OF THE SELECTED PIPING SYSTEMS DESIGN
- CONTROL THE DESIGN PROCESSES RELATED TO THE BWR NEW LOADS ADEQUACY EVALUATION PROGRAM

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Quality Assurance Evaluation - Objectives

- PROGRAM REVIEW

  CONFIRM COMPLIANCE WITH LICENSING COMMITMENTS

- AUDIT

  VERIFY COMPLIANCE WITH ESTABLISHED PROCEDURES

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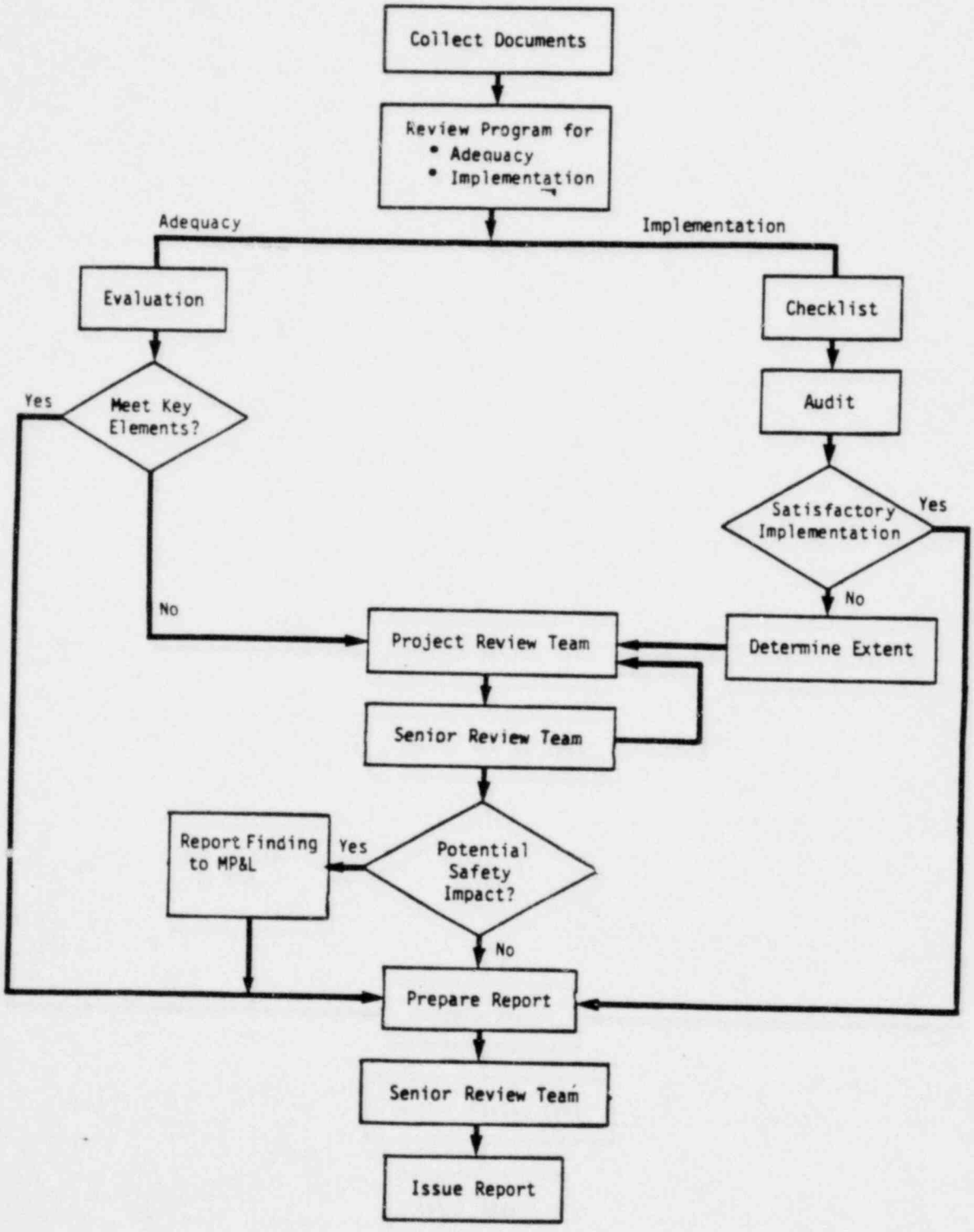
Quality Assurance Review Logic



