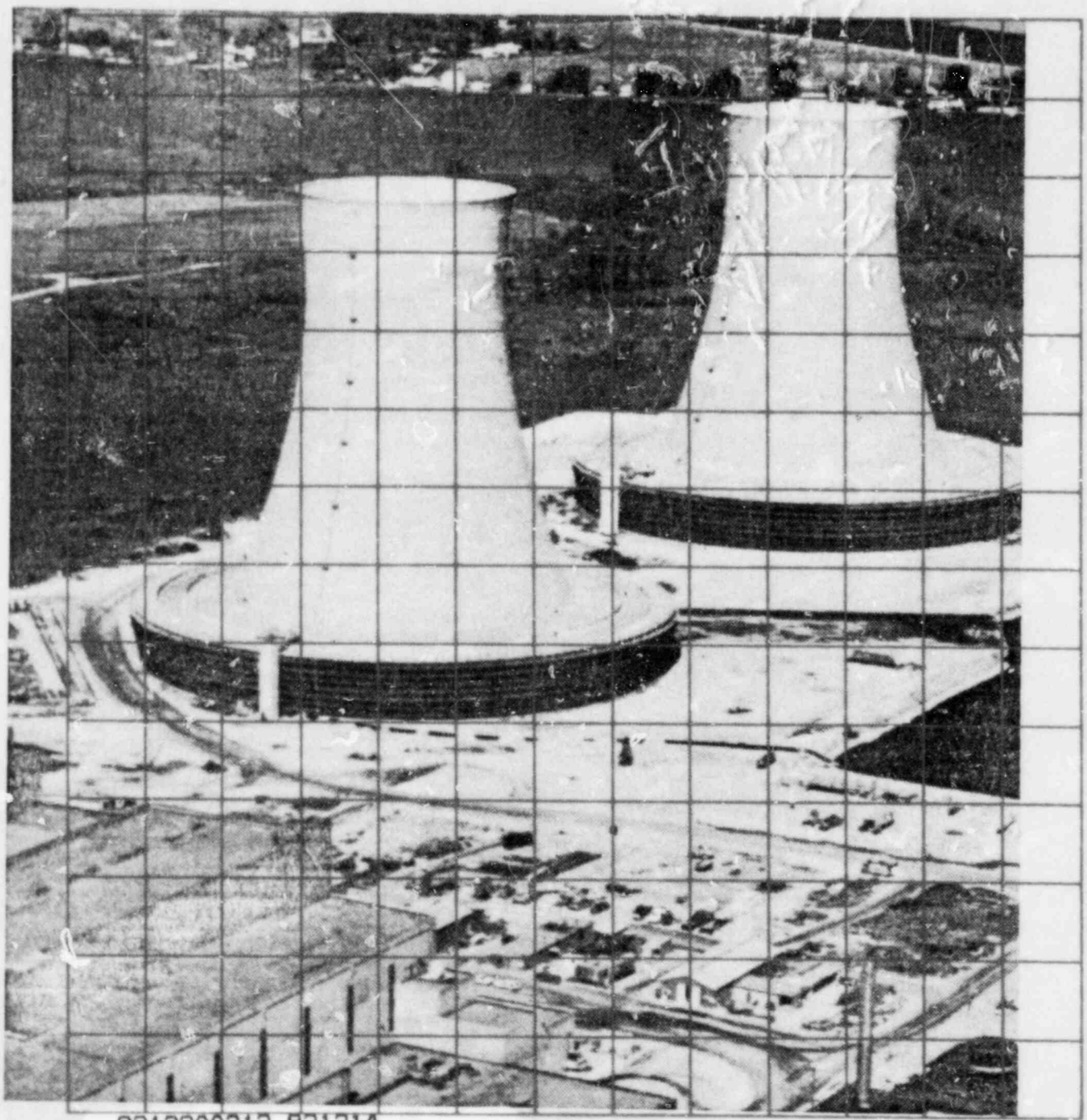
CYGNA

Independent Design Verification Program

Detroit Edison Company - Fermi 2

Proposal C83004

December 14, 1982



ERRATA TO

INDEPENDENT DESIGN VERIFICATION PROGRAM

DETROIT EDISON COMPANY, FERMI 2

CYGNA PROPOSAL 83004

DECEMBER 14, 1982

It was discovered that there were a few errors made in printing the above document. Please make the changes identified below:

Item

P.1, 2nd paragraph, first sentence - delete "proceeds"

P.7, 2nd paragraph, fourth line - change "Office" to "Officer"

P. 20 was missing - please insert the attached P. 20 in your report

P. 39 was missing - please insert the attached P. 39 in your report

placed on developing attributes pertaining to activities which, if not properly implemented, would result in the greatest impact on quality. The checklist will serve the purpose of ensuring depth and comprehensive coverage in the review. It is intended to be utilized only as a guide during the evaluation process and will not restrict the review investigation. To provide further review continuity, the checklist will be prepared by an individual who will participate in the actual review. This will ensure that it is performed in accordance with both the content and intent of the checklist.

2. Conduct an implementation review at Detroit Edison's offices. This review will concentrate on the items contained in the checklist and will be structured to identify weaknesses, assess their extent, and evaluate their impact on plant safety. The actual review will be performed by qualified personnel who will:
   - Verify by examination and evaluation of objective evidence that the established design control program has been implemented.
   - Assess the degree of implementation
   - Identify the impact of failures (if any) to implement the quality assurance program.

4.1.3 Review Contractor's Design Control Programs

1. In conjunction with the Detroit Edison design control program review, Cygna will perform a review of selected contractor's design control programs. This review will be performed to assess how well the contractor's design

- Check breaker trip setting with relay/breaker setting sheets.
- Review breaker control circuit design against appropriate regulations and standards which were identified in SAR, Section 8.

A flow chart is provided in Exhibit 4.11 which identifies the design process and interfaces for the RHR cooling tower fan motor and associated power cabling from the emergency 480V. bus.

4.2.4 Plant Walkdown Review Activitiy

The plant walkdown group leader will verify that the final design results are reflected in the as-built configuration. Those individuals performing the review will be guided by checklists and drawings which have been coordinated with the design reviewers. The walkdown will concentrate on verifying that the items reviewed will perform their intended function in the installed condition. This functional review will consist of approximate measurements of critical items and visual inspection to ensure the as-built configuration is consistent with the intended design function. To accomplish this, the Cygna walkdown team will consider the overall assembly from a functional vantage point rather than inspecting detailed individual parts and components.

Specific examples of walkdown activities are listed below. Of course, the extent of each of these activities will depend upon accessibility.

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LIST OF EXHIBITS

1.0 EXECUTIVE SUMMARY

At Detroit Edison's request, Cygna Energy Services has outlined a design verification program for the Enrico Fermi 2 Nuclear Power Plant. The broad based objective of this program is to assess the overall adequacy of Detroit Edison's design of Fermi 2, design control during the plant construction and interface practices with outside contractors. The methodology proposed for this review program follows that of a similar independent design review program conducted by Cygna for Mississippi Power & Light's Grand Gulf Unit 1, although it has been expanded to be a multidisciplined review.

The general approach taken to achieve the program objectives proceeds is to evaluate a given project scope along two distinct paths. The first is to independently evaluate the adequacy of the design control process used on the project for that scope. This review is broad based and covers the design control requirements that would apply to the total plant design effort. This is referred to as the "horizontal" review. The second path is to evaluate the implementation of the design control process in the design of selected systems or elements within the total plant design. This review evaluates the conformance of the technical design to the design control requirements. The design review also evaluates the final design's conformance with design criteria and licensing commitments, and tests the validity of the assumptions made and methods utilized in the design process. Because it follows the design process for selected systems or elements this is referred to as the "vertical" review.

The scope of the technical review presented in this document has been developed to address the areas of interest and recommendations contained in the NRC letter (Mr. D.G. Eisenhut to Mr. H. Tauber) dated October 29, 1982 and related communications. The following criteria were considered in selecting the systems or elements for this scope of work:

- the design must be safety-related;
- the design must represent a cross section of disciplines;
- the design must have several consultant interfaces over a significant period of time;
- the design should have undergone changes during this period of time;
- the design must have characteristics which cannot be verified or performance tested under actual design conditions; and
- the design aspects reviewed must include specific concerns identified by the NRC.

Taking the above criteria into consideration, the following thre elements of a decay heat shutdown cooling path to the ultimate plant heat sink were chosen for the Independent Design Verification Program:

- primary shutdown path suction line components of the Residual Heat Removal System from the recirculation system interface to, and including, the outboard containment isolation valve;
- primary components in the fluid path of the Residual Heat Removal Service Water system from the RHR SW return to an RHR cooling tower; and
- one Residual Heat Removal cooling tower.

The technical review portion will encompass mechanical, electrical, and structural aspects of representative components within the above elements.

The Independent Design Verification Program will commence upon NRC acceptance of the program and authorization to proceed by Detroit Edison. The program will culminate in a final report, submitted simultaneously to the NRC and Detroit Edison, by April 13, 1983, two months prior to the scheduled fuel load date for Fermi 2.

Multiple checks and balances are built into the normal design process of any nuclear plant. These checks, which revolve around the licensee's Design Control Program, include project review and approval of all design input, calculations and drawings as well as third party design verification for certain critical aspects of the design. In addition to these, Detroit Edison has conducted self-initiated design reviews to assure that all aspects of its program were being implemented. The Safety Review Task Force, which was formed April 10, 1979 to investigate safety-related cooling and auxiliary systems in light of the Three Mile Island 2 accident, is one example of such a review program. A design control review performed by Detroit Edison on the Core Spray System is yet another example. In addition, numerous other design reviews and five major verification programs have been completed to date. Thus, the Independent Design Verification Program outlined here is one additional check in the hierarchy of controls to assure that the plant has been designed safely and in accordance with the commitments made during the design and licensing process.

The project organization proposed by Cygna for this effort is divided into three functional tiers: the Project Team, the Senior Review Team, and in-house consultants. The Project Team will be composed of the Principal-in-Charge, Project Manager, Project Engineer, and Lead engineers in the areas of quality assurance, design review, and as-built verification. This team not only has considerable experience in the specific areas to be addressed, but several of its members performed similar functions during the implementation of the Grand Gulf review. A Senior Review Team will be formed to review the performance and the findings of the Project Team. This Senior Review Team

will be made up of Messrs. B.K. Kacyra, J.E. Ward and E.F. Trainor. Mr. Kacyra, the Chief Executive Officer of Cygna Corporation, is a recognized expert with significant design experience in the field of structural design and dynamic analysis. Mr. Ward, Chief Executive Officer of Cygna Energy Services, is a recognized expert and industry spokesman on regulatory requirements and systems design. Mr. Trainor, Vice President, Quality Assurance, offers extensive experience in the fields of quality assurance and management controls. This team, with assistance from in-house consultants, will review all phases of work performed by the Project Team and will be the final authority within Cygna in judging the safety impact of any potential finding.

Cygna Energy Services has never worked for Detroit Edison. No member of the project organization has ever worked for Detroit Edison or on the Fermi 2 project while employed by any other consultant organization. Furthermore, no member has any interest or stock ownership position in Detroit Edison, Sargent & Lundy, General Electric, or any other organization that will be covered by this review.

In summary, Cygna believes the program outlined in this document represents a rational approach to an independent design review. If the stated objectives are met Cygna will be able to make a definitive statement regarding the adequacy of the design of Fermi 2 and Detroit Edison's design control process in establishing, maintaining, and implementing design standards for all aspects of the Fermi 2 project. Thus, the effort undertaken will prove useful to both the NRC and Detroit Edison in assuring that the health and safety of the public has been adequately protected, and also to Detroit Edison as further assurance that the interest of its customers and the investment of its shareholders have been safeguarded.

2.0 INTRODUCTION

An Independent Design Verification Program will be conducted on the Fermi 2 plant by Cygna Energy Services. The review will follow the recommendations offered by the NRC Office of the Nuclear Reactor Regulation and NRC Region III in that it will: 1) address selected piping system elements which are important for safe plant shutdown and cooling, 2) it will cover multidisciplined aspects in the design process and 3) will involve piping systems which were designed and built by many contractors over a long period of time. The verification program will be initiated in December 1982, and a final report will be available for NRC review by April 13, 1983.

In conducting the program, Cygna will utilize essentially the same project approach used in our Independent Design Review Program performed for Mississippi Power & Light on Grand Gulf Unit 1. The basic steps in this approach are presented in Section 3.0. The verification program by Cygna on Fermi 2 will address the elements of Detroit Edison's Design Control Program, and an in-depth, multidisciplined technical review of specified plant systems. The horizontal review of the specified systems will be broad-based and is intended to provide assurance of the adequacy of Detroit Edison's design control process as it applies to the plant design and construction effort (Exhibit 2.1). The vertical review will evaluate the technical application of the design control process on three system elements which are integral parts of a plant shutdown and cooling path. Licensing and design documents will be reviewed to formulate criteria and checklists which will be used to establish that as-built systems meet design commitments. The review will culminate in a final report which will be reviewed by the NRC and Detroit Edison to conclude that the health and safety of the public has been adequately protected and also by Detroit Edison as further assurance that the interest of its customers and the investment of its shareholders have been safeguarded.

The scope of the technical review will focus on 1) a portion of piping from the suction tap on the "B" recirculation loop to the first containment isolation valve outside containment, 2) on a portion of piping between the service water side of the RHR heat exchangers and the "B" cooling tower on the safe shutdown reservoir and 3) on the "B" cooling tower itself. A major part of the technical review will be in the mechanical discipline and will consist of a comprehensive assessment of the stress and support calculations for the selected portions of piping. The electrical and structural review will concentrate on components and structures selected inside the RHR complex building. Items of interest which will be addressed as part of the technical review are identified in Section 4.0, "Scope of Work."

The objective of providing independent assurance that the design of a key shutdown cooling path is adequate can be met by performing a thorough and competent third-party review with the identified scope. In addition, the work scope boundaries of the review permit a sufficiently comprehensive look at the design process for Cygna to draw a substantive conclusion regarding the overall design of Fermi 2.

Cygna is in a unique position to provide the necessary independence and services to accomplish these design review objectives. A signed Statement of Independence stating Cygna's complete independence of Detroit Edison is provided in Section 7.0. Although Cygna has not participated in the design and construction of Fermi 2, recent and ongoing work experience includes seismic re-evaluation of Category I piping and structures on Maine Yankee and Vermont Yankee, responses to I&E Bulletins 79-02 and 79-14 on Vermont Yankee, responses to I&E Bulletins 79-01B and 80-11 on Pilgrim 1 and Millstone 1, piping seismic analyses and retrofit design and field support services on Diablo Canyon 1 and 2, a control room habitability study at R.E. Ginna, primary consultant for NRC's SEP program on Yankee Rowe, Appendix R analyses and design modifications on Nine Mile Point 1, NUREG-0612 analyses on Shoreham, and seismic and hydrodynamic equipment requalification work on

WNP-2. In addition, Cygna completed an Independent Design Review for Mississippi Power & Light's Grand Gulf Unit 1 and participated in Public Service Indiana's self-initiated INPO evaluation at Marble Hill. Cygna personnel have conducted independent quality assurance evaluations for Houston Lighting and Power, Northern States Power, Arkansas Power & Light, Boston Edison and others.

Cygna is committed to staff the Independent Design Review effort with senior personnel with extensive experience in quality assurance and nuclear plant engineering and design. Our senior review team assigned for this effort will consist of Mr. Ben Kacyra, Chief Executive Office of Cygna Corporation, Mr. John Ward, Chief Executive Officer of Cygna Energy Services and Mr. Eugene Trainor, Vice President and Manager of Quality Assurance. By assignment of experienced personnel, Cygna can assure the NRC and Detroit Edison of a meaningful and useful review. The project organization is identified in Section 5.0. The schedule for conducting the Independent Design Verification Program is developed in Section 8.0.

3.0 METHODOLOGY

To best accomplish the objectives discussed in the previous section, Cygna will focus its extensive quality assurance and technical experience in this program through a two-tier approach in which every potential finding receives the attention of both the project team and a senior review team. In order to facilitate an understanding of the project approach discussed below, Exhibit 3.1 provides a listing of the specific terminology which was established with the NRC during the Independent Design Review Program for Mississippi Power & Light. The same terminology will be followed in this Independent Design Verification Program for Detroit Edison.

The basic steps involved in the review process are listed below:

Step 1: Collect Documents
Step 2: Develop Review Criteria
Step 3: Develop Review Procedures
Step 4: Conduct Design Control and Technical Reviews
Step 5: Project Team Review
Step 6: Senior Review Team
Step 7: Report Results

Exhibit 3.2 charts the review process from a line item on the checklist (Step 4) to the final report (Step 7). Throughout this process, items identified as having definite potential impact on plant safety are given immediate attention, as indicated on the flowchart. This is to ensure that Detroit Edison and the NRC receive timely notification of those items concluded to have a definite potential for impacting plant safety. Cygna will make maximum use of review criteria, checklists and observation records already developed and implemented on the Independent Design Review Project for Mississippi Power & Light.

Each of these basic steps is described in the following subsections.

Step 1: Collect Documents

Documents are collected and reviewed in two stages. During the first stage, the review teams identify those central documents which guide the system design and design control process, such as the SAR, QA manuals, project procedures, design criteria, functional system descriptions and plant and instrumentation drawings. Reviewing these central documents provides an understanding of how the work process is structured and directed.

During the second stage of data collection, the review teams identify and gather those documents needed to complete the review. Where practical, these documents are collected from Detroit Edison for review in the Cygna offices.

All documents utilized during the course of the review are recorded.

Step 2: Develop Review Criteria

A key element in the review is the development of review criteria to measure the adequacy of system design and the design control process. These review criteria are a composite of licensing commitments, Fermi 2 design requirements, and appropriate industry standards. The review criteria developed in the design control and technical areas are considerably different in both content and approach and are described separately below.

Design Control Review Criteria

Detroit Edison's QA program as it applies to the selected scope will be evaluated using a matrix which compares the key elements of their design control programs to industry standards and licensing commitments.

Design Review Criteria

Review criteria will be developed and used as standards to determine design adequacy. These criteria will be based upon industry codes and standards, project design information, licensing commitments and Cygna engineering and design experience.

Step 3: Develop Review Procedures

The review criteria discussed above provide a means for measuring the adequacy of a system design and design control process. In addition to these standards, each reviewer is guided by checklists that identify key elements to be evaluated during the design control and technical reviews. If a reviewer determines that a line item on the checklist is inadequately addressed, an "Observation Record" is prepared. All observations are then reviewed to determine their potential impact on plant safety. For those determined to have potential safety impact, a "Potential Finding Report" (PFR) is prepared.

Checklists, Observation Records and PFR's are described below.

Checklists

Checklists provide the reviewers with a listing of key design and control elements to be considered. Appendix A provides a sample checklist form for the design control review. As a reviewer checks each line item on a checklist, its adequacy is evaluated against the review criteria. If the requirements are met, the line item is marked "satisfactory." Whenever significant conservatisms are identified, they are so noted in the "comments" column. If the reviewer is not fully satisfied that requirement has been met, an Observation Record is prepared and its number is recorded in the comments column of the checklist.

Observation Record

A sample Observation Record form is provided in Appendix A. The observation number is a unique number sequentially assigned to each observation within a checklist.

Each observation record is prepared by the originator of the observation and then reviewed by a qualified person assigned by the Project Manager. Based on this review, interaction with the project Group Leaders, consultation with Cygna specialists, and an informal conference with Detroit Edison, the Project Engineer prepares the Observation Review Record. This review record rules on the validity and potential safety impact of each observation.

The disposition of all observations, including those that are invalidated, is recorded on an Observation Log. (see Appendix A for a sample form).

Potential Finding Report

Potential Finding Report (PFR) forms are also illustrated in Appendix A. Each PFR receives a sequential number which is correlated to the observation number on the Observation Log. On this form, the cognizant Group Leader records a description of the observation, an assessment as to the extent of the observation plus an evaluation of the design and safety impact.

Step 4: Conduct Design Control and Technical Reviews

Reviews of a system design or a system element design and the design control process on Fermi 2 are performed by the seven separate teams listed below:

- Design Control (QA)

- Pipe Stress
- Pipe Support Design
- Equipment Qualification
- Structural
- Electrical
- Plant Walkdown

Each team, except the walkdown team, is composed of at least two individuals capable of both performing and reviewing the work.

These review teams are guided by the review criteria and checklists described in the previous subsections. Members of the teams perform the initial reviews, complete the checklists, and originate observations. During such reviews, any identified significant conservatisms are also recorded.

Step 5: Project Review

Exhibit 3.2 illustrates the role of the Project Team review in the decision process. Once an observation has been originated and reviewed by a qualified individual, the Project Team review is performed to verify the accuracy of the observation, its completeness, the design impact, and the extent. Given this information, the potential safety impact is evaluated.