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Quality Assurance Evaluation-
Review Program Documentation

- NUCLEAR QA MANUAL
- BECHTEL QA MANUAL - ASME III, DIVISION 1
- PROJECT ENGINEERING AND PROCEDURES MANUAL
- QA DEPARTMENT PROCEDURES MANUAL

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Quality Assurance Evaluation- Develop Cross Retrieval Matrix

PROGRAM COMMITMENTS VS. THE FOLLOWING KEY DESIGN CONTROL ELEMENTS:

- DESIGN INPUTS
- DESIGN ANALYSES
- DRAWING CONTROL
- SPECIFICATION CONTROL
- INTERFACE CONTROL
- DESIGN VERIFICATION
- DOCUMENT CONTROL
- DESIGN CHANGE CONTROL
- CORRECTIVE ACTION
- AUDITS AND SURVEILLANCES

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Quality Assurance Evaluation-Audit Plan

- IDENTIFY "NEW LOADS" WORK FLOW
- DEVELOP AUDIT CHECKLIST
  - INCLUDE ATTRIBUTES DERIVED FROM DESIGN CONTROL PROCEDURES
  - EMPHASIS CONTROL ELEMENTS RELEVANT TO PLANT SAFETY

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Quality Assurance Evaluation— Checklist

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Quality Assurance Audit Checklist

Auditor(s)	John Doe (Lead) Joe Smith	Audit No	C-82-2
Organization/Activities Audited	Engineering	Audit Dates	June, 1980
Personnel Contacted		Job No (s)	85016

Item No.	Audit Attributes	Reference Document	SAT	UNSAT	NA	Comments
	Calculations					
1	Does the responsible engineer assure that calculations are in agreement with the design basis, criteria, SAR, etc.?	QAP, para. 4.4.3				
2	Are references made to sketches or drawings when calculations are based upon such documents?	QAP, para. 4.4.3				
3	Is a copy of the drawings filed with calculations when practicable?	QAP, para, 4.4.3				
4	Are calculations neat and legible and performed on standard calculation sheets so that assumptions, calculated results, and conclusions can be easily checked by others?	QAP, para. 4.4.3				

Lead Auditor/Date: Last Attribute No.: Page 1 of

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Quality Assurance Evaluation- Perform Implementation Audit

- UTILIZE CHECKLIST AS A GUIDE FOR AUDIT DEPTH AND CONTINUITY
- EVALUATION OF OBJECTIVE EVIDENCE
- IDENTIFY POTENTIAL FINDINGS
- ASSESS EXTENT OF POTENTIAL FINDINGS
- EVALUATE IMPACT ON PLANT SAFETY

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Technical Review—Overview

- SCOPE
- SYSTEM SELECTION
- LOGIC
- REVIEW CRITERIA DOCUMENTS

- PIPE STRESS REVIEW
  - INPUT DATA
  - PIPING MODEL
  - STRESS RELATED CALCULATIONS
  - REPORTS AND CONCLUSIONS

- PIPE SUPPORT REVIEW
  - INPUT DATA
  - DESIGN CALCULATIONS
  - DRAWINGS
- AS-BUILT REVIEW OF PIPE SUPPORTS

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Technical Review — Scope

- RESIDUAL HEAT REMOVAL (RHR) SYSTEM, TRAIN "A"
- PIPING AND PIPE SUPPORTS
- LOADING COMBINATION: SRV (ADS) + SSE
- LARGE PIPE ($\geq$ 2-1/2" DIA.)