An integral part of the Project Team review is interfacing with the reviewer to confirm the accuracy of an observation and to evaluate the design impact. To maintain independence, Cygna will not disclose an observation until it has been recorded.

In addition to reviewing observations, the Project Team reviews the completed checklists to verify their completeness and accuracy.

The Project Team is responsible for the preparation of the final report.

Step 6: Senior Review Team

All valid observations and reports are reviewed by the Senior Review Team.

A cognizant member of this team, assisted as necessary by Cygna in-house consultants, will review each PFR for completeness, accuracy, and potential impact on plant safety. Based on their assessment, the Senior Review Team may do one of the following:

- Direct the Project Team to perform more work, such as clarifying data, redirecting the review or performing limited independent analyses within the current work scope.

- Determine that the PFR has insignificant impact on plant safety. The finding may therefore be either invalidated or closed. In this case, the PFR will be recorded in the Final Report.

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

- Notify Detroit Edison and the NRC that a finding has a definite potential impact on plant safety.

The Senior Review Team will also evaluate the collective safety impact of observations that are individually concluded to have insignificant safety consequences. During the entire review process, those potential findings which are identified as having potential safety impact will receive immediate and first priority attention. Should the Senior Review Team conclude that the observation does indeed have a definite potential impact on plant safety, the finding will be reported immediately to Detroit Edison and the NRC in accordance with Title 10 of the Code of Federal Regulations, Part 21.

Step 7: Report Results

The results of the review process will be recorded in a final report issued concurrently to Detroit Edison and the NRC. This report will contain the following:

- Review criteria
- Checklists
- Observation Log
- Potential Finding Reports
- Significant conservatisms identified
- An assessment of the effectiveness of the design control program
- An assessment of the implementation of the design control procedures based upon the selected scope under review
- An assessment of the quality of the overall plant design as inferred by the results of this Independent Design Verification Program

4.0 SCOPE OF WORK

This section describes the scope of work for the Independent Design Verification Program for the Enrico Fermi 2 Nuclear Power Plant and will be used by Cygna Energy Services as a reference and basis for conducting the review. The scope of the Independent Design Verification Program for Fermi 2 was specifically chosen to be responsive to the areas of interest identified in the letter from Mr. Darrell Eisenhut of the NRC to Mr. Harry Tauber of Detroit Edison dated October 29, 1982 and related communications. The intent is to concentrate the review on a scope of work which will provide an independent, multidisciplined assessment as to the design adequacy of an important plant shutdown cooling path. In addition, the review should provide the NRC substantive assurance that Detroit Edison's design, design control and interface practices with outside contractors has been adequate.

To address the concerns of the NRC, the following criteria were considered in developing the scope of work:

- The scope should involve a number of interfaces between various contractors operating both concurrently over a relatively short time interval and sequentially over a longer time span.

- The scope should provide for a review of a cross-section of disciplines (mechancial, electrical, structural, etc.) and plant features (various systems, diverse elements).

- The scope should involve systems or elements important to safety (preferably a safety-related shutdown cooling path).

- The scope should involve systems or elements having undergone design changes or improvements over time.

- The scope should include systems or elements involving Sargent and Lundy in the design process.

In developing a meaningful scope, it was also considered prudent to choose systems or elements having performance and design characteristics which cannot be verified or tested under actual design conditions, since testing is a means of design verification in itself.

With these criteria in mind, the Independent Design Verification Program scope of work was established to include three elements of a decay heat shutdown cooling path to the ultimate plant heat sink. Specifically, the review will cover the following (refer to Exhibit 4.1):

- The Residual Heat Removal System, Division II, primary shutdown path suction line components from the recirculation system interface (suction line connection) to and including the first isolation valve outside containment;

- The Residual Heat Removal Service Water System, Division II, primary components in the fluid path from the RHRSW return (RHR Complex Building interface) to the RHR cooling tower; and

- The "B" RHR Cooling Tower, Division II, in the RHR Complex Building.

The Independent Design Verification Program will review the design of the selected elements in two directions. First, the horizontal review will confirm that an adequate design control process was established by project procedures and was implemented throughout all phases of the design activity. Secondly, an in-depth, multidisciplined technical review will be performed to confirm that the as-built configuration agrees with applicable design specifications, design criteria and licensing commitments. This vertical review will confirm the accuracy and completeness of the overall design

process on the system elements including interfaces and design changes, and configuration checks in the field as required. These two reviews are discussed below in more detail.

4.1 Design Control Review

An evaluation of the Design Control Program governing design of selected elements of the shutdown cooling path will be performed to assure that adequate design control measures have been exercised. Specifically, this evaluation will encompass the following goals:

- Determine whether Detroit Edison's design control activities as defined in their design control program documentation satisfy the licensing commitments of Fermi 2.

- Determine whether the design control activities of selected contractors utilized by Detroit Edison satisfy the commitments of contract documents and the Fermi 2 SAR.

- Evaluate Detroit Edison's and selected contractors' implementation of the design control commitments as delineated in their respective design program documentation.

To accomplish the above goals, the following will be performed:

4.1.1 Design Control Program

1. Review of Detroit Edison's Design Control Program

Cygna proposes to perform an evaluation of the key elements of the Detroit Edison design control program

as applied to selected elements of the shutdown cooling path. These key elements to be included are:

- Design input documents
- Design analyses control
- [illegible]g control
- Procurement control
- Internal/external interface control
- Design verification
- Document control (controlled documents), including revisions
- Design change control
- Corrective action
- Internal/external audits and surveillances

This evaluation will encompass reviewing the Detroit Edison design control program documentation to assess how well it addresses Fermi 2 SAR commitments with respect to the above key design control elements. The evaluation will involve developing a quality program matrix which identifies the quality requirements committed to with a cross correlation to the Detroit Edison design control program. Appropriate portions of Detroit Edison documents, such as the following, will be used to develop the matrix:

- Detroit Edison Quality Assurance Manual
- Project Procedures Manual (Editions 1 and 2)
- Project Engineering Administrative Manual
- Design Instructions

Other documents may be added as the review progresses. Once the matrix is established, an analysis will be performed to:

a. Determine the adequacy of the design control program in addressing the specific quality commitments.

b. Assess the impact of the design control program deficiencies and/or weaknesses with respect to committed requirements governing design.

c. Determine areas requiring concentrated attention during the design control program implementation evaluation.

4.1.2. Implementation Evaluation of Detroit Edison's Design Control Program

As a second phase of the independent Design Quality evaluation, Cygna will develop a plan to evaluate the implementation of controlling the key elements of Detroit Edison's design control system applicable to the selected scope. Specific activities in the second phase of the design control review are described below:

1. Develop an implementation review checklist. The checklist is designed to focus the review activities towards key areas of the implementation process. The checklist will contain key design control element attributes (questions derived from procedural commitments to be reviewed during the review). Emphasis will be

control programs applicable to the selected scope address the commitments imposed through Detroit Edison's contract documents and the Fermi 2 SAR. As a minimum, the design control will be evaluated against the following key design control elements, as applicable:

- Design input documents
- Design analysis control
- Drawing control
- Procurement control
- Internal/external interface control
- Design verification
- Document control
- Design change control
- Corrective action
- Internal/external audits and surveillance

The evaluation will involve developing quality program matrices similar to that developed during the review of Detroit Edison's design control program which identifies the design control requirements imposed through contract documents and Fermi 2 SAR.

Design contractors chosen for this review are:

- Sargent & Lundy
- Stone and Webster

2. Implementation Evaluation of Contractors Design Control Programs:

To assess Detroit Edison's control over contracted design activities, Cygna will develop a plan to evaluate the implementation of the above selected contractor's design control programs, applicable to the selected scope. The method of performing this evaluation will be the same as that utilized for the implementation evaluation of Detroit Edison's design control program.

Depending upon the results of the review of Detroit Edison's and selected contractors' design control programs and the results of the implementation evaluations, additional contractors may be selected for further evaluation.

4.1.4 Design Control Review - Summary

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

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

- Implementation not in accordance with the documented design control program.

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

Cygna's proposed approach to this review follows the schematic logic illustrated in Exhibit 2.1 of this document.

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 the overview process, findings which individually have no impact on plant safety are assessed collectively to evaluate their cumulative effect on plant safety.

4.2 Design Review

This part of the verification program will consist of the multidisciplined review of the three system elements. The design information will be reviewed from the conceptual stage until the final drawings and design documents are released to construction for fabrication and installation and will include an as-built check by field walkdown. The technical review will cover the mechanical, electrical and civil/structural aspects of the selected system elements as performed by Detroit Edison and its various contractors. Each review discipline is discussed below to provide additional insight into the depth and latitude of the efforts. The as-built configuration check (plant walkdown) is also discussed.

4.2.1 Mechanical Review Activities

The mechanical review activities will consider, to whatever extent it exists, the flow of information between Detroit Edison and its engineering consultants and contractors.. Namely, it will look at what was received and how it was integrated into the design on the selected review elements for Fermi 2. As such, some of the activities outlined below may involve review of documents, drawings, analyses and other design information furnished in whole or in part by the NSSS vendor or outside engineering organizations.

1. RHR Cooling Element Review Activities

As shown in exhibits 4.1, 4.2, 4.3, and 4.4 the RHR Cooling Element mechanical review will concentrate on the pipe and pipe support activities of the Residual Heat Removal System, Division II, primary shutdown path components from the recirculating system interface (suction line connection) to and including the first isolation valve outside containment.

The objective of this mechanical portion of the review is to perform an assessment of pipe stress, pipe support, and equipment qualification calculations to ensure correctness with respect to applicable code requirements, industry standards and licensing commitments. In this review, particular attention will be paid to the key loading combination. This loading combination will include applicable seismic load cases. In addition, an as-built review will be performed to ensure 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.

a. Detailed Review of Criteria Documents

In order to obtain an independent assessment of the methodologies and approaches implemented in the piping analyses performed by Detroit Edison, the Cygna team will review the applicable design criteria documents. Based on Cygna's own expertise in piping design and analyses, a determination will be made as to the validity of the

criteria encountered. As a minimum, the appropriate sections of the following documents will be reviewed:

- Design Specification for Piping Systems for Nuclear Service
- Design Specification for Supports and Restraints for Nuclear Service
- Field Fabrication and Installation Specification for Piping for Nuclear Service
- Final Safety Analysis Report

The above documents will form the basis for the development of checklists to be used during the verification program.

b. Pipe Stress Analysis Review Activities

The technical review of the stress analyses will consist of the following activities:

- Input Data Check
- Piping Model Check
- Review of Stress-Related Calculations
- Review of Stress Reports

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

Input Data Check

Cygna will perform a check of the piping analyses to ensure that data was appropriately input. The input data

is provided by Detroit Edison; however, the Cygna team will review this input for general conformity to industry standards. As a minimum, the following input data will be considered:

- Internal piping pressure
- Thermal load cases
- System operating modes
- Specified anchor movements
- Application of given seismic spectra
- Application of other given external dynamic loadings

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 review of the piping models developed for the stress analysis. 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 nodal spacing and support stiffness

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:

- Seismic anchor movements
- Valve dynamic response characteristics
- Support, restraint, and penetration load summaries
- Flued head reports
- Local stress calculations for integral welded attachments (e.g. lugs, stanchions)

Review of Stress Reports

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 original designers. The basis for this evaluation will be a careful study of the design reports issued to date. As a minimum, particular attention will be given to the following items:

- Load cases considered in analyses
- Summary of load combinations
- Nozzle reactions and valve acceleration check
- Pipe displacements

c. Pipe Support Design Activities

The technical review of the design of selected pipe supports and restraints will consist of the following activities:

- Review of input data and load combinations
- Review of design calculations
- Review of issued drawings

This review applies only to supports and restraints on the primary flow path as identified under the piping scope. Each of the pipe support review activities is described in detail below.

Review of Input Data

The Cygna review team will take a close look at the support guidance generated by the stress group for the pipe support group. Some items to be reviewed in detail are:

- Support stiffness
- Support types and locations
- Piping deflections for all essential load cases
- Load directions and magnitudes

Review of Design Calculations

Using the criteria and support guidance established above, the Cygna team will review the calculations performed by the pipe support designers. For those

supports and restraints on the primary flow path, Cygna will review 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 baseplate flexibility effects

Review of Drawings Issued

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

- Correct type, orientation, and location
- Appropriate clearances specified
- Sufficient structural and weld data
- Correct component sizes

d. Equipment Qualification Activities

The mechancial review will also consider the seismic qualification of two motor operated valves and will consist of the following activities:

- Review of the qualification files
- Review of valve drawings and loading input to design calculations
- Review of design calculations performed
- Review of test results

Each of the above four activities are described in detail below:

Review of Qualification File

Cygna will review the qualification files for the selected valves to ensure that all of the proper documentation is included. The qualification status forms will be reviewed for completeness and agreement with drawings, analyses and test results.

Review of Valve Drawings and Loading Input to Design Calculations

Cygna will review the design calculation input data to ensure that proper dimensions, weights, material properties, temperature, pressure, and seismic loadings were used.

Review of Design Calculations

Cygna will review the valve design calculations to ensure that the methodology and results are in accordance with applicable code requirements, industry standards and licensing commitments.

Review of Test Results

Cygna will review the test method to assure that it complies with the applicable NRC and IEEE Standards. Input loading will be inspected to ensure that it properly envelopes the required loads. Test results will be reviewed and compared to the proper qualification criteria.

2. RHR Service Water Element Review Activities

As shown in exhibits 4.1, 4.5, 4.6, and 4.7, the mechanical review will also concentrate on the Residual Heat Removal Service Water System, Division II, primary components in the fluid path from the RHR SW return (RHR Complex Building interface) to an RHR cooling tower.

For this scope portions of the listed items in sections 4.2.1.1.b (Pipe Stress Analysis Review Activities) and 4.2.1.1.c (Pipe Support Design Activities) will be reviewed. The portions to be reviewed are selected to verify that design has been adequately controlled throughout the design process including internal and external interfaces for the contractor Detroit Edison, and the constructor(s). That is, mechanical design

information was correctly transmitted from the contractors' mechanical analyst to the structural analyst; mechanical information was correctly transmitted to the constructor; and the results were implemented in the field.

This portion of the review will particularly concentrate on the transfer of load from the RHR SW piping system to the structural elements of the RHR complex. The review will include the following activities:

- Confirm the transfer of loads from the piping system to the selected pipe supports.
- Review the selected pipe supports.
- Confirm the transfer of pipe support loads to the structure.
- Review the structural design for these pipe support loads.

4.2.2 Structural Review Activities

As shown on Exhibits 4.1 and 4.8, each of the four RHR cooling towers consists of a fan unit protected by a reinforced concrete tower and a distribution system to transport water to be cooled to spray headers located near the roof level. The structural review of these cooling towers will concentrate on their foundations, which in effect is the RHR complex.

Exhibit 4.9 illustrates the flow of work for the design of the RHR cooling tower foundation. The division of responsibility for this work is summarized in tabular form on Exhibit 4.10 which essentially shows that the cooling tower foundation was analyzed and designed by Sargent and Lundy.

To verify the adequacy of the RHR cooling tower foundation, the following activities will be performed.

- Review criteria documents
- Select controlling load combination
- Review seismic analysis
- Select major structural elements
- Review structural analysis
- Review design
- Review results and conclusions
- Review design drawings

1. Review Loading

The RHR complex will experience a variety of loads, including dead, live, seismic, tornado and impact loads. For this evaluation, a loading combination containing seismic loads will be selected since it is our experience that seismic loads generally control design.

2. Review Seismic Analysis

The seismic analysis for the RHR complex will be reviewed to ensure that it has been performed in accordance with standard practice and project design standards. The

following basic elements of the seismic analysis will be evaluated:

- Input motions - (Input acceleration to the seismic model and applicable ground properties as provided by Detroit Edison)

- Foundation characteristics

- Seismic model
  - Mass distribution
  - Material properties
  - Element stiffnesses
  - Damping

- Analysis
  - 3-D considerations
  - Number of modes
  - Cutoff frequency
  - Time step
  - Torsional effects
  - Computer code selection
  - Equipment coupling

- Results
  - Computer output
  - Eigenvalues and vectors
  - Accelerations
  - Building forces

3. Select Major Structural Elements

To evaluate the adequacy of the structural design, a number of major load carrying elements will be selected for a detailed design review. These elements will be chosen by first tracing the transfer of gravity and lateral loads from the RHR cooling tower to the basemat, and then selecting the structures which carry the majority of these loads.

4. Review Structural Analysis

The structural analysis of the RHR complex will be reviewed to ensure that the proper loads were input and that standard practice was followed. As a minimum, the portions of the analysis listed below will be evaluated.

- Input loads - (Input acceleration to the seismic model and applicable ground properties as provided by Detroit Edison)

- Material properties
- Computer code selection (if any)
- Stiffness characteristics
- 3-D effects
- Boundary conditions
- Mass distribution
- Results

5. Review Design

Structural design of the selected structural elements will be reviewed against the appropriate design standards. This review will include consideration of the following:

- Stress allowables
- Wall thicknesses
- Material properties
- Rebar sizing and placement
- Connections
- Load transfer

6. Review Results and Conclusions

During the review of the design calculations, all assumptions and conclusions will be evaluated based on project standards and industry practice. Basic assumptions will receive particular attention throughout this review process to first ensure their reasonableness and then to confirm that the final design is consistent with the assumptions.

7. Review Design Drawings

Cygna will review the design drawings for the selected structural elements to confirm that the final drawings reflect the results of the design calculation.

4.2.3. Electrical Review Activities

As shown in Exhibit 4.11, the electrical discipline review will focus on a RHR cooling tower fan motor and its power distribution from the 480V Class 1E bus. We will review the SAR commitments and preliminary design information including the functional system requirements, design instructions and general motor and cable design specifications to obtain review criteria. The electrical power distibution, cable separation and routing, and equipment qualification requirements will also be noted. Review checklists will be prepared to verify the design information was accurately and sufficiently carried through the design process into the final drawings and criteria for field fabrication and installation. In addition, the flow of design information across the contractor interfaces from Sargent and Lundy, Marley, Detroit Edison Purchasing, Detroit Edison Fermi 2 Project Electrical Engineering Group and, possibly, the Detroit Edison Fermi 2 Project I&C Group, will be checked to ensure that correct and adequate design information was transmitted. The specific examples of design information to be reviewed and checked are as follows:

- Verify that electrical distribution system on one-line diagrams comply with basic design considerations of electrical engineering guidelines.

- Review electrical systems overall design against appropriate regulations and standards identified in SAR, Section 8 for the RHR complex.

- Review motor horsepower sizing for proper voltage level assignment.

- Review electrical design criteria for voltage tolerance limits and incorporation into cooling tower fan specifications and motor nameplate data.

- Check cable size for adequate ampacity, voltage drop and short circuit considerations.

- Check cable voltage rating and insulation rating against electrical design criteria.

- Check cable specification and cable manufacturer's data for incorporation of cable ratings.

- Review cable schedule and raceway design for maintenance of voltage and system separation requirements during routing.

- Review cable installation criteria for methods and procedures used to prevent the maximum allowable pulling tension being exceeded.

- Check short-circuit analysis for maximum fault current at emergency 480V. bus.

- Check one-line diagrams and relay coordination curves for compliance with protective relay philosophy.

- Check breaker interrupting rating for compliance with 480V. switchgear specification.

- Check the approximate location and orientation of the selected piping elements. This will be accomplished by visually inspecting the pipe supports and anchors which were addressed in the design review and by verifying the orientation of valves along the selected flow path.

- Check the type, size, adjustment (as available) and stops of components such as springs and snubbers.

- Check the approximate dimensions of critical members of the support assembly. The design reviewers will guide this task by highlighting the critical items on the final design drawings.

- Check cable tray and raceway separation for the cabling associated with the "B" cooling tower fan motor.

- Verify the fill capacity of selected cable trays.

5.0 PROJECT ORGANIZATION

Figure 5.1 illustrates the organization which Cygna would propose for the Project Team and their interrelationship with the Senior Review Team. The commitment and interest of Cygna's management in meeting the needs of Detroit Edison in this effort are demonstrated by the assignment of some of Cygna's most senior personnel.

Mr. Joseph A. Famiglietti, Jr. would act as Principal-in-Charge for the performance of this effort. In this capacity, he would be the prime contact with Detroit Edison management for all aspects of the work. As a Principal of the firm and General Manager of the Chicago office, he would ensure that the appropriate resources are concentrated on this effort and the utilization of the Senior Review Team is carried out in an effective and efficient manner. In addition, Mr. Famiglietti has the authority to represent Cygna in all matters, including contractual and commercial. He has over 13 years of nuclear-related experience and prior to joining Cygna was the Principal Civil Engineer and Civil/Structural Group Leader at Boston Edison. He was also responsible for implementing NRC I&E Bulletins 79-02, 79-07, and 79-14 at Pilgrim 1.