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Technical Review—System Selection

CRITERIA	RHR TRAIN "A"
• SEISMIC CATEGORY I	✓
• PART OF REACTOR COOLANT PRESSURE BOUNDARY	✓
• VARIETY OF COMPONENTS	✓
– PIPING	
– PUMP	
– VALVES	
– FLUED HEADS	
– SUPPORTS	
– BRANCH PIPING	
– HEAT EXCHANGERS	
• SEVERAL DESIGN INTERFACES	✓
• LOCATED IN MORE THAN ONE BUILDING	✓

Grand Gulf Unit 1 Independent Design Review

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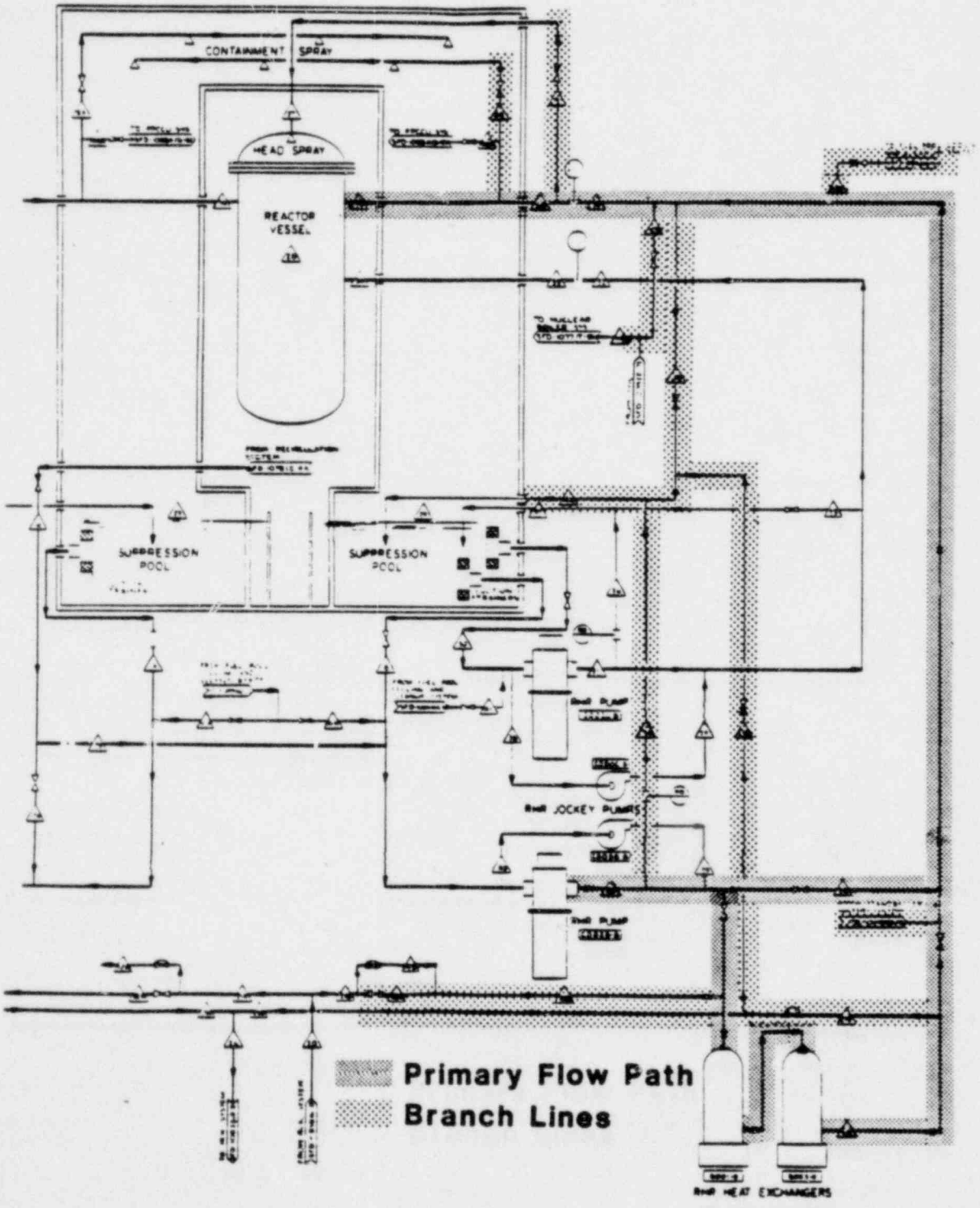
Residual Heat Removal System



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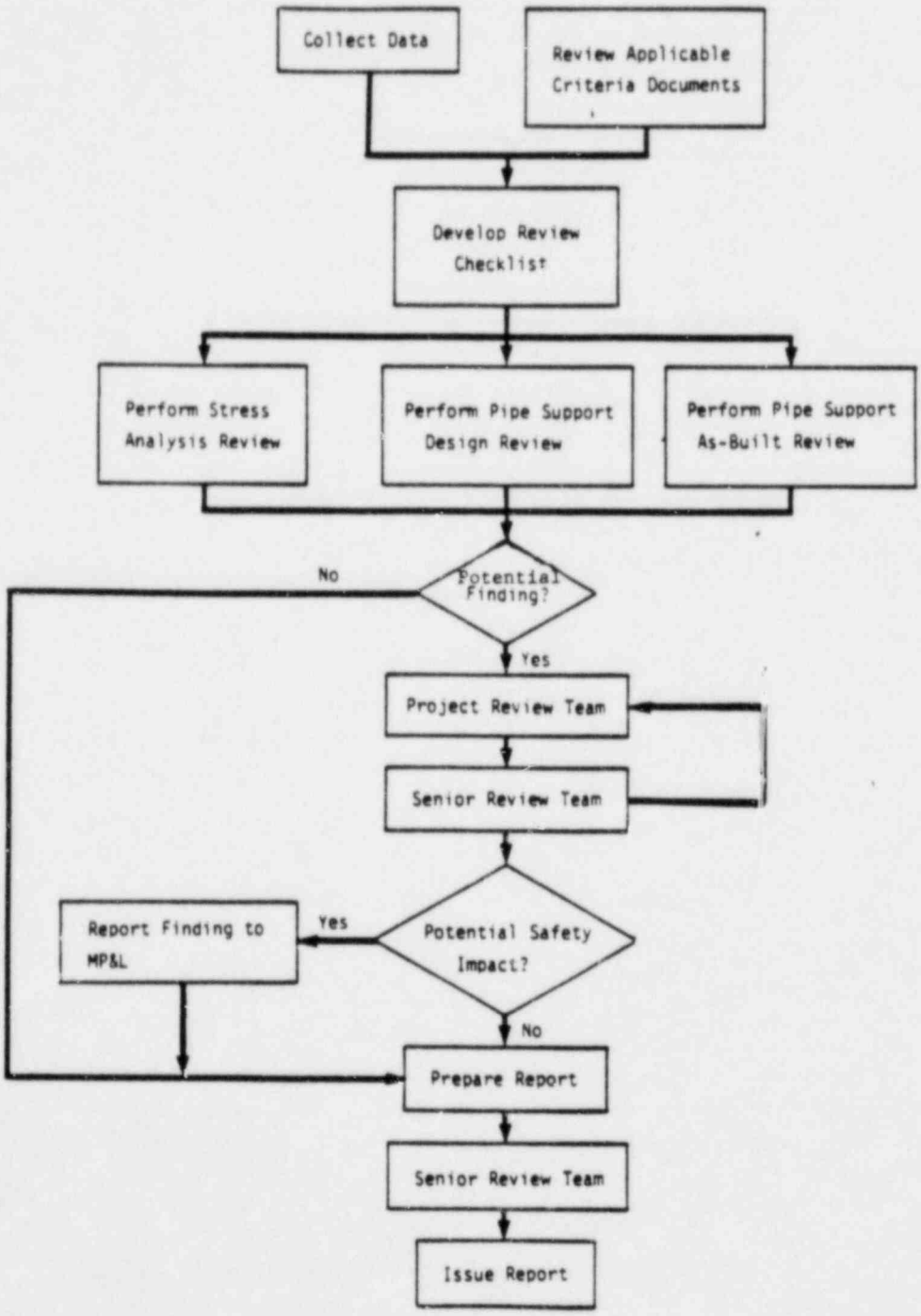
Technical Review Logic



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Technical Review — Criteria Documents

- DESIGN SPECIFICATION FOR NUCLEAR PIPING SYSTEMS
- DESIGN SPECIFICATION FOR HANGERS AND SUPPORTS, NUCLEAR SERVICE
- FIELD FABRICATION AND INSTALLATION OF NUCLEAR SERVICE PIPING
- CRITERIA FOR HANGER INSTALLATION
- COMPENSATION ALLOWANCES FOR PIPING MISALIGNMENT

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Technical Review—Pipe Stress Input Data