Dr. David A. Ferg would act as Project Manager for this proposed scope of work. He would direct all aspects of the project and would be the prime contact with Detroit Edison staff representatives. In this capacity, he would be responsible for the day-to-day monitoring of the progress of the work including performance against established budgets and schedules. Dr. Ferg has over 11 years of experience with respect to the engineering and analysis of nuclear power projects. In addition, his specific experience in the areas of project organization, technical review and licensing will be directly applicable to the work being performed for Detroit Edison.

Mr. Ted T. Wittig would act as Project Engineer for this effort and be responsible for the day-to-day review activities and directly supervise the work performed by the project group leaders. He would ensure that the review criteria, documentation, procedures and quality assurance measures are properly implemented at the engineering task level. He would provide valuable support to the project team having performed the function of Project Manager on the successful Grand Gulf Independent Design Review effort. Mr. Wittig has over 12 years of experience with respect to the engineering and analysis of nuclear power projects.

Since the primary emphasis of the job will require a concentration in the principal areas of quality assurance and piping analysis and pipe support design technology, Cygna would propose to utilize individuals with extensive experience in each of these areas, as well as with the specific tasks performed on the Grand Gulf Independent Design Review effort.

Mr. Paul D. DiDonato would serve as lead quality assurance reviewer for this effort. He would direct and participate in the review of the design control portion of Detroit Edison's quality assurance program. His eight years of experience in the development, implementation, evaluation and auditing of quality assurance programs uniquely qualifies him for this scope of work. Mr. DiDonato's experience has encompassed all aspects of nuclear quality assurance. He would be assisted by highly qualified quality assurance engineers, as necessary, for this effort.

The extensive experience of Messrs. Lee J. Weingart, Chuan Liu, Donald F. Green, Wayne E. Schweidenback, and Alan Ho in the areas of pipe stress analysis, pipe supports, structural, electrical, and as-built verification, would be brought to bear for this effort as lead engineers. In this role, they will be responsible for the technical quality of the review in their areas of expertise. They will also be responsible for developing review criteria, checklists and work instructions. Each of these lead engineers will participate, as needed, in reviewing and resolving observations.

Mr. Weingart has over nine years experience with particular emphasis in the analysis of piping systems and pipe support structures. He was also the lead pipe stress engineer on the independent design review project for Grand Gulf Unit 1.

Mr. Liu was the lead pipe support reviewer on the Grand Gulf Unit 1 independent design review. His 14 years of design experience includes work on pipe supports for five other nuclear plants.

Mr. Donald F. Green has more than 20 years experience in structural engineering, which includes teaching at the university level and analysis/ design in both the aerospace and nuclear fields. He recetly participated in the Independent Design Review of Grand Gulf Unit 1 as a computer code reviewer.

Mr. Schweidenback has over eight years of experience in electrical engineering and design. This experience includes the electrical system design for a cogeneration facility and various power plants.

Mr. Alan Ho will be assigned as responsible engineer for the as-built verification activity. His experience in the area of pipe stress analysis and structural design and analysis provide the level of proficiency necessary to ensure that any required activities would be completed in an effective and efficient manner. He would participate in the development of any required as-built verification procedures and would participate in the execution of this effort.

Since Detroit Edison management will be relying on the results of the independent review as an assessment of the adequacy of the design for Fermi 2, Cygna's approach includes the formation of a Senior Review Team to review all observations. This effort will include a review of observations from both the Design Control and Technical review activities. The Senior Review Team will

be comprised of Mr. b.K. Kacyra, Chief Executive Officer (Cygna Corporation), Mr. J.E. Ward, Chief Executive Officer (Cygna Energy Services), and Mr. E.F. Trainor, Vice President (Cygna Energy Services). The composition of this team brings to bear Cygna's depth of experience in the areas of structural/piping analysis, system design and licensing, and quality assurance, respectively.

In addition to the key project team members discussed above, Cygna would access speciality consultants, as needed, in the areas of BWR design, system analysis, codes and standards, electrical, and I&C. These individuals would be utilized in a support capacity for activities which may be required, such as technical interpretation of the codes and standards as applied to the Fermi 2 piping design. From time to time, certain other support personnel could be utilized in order to ensure the cost efficiency of the effort. Typical resumes of support personnel who would be utilized are provided in Appendix B.

6.0 QUALITY ASSURANCE

Cygna would perform the work as applicable, in conformance with the requirements of the Cygna Quality Assurance Manual (QAM). The requirements set forth in the QAM are in conformance with the requirements of 10CRF50, Appendix B, ASNI N45.2, and ASME III, NCA 4000. The program has been successfully exercised and approved by and for Mississippi Power and Light, Pacific Gas and Electric Company, Commonwealth Edison Company, Bechtel Power Corporation, Yankee Atomic Electric Company, and Northeast Utilities Service Company, to name a few. The QAM is listed in the CASE Register of Quality Control Evaluated Suppliers.

7.0 STATEMENT OF INDEPENDENCE

STATEMENT OF INDEPENDENCE

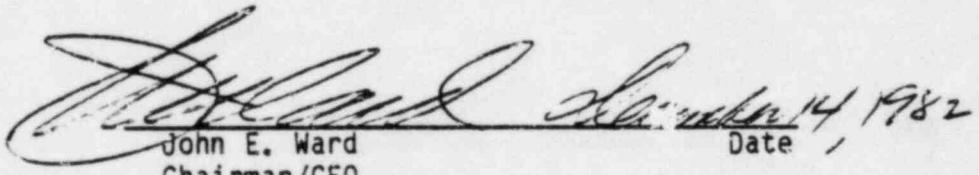
This statement attests to the fact that Cygna Energy Services and the membership of the Independent Design Review project team have no vested interest in the outcome of our effort to assess the adequacy of the Fermi 2 design control scheme nor the manner of its application to the detailed design of a specific system.

Cygna Energy Services has performed no engineering work or consulting services for Detroit Edison's Fermi 2 project, nor for any other Detroit Edison project.

No member of the Cygna Project Team nor of the Cygna Energy Services corporate management has ever worked for Detroit Edison nor been associated with any design activities on Fermi 2 with any outside engineering firm.

No member of the Project Team or any corporate officer or any relative thereof owns stock in Detroit Edison.

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



John E. Ward
Chairman/CEO

January 14, 1982
Date

8.0 SCHEDULE

The schedule proposed by Cygna to complete the effort associated with this Independent Design Verification Program is shown in Exhibit 8.1. This schedule reflects a manpower loading which is sufficient to complete the verification effort by April 13, 1983.

9.0 FINAL REPORT

The final report will be issued concurrently to the NRC and Detroit Edison on April 13, 1983. an outline of this report is provided below:

1.0 Executive Summary
- 1.1 Introduction
- 1.2 Project Organization
- 1.3 Review Objectives
- 1.4 Summary

2.0 Definitions and Notation

3.0 Review Approach
- 3.1 Collect Documents
- 3.2 Develop Criteria
  - 3.2.1 Design Control Criteria
  - 3.2.2 Technical
- 3.3 Procedures
  - 3.3.1 Checklists
  - 3.3.2 Observation Records
  - 3.3.3 Potential Finding Reports
- 3.4 Design Control and Technical Reviews
- 3.5 Project Review
- 3.6 Senior Review Team

4.0 Summary and Conclusions
- 4.1 Scope of Program
- 4.2 Results of Program
- 4.3 Design Control Review Conclusions
- 4.2 Technical Review Conclusions

Attachments:

Appendix A: Material Reviewed

Appendix B: Review Criteria

Appendix C: Checklists

C1 Design Control Review Checklists

C2 Technical Review Checklists

Appendix D: Potential Finding Reports

Appendix E: Observation and Observation Review Records

Appendix F: Statement of Independency

Figures

EXHIBITS

EXHIBIT 2.1

HORIZONTAL REVIEW

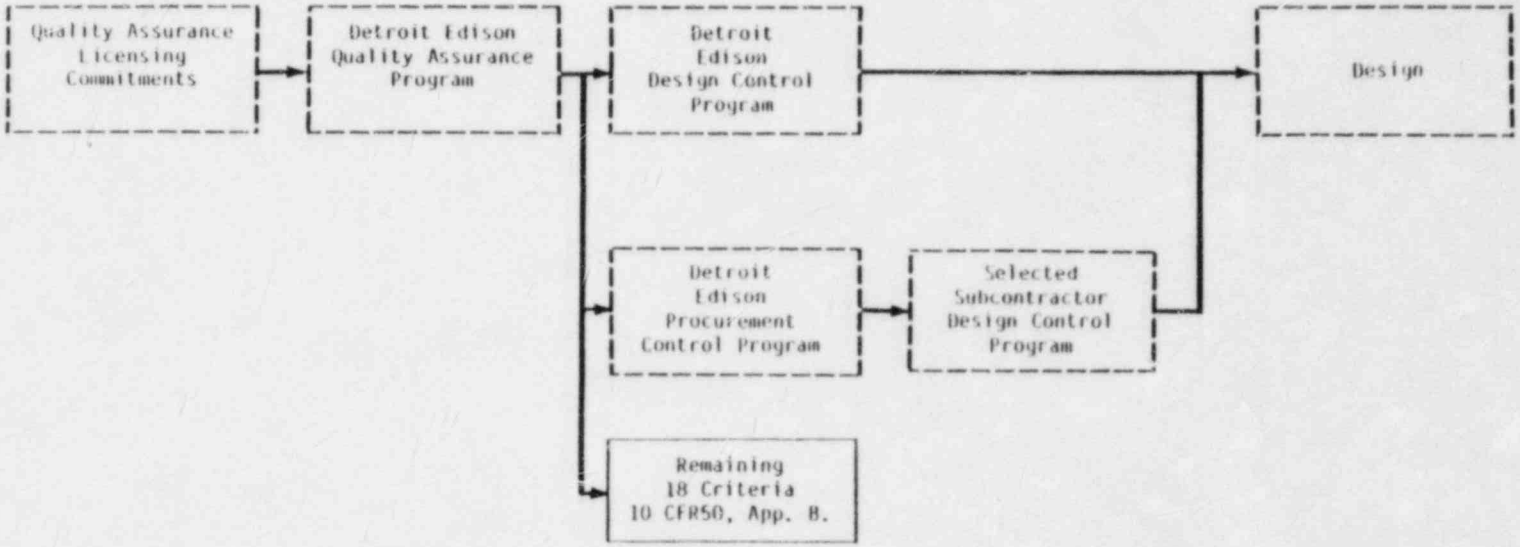


EXHIBIT 3.1

TERMINOLOGY

Term	Definition
Checklist	A listing of key items to be checked during the independent design review. The checklist provides a guide to the reviewer; it is neither all inclusive nor limiting
Review Criteria	A complilation of acceptable procedures and standards. The adequacy of the design and design control process is measured against these criteria.
Observation	Identification of an item in nonconformance with the project review criteria.
Invalid Observation	Any observation which is judged to be inaccurate as a result of further review.
Valid Observation	An accurate and complete observation as judged by the Project and Senior Review Teams.
Potential Finding	A valid observation having a potential impact on plant safety as judged by the project review team.
Vertical Review	A review of selected systems or elements of the total plant design.
Horizontal Review	A quality assurance review of design control procedures and their implementation.
Definite Potential Finding	A potential finding verified by the senior review team to have a potential impact on plant safety. This is a reportable finding to Detroit Edison and the NRC.

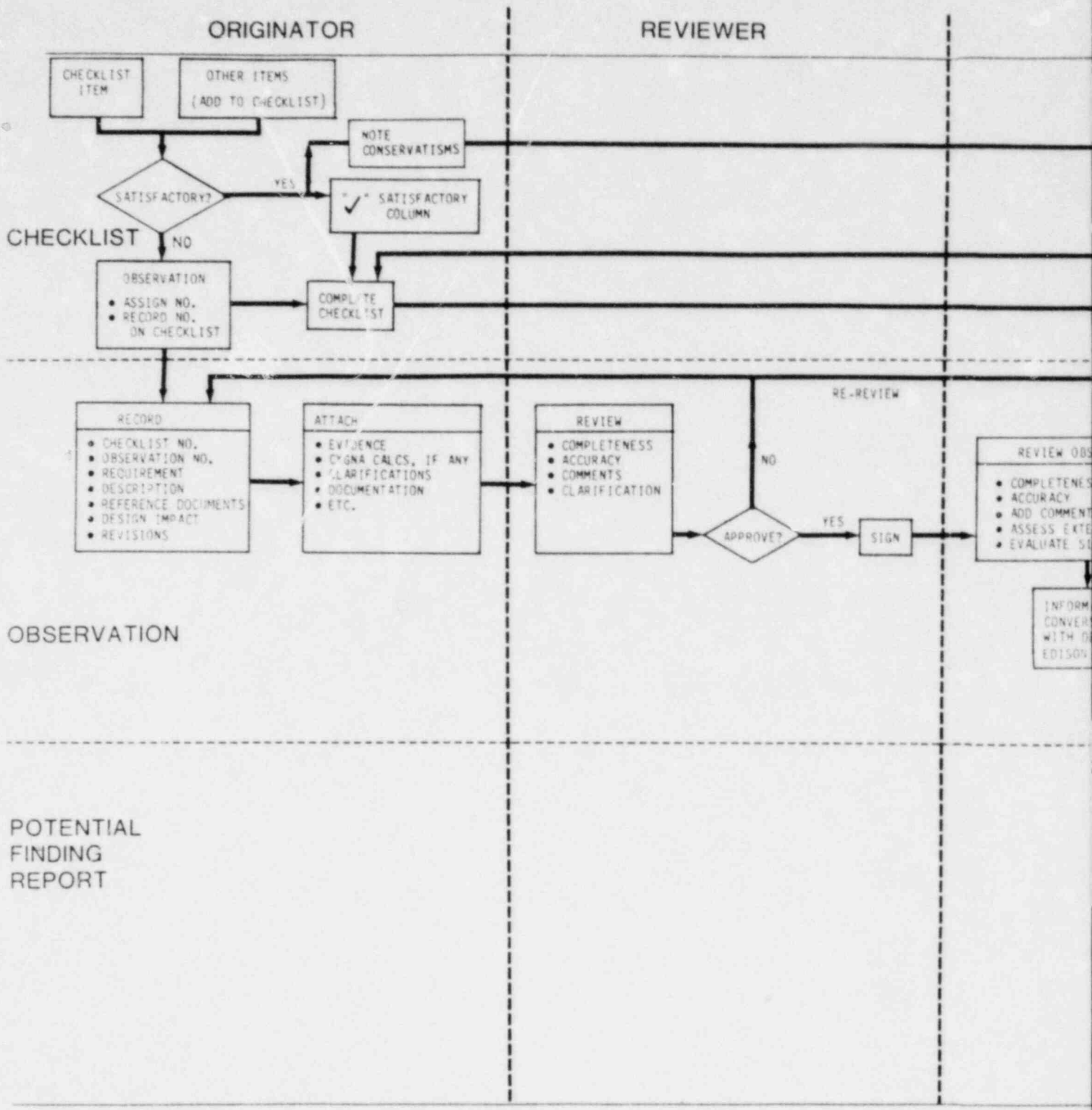
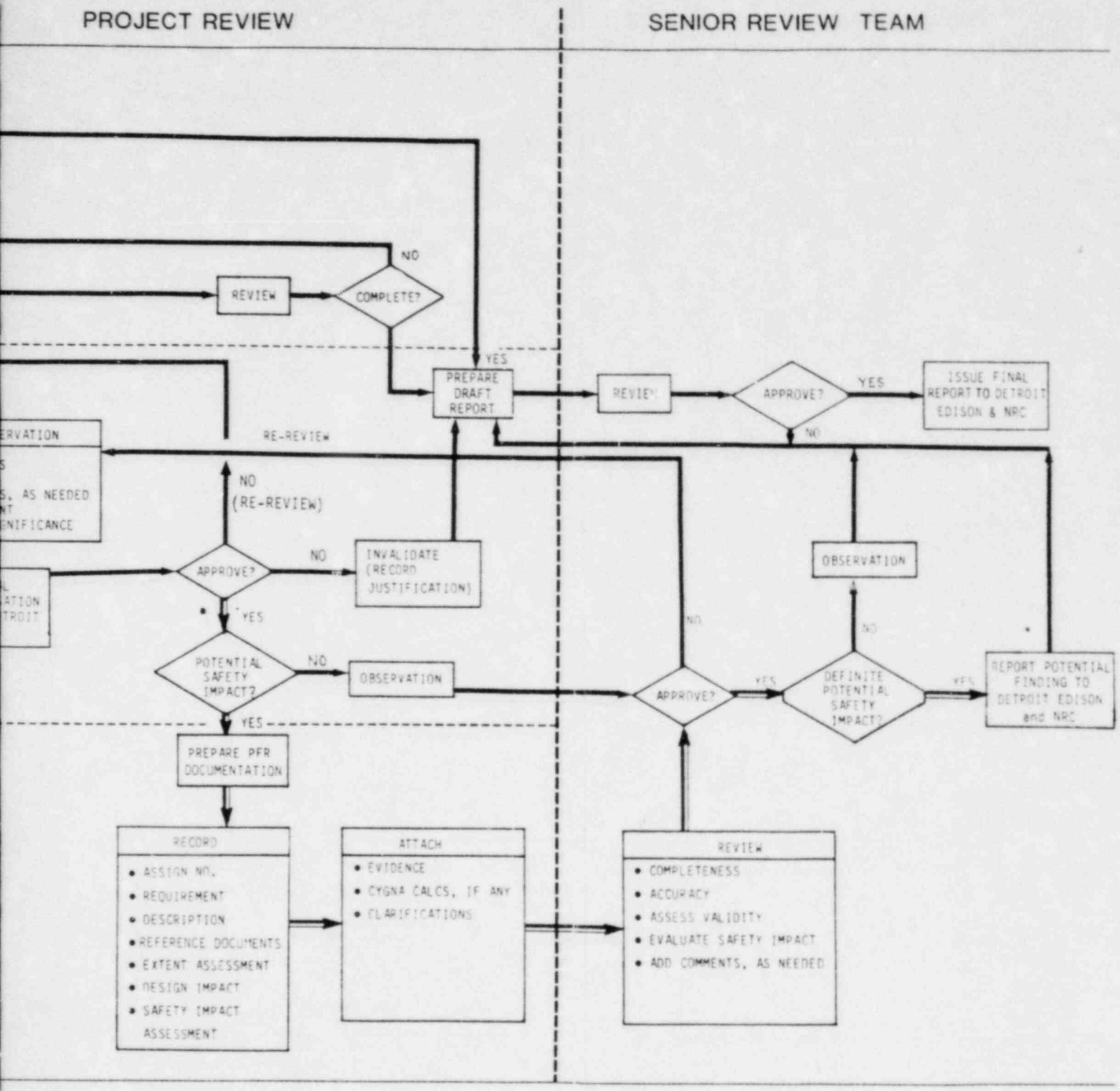