- CONFIRM THAT DATA WAS PROPERLY INPUT
- REVIEW CONFORMANCE TO INDUSTRY STANDARDS
- REVIEW LOAD CASES
  - INTERNAL PIPING PRESSURE
  - THERMAL LOAD
  - SYSTEM OPERATION MODES
  - SEISMIC SPECTRA AND ANCHOR MOVEMENTS
  - SRV SPECTRA AND ANCHOR MOVEMENTS
  - OTHER APPLICABLE HYDRODYNAMIC LOADINGS

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Technical Review—Pipe Stress Model

- PIPING GEOMETRY
- PIPING SECTION PROPERTIES
- SUPPORT AND RESTRAINT TYPES AND LOCATION
- FITTINGS, NOZZLES AND VALVES
- OPERATING CONDITIONS
- SYSTEM BOUNDARIES AND CLASSIFICATION
- OTHER CONSIDERATIONS SUCH AS MODAL SPACING AND SUPPORT STIFFNESS

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Technical Review—Pipe Stress Calculations

- STRESS INTENSIFICATION FACTORS FOR WELDOLETS
- FLOW IMPACT LOADS AT ELBOWS
- POOL SWELL IMPACT LOADING ON PIPING
- SEISMIC ANCHOR MOVEMENTS
- VALVE NATURAL FREQUENCY CHECK
- SUPPORT, RESTRAINT AND PENETRATION LOAD SUMMARIES
- FLUED HEAD REPORTS (BY VENDOR)

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Technical Review–Pipe Stress Reports & Conclusions

- LOAD CASES CONSIDERED IN ANALYSIS
- LOAD COMBINATIONS SUMMARIZED
- PIPE STRESS CODE CHECK
- NOZZLE REACTIONS AND VALVE ACCELERATION CHECK

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Technical Review - Pipe Support Input Data

- SUPPORT LOADS GENERATED FOR ALL ESSENTIAL LOAD CASES
- SUPPORT TYPES AND LOCATIONS
- PIPING DEFLECTIONS FOR ALL ESSENTIAL LOAD CASES
- OTHER APPLICABLE HYDRODYNAMIC LOADINGS

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Technical Review - Pipe Support Calculations

- SUPPORT STIFFNESS
- WELD CALCULATIONS
- STRESS ALLOWABLES
- VENDOR ALLOWABLES FOR CATALOG HARDWARE
- PROPER MODELING FOR COMPUTERIZED CALCULATIONS
- EXPANSION BOLT ALLOWABLES AND BASE PLATE FLEXIBILITY

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Techical Review - Pipe Support Drawings

- PROPER TYPE, ORIENTATION AND LOCATION SPECIFIED
- PROPER CLEARANCES SPECIFIED
- PROPER STRUCTURAL AND WELD DATA
- PROPER COMPONENT SIZES

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Technical Review- As-Built Review Of Pipe Supports

- DEVELOP A WALKDOWN PLAN
- CHECK APPROXIMATE LOCATION AND ORIENTATION WITH RESPECT TO THE PIPING SYSTEM
- CHECK THE TYPE, SIZE AND ADJUSTMENT OF COMPONENTS SUCH AS SPRINGS AND SNUBBERS
- CHECK THE APPROXIMATE DIMENSIONS OF CRITICAL MEMBERS OF THE SUPPORT ASSEMBLY
- CHECK MISCELLANEOUS CONSIDERATIONS SUCH AS CLEARANCE BETWEEN PIPE AND RESTRAINT STEEL AND GAPS BETWEEN BASEPLATES AND CONCRETE SURFACES

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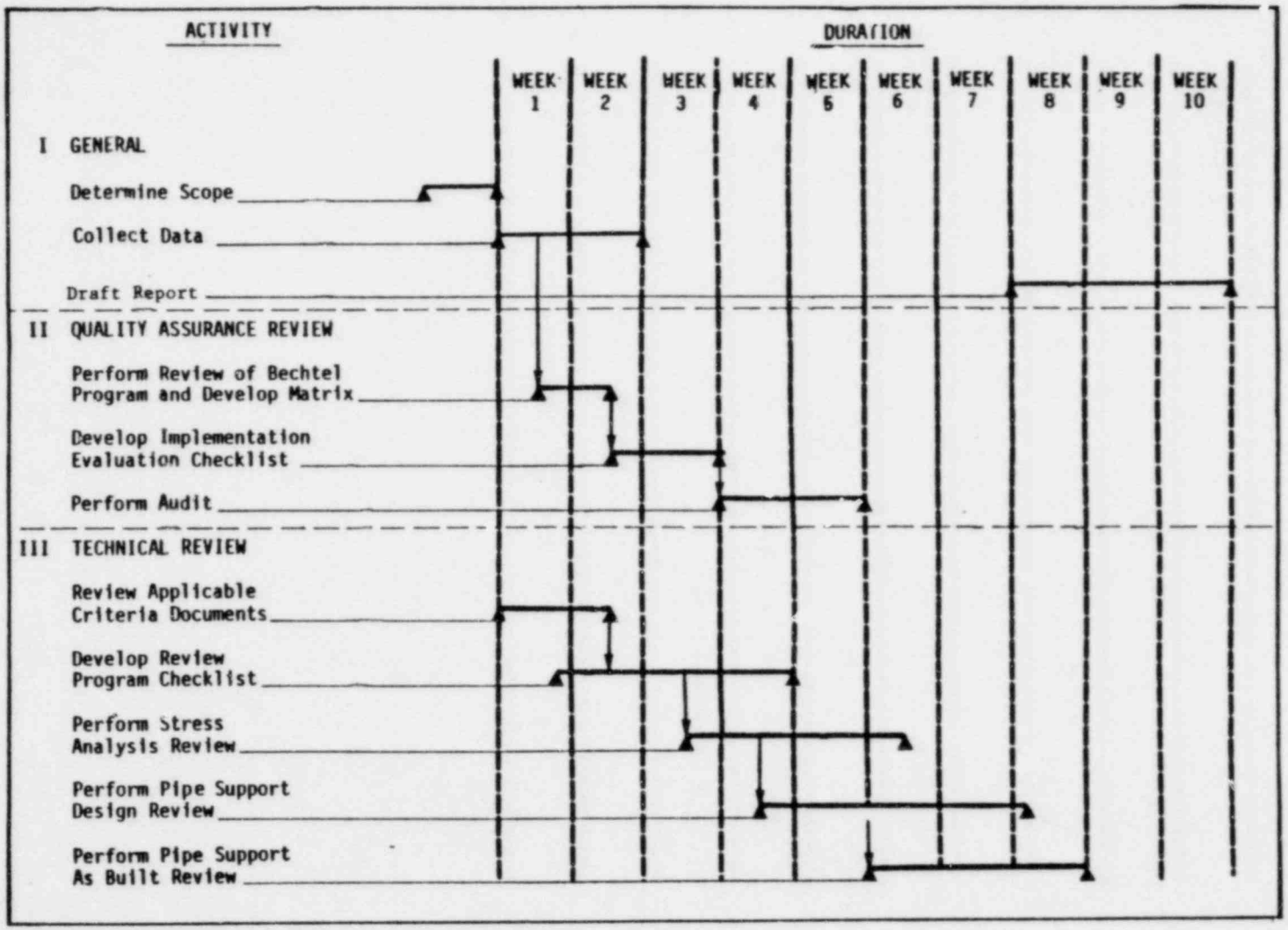
Project Schedule



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Mississippi Power & Light Company
Grand Gulf Unit 1
Independent Design Review

This statement attests to the fact that Cygna Energy Services and the membership of the Independent Design Review project team have no vested interest in the outcome of our effort to assess the adequacy of the Grand Gulf design control scheme nor the manner of its application to the detailed design of a specific system.

Cygna Energy Services has performed no engineering work or consulting services for Mississippi Power & Light's Grand Gulf project, nor for any other MP & L project.

No member of the Cygna Project Team nor of the Cygna Energy Services corporate management has ever worked for Mississippi Power & Light nor its engineering firm, the Gaithersburg office of Bechtel Power Corporation.

No relative of the Cygna Project Team or of a corporate officer has ever worked for MP & L or Bechtel - Gaithersburg.

No member of the Project Team or any corporate officer or any relative thereof owns stock in Mississippi Power & Light.

I believe this satisfies the current NRC requirements regarding the independence of the design review engineering firm.

3/18/82

John E. Ward
Chairman/CEO

date