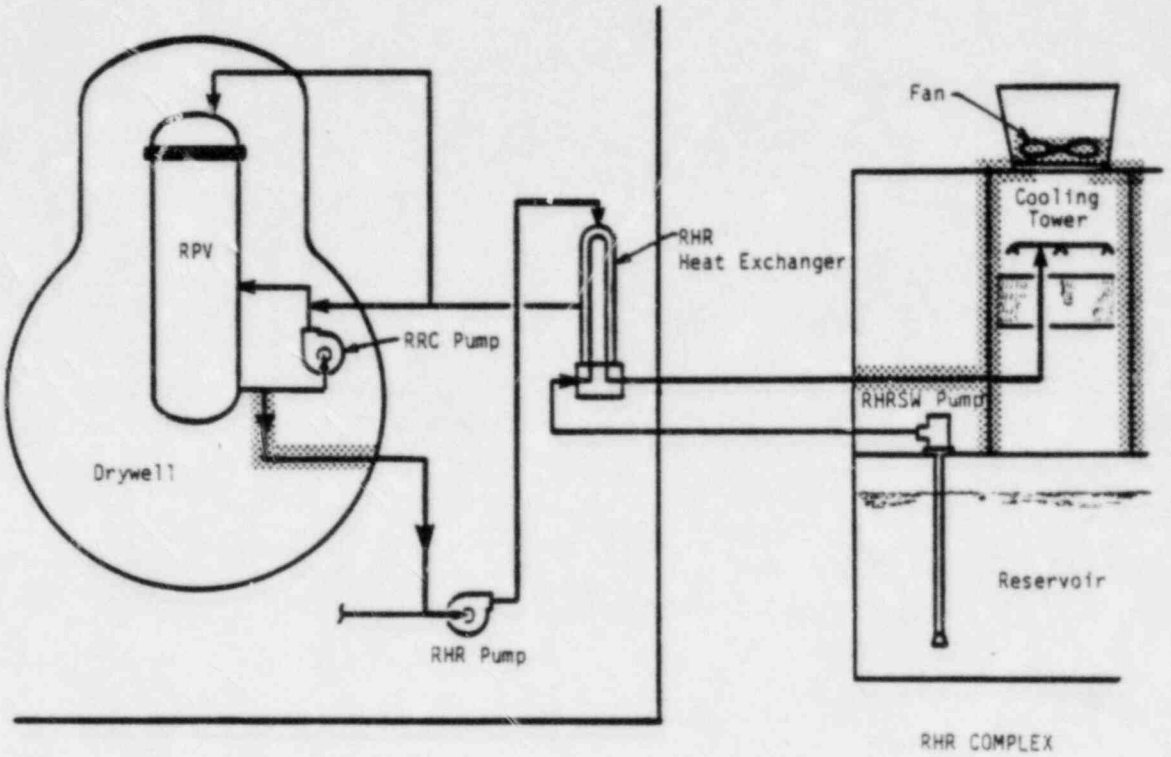
EXHIBIT 3.2 : Review Proce



ss Flow Chart

EXHIBIT 4.1

MAJOR SHUTDOWN
COOLING PATH SYSTEM



Legend

= In Scope Work

EXHIBIT 4.2

VERTICAL REVIEW
RHR COOLING

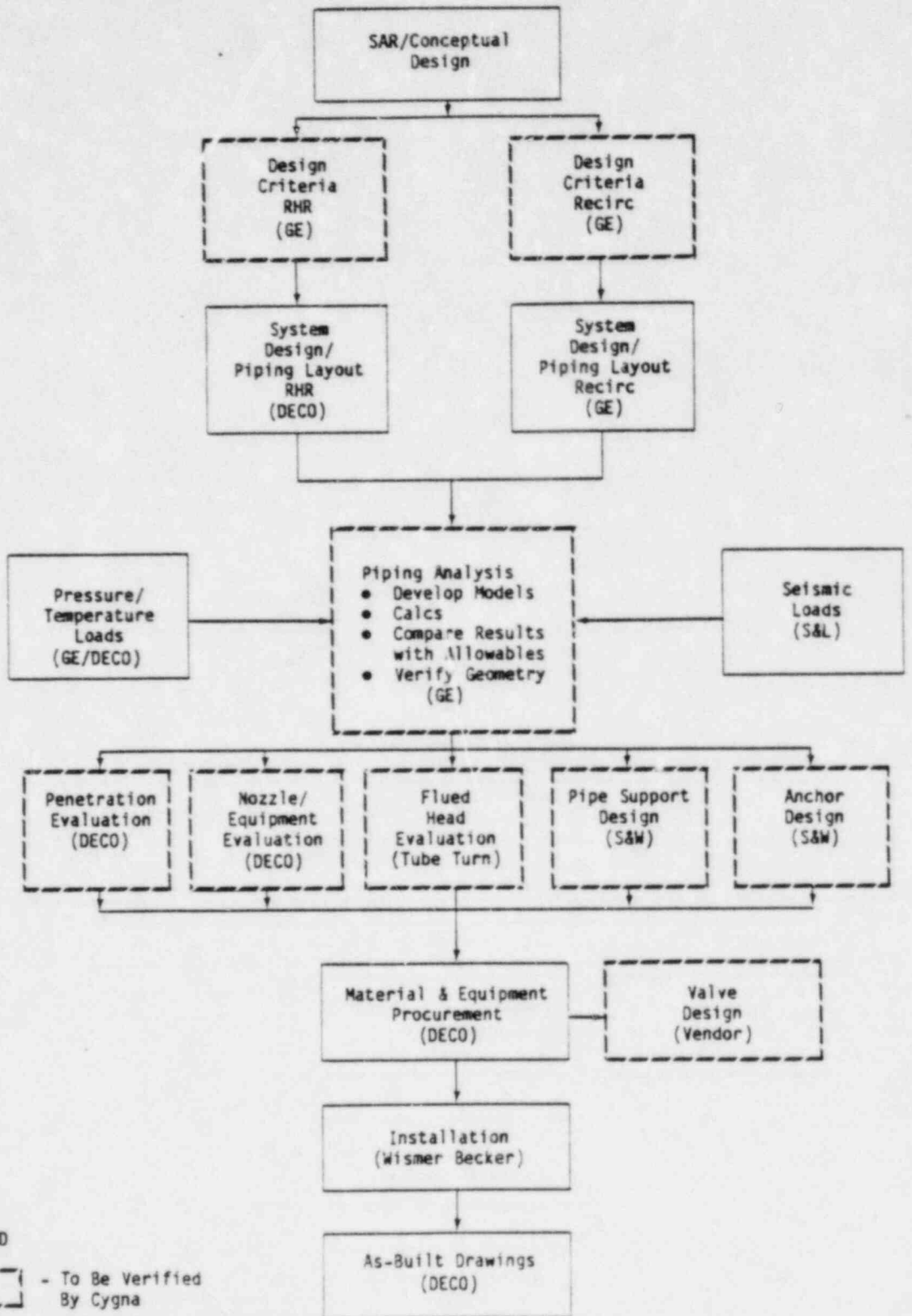


EXHIBIT 4.3
RHR SHUTDOWN COOLING MODE ELEMENT

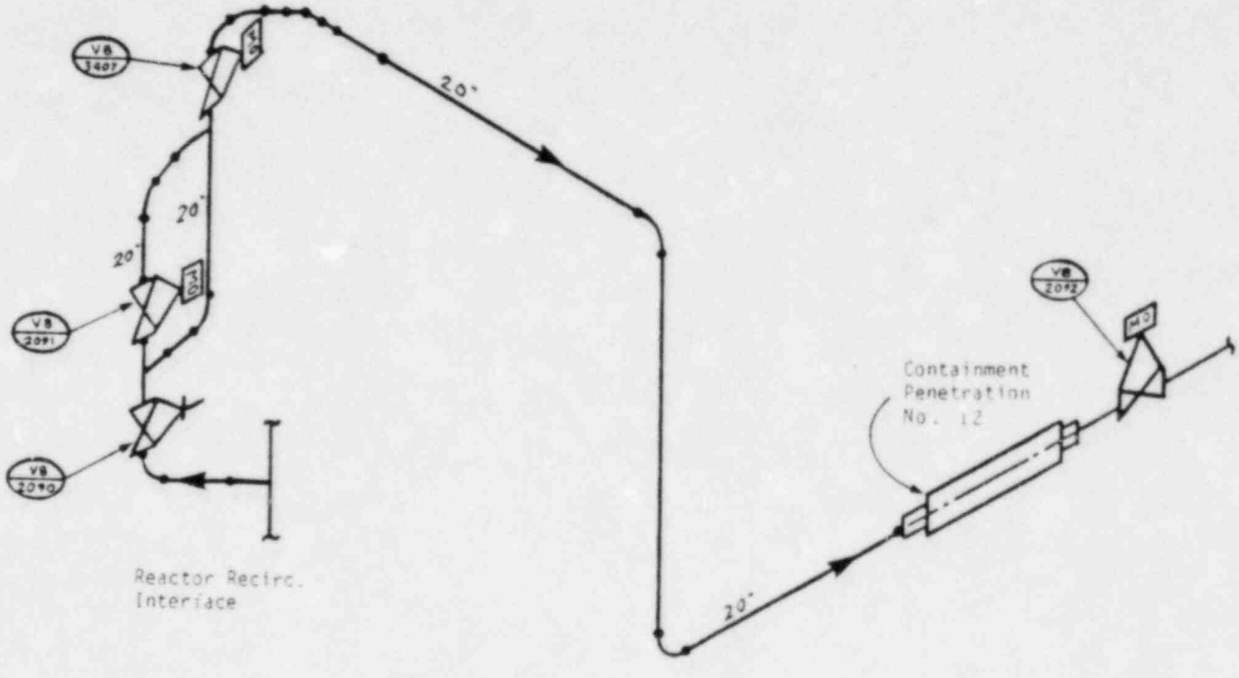


EXHIBIT 4.4

RESPONSIBILITY MATRIX
(RHR COOLING)

		DECO	S&L	GE	S&W	Wismer Becker
1)	Conceptual Design	X				
2)	Design Criteria	X		X		
3)	System Design	X		X		
4)	Piping Layout	X		X		
5)	Pipe Stress Analysis		X	X		
6)	Input to Pipe Stress					
	a) ARS		X			
	b) SAM		X			
	c) Hydrodynamic Loads		N/A			
	d) Support Stiff.			X		
	e) Valve Stem Flex	X				
7)	a) Nozzle Evaluation	X				
	b) Equipment Evaluation	X				
8)	Pipe Support Design			X	X	
9)	Pipe Anchor Design	X				
10)	Transfer of Load to Structure	X	X			
11)	Installation					X
12)	Purchase Spec.	X				
13)	As-Built Dwgs					
	a) Pipe	X				
	b) Pipe Supports	X				

EXHIBIT 4.5
VERTICAL REVIEW
RHR SW

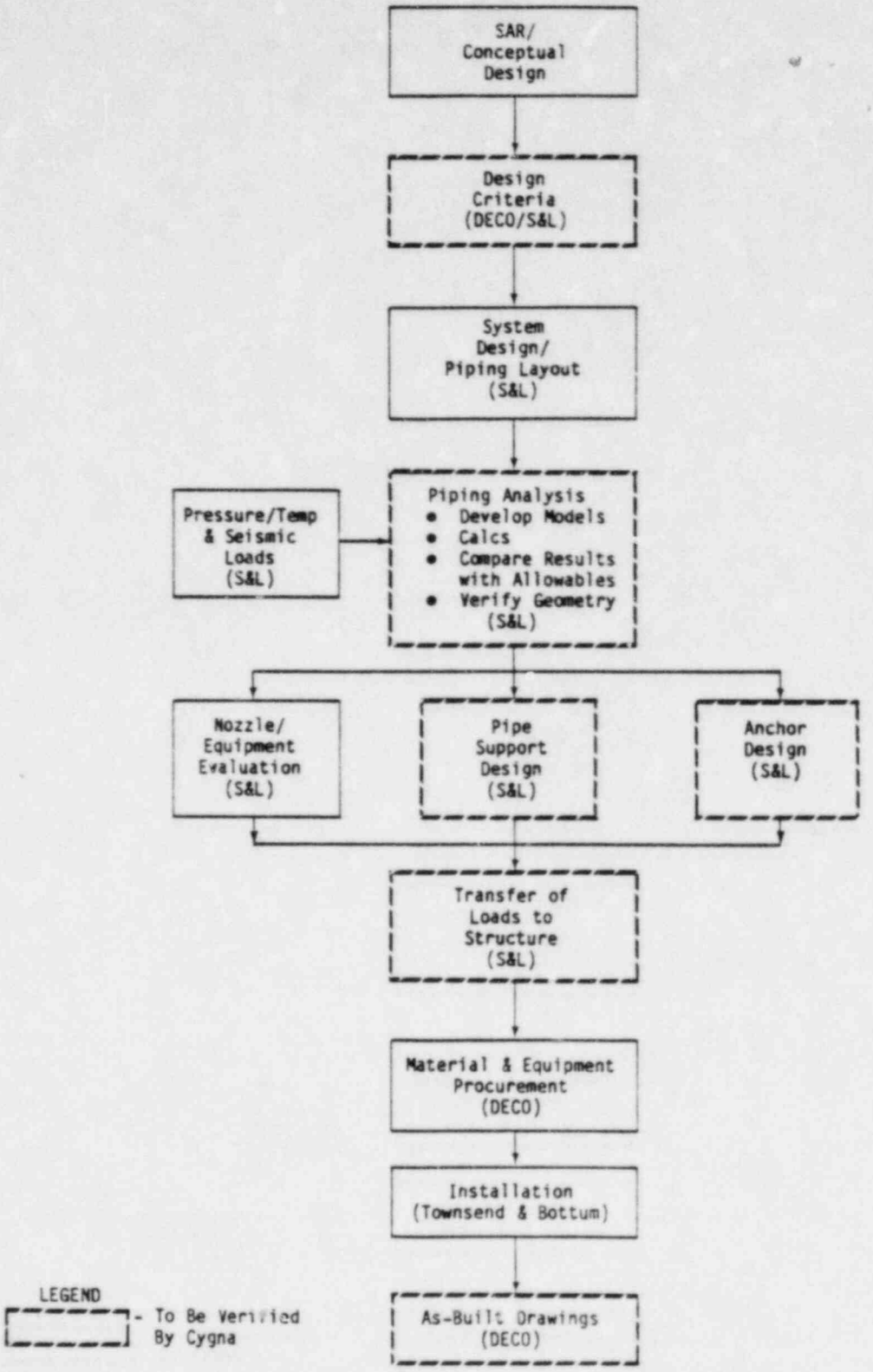


EXHIBIT 4.6

RHR SERVICE WATER ELEMENT

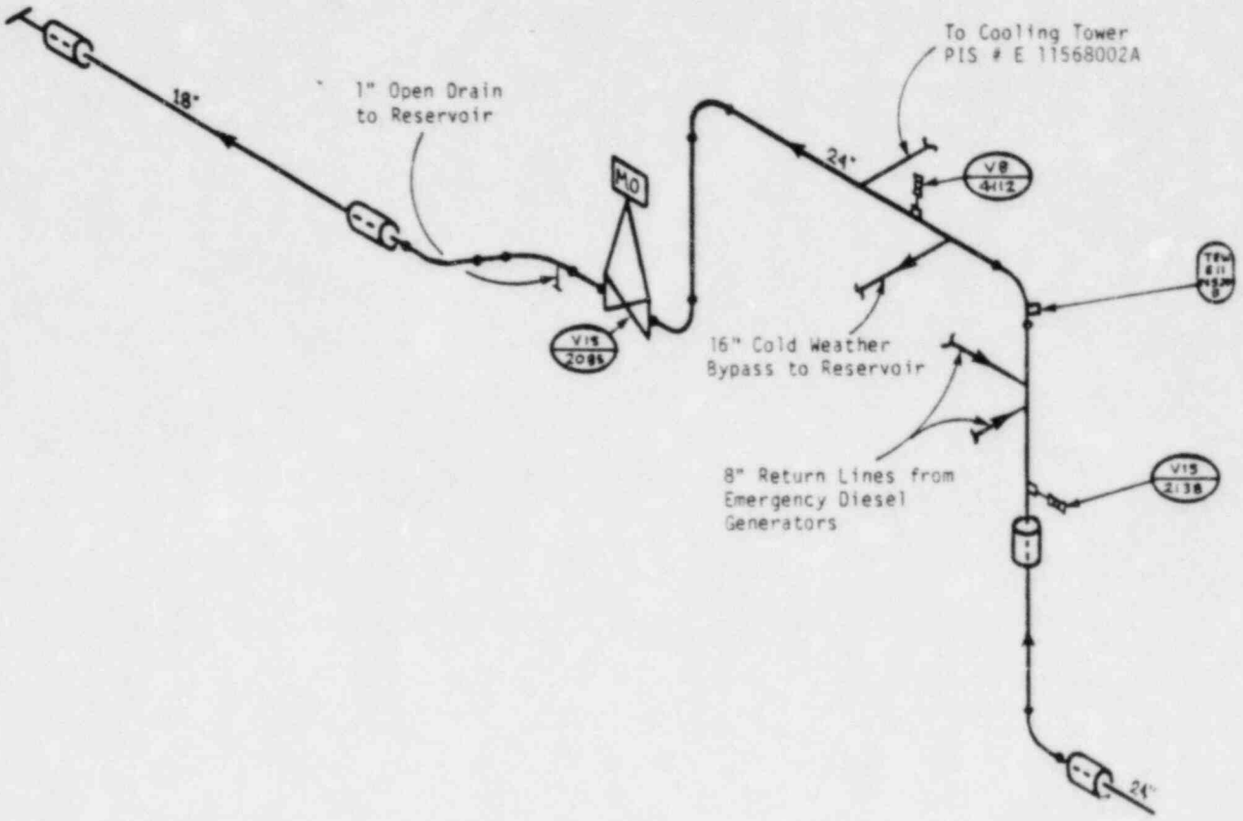


EXHIBIT 4.7

RESPONSIBILITY MATRIX
(RHR SW)

		DECO	S&L	Townsend & Bottum
1)	Conceptual Design		X	
2)	Design Criteria	X	X	
3)	System Design		X	
4)	Piping Layout		X	
5)	Pipe Stress Analysis		X	
6)	Input to Pipe Stress			
	a) ARS		X	
	b) SAM		X	
	c) Hydrodynamic Loads		N/A	
	d) Support Stiff.		X	
7)	a) Nozzle Evaluation		X	
	b) Equipment Evaluation		X	
8)	Pipe Support Design		X	
9)	Pipe Anchor Design		X	
10)	Transfer of Load to Structure		X	
11)	Installation			X
12)	Purchase Spec.	X		
13)	As-Built Dwgs			
	a) Pipe	X		
	b) Pipe Supports	X		

EXHIBIT 4.8

GENERAL ARRANGEMENT DRAWING,
RHR COMPLEX, ROOF PLAN

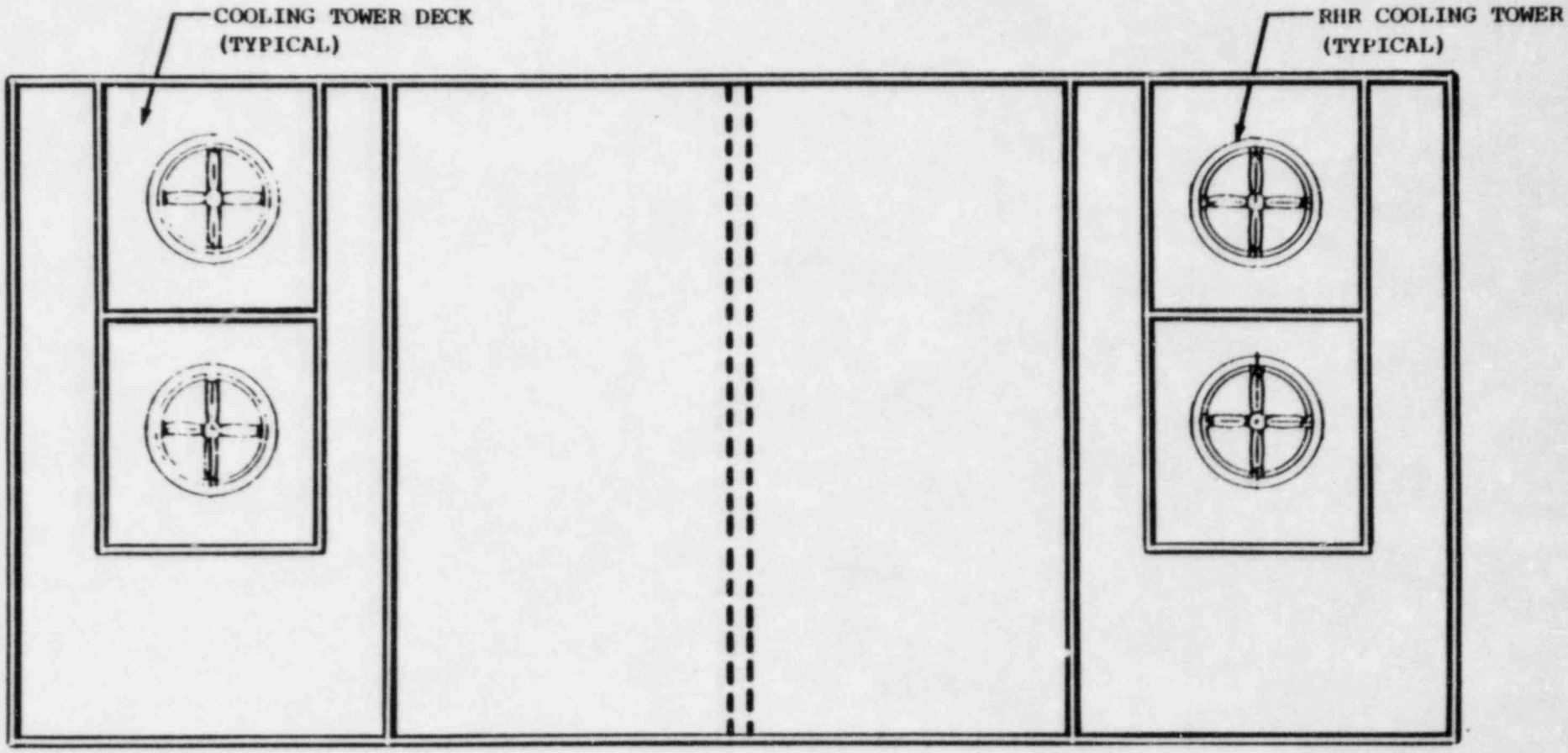


EXHIBIT 4.9

RHR COOLING TOWER FOUNDATION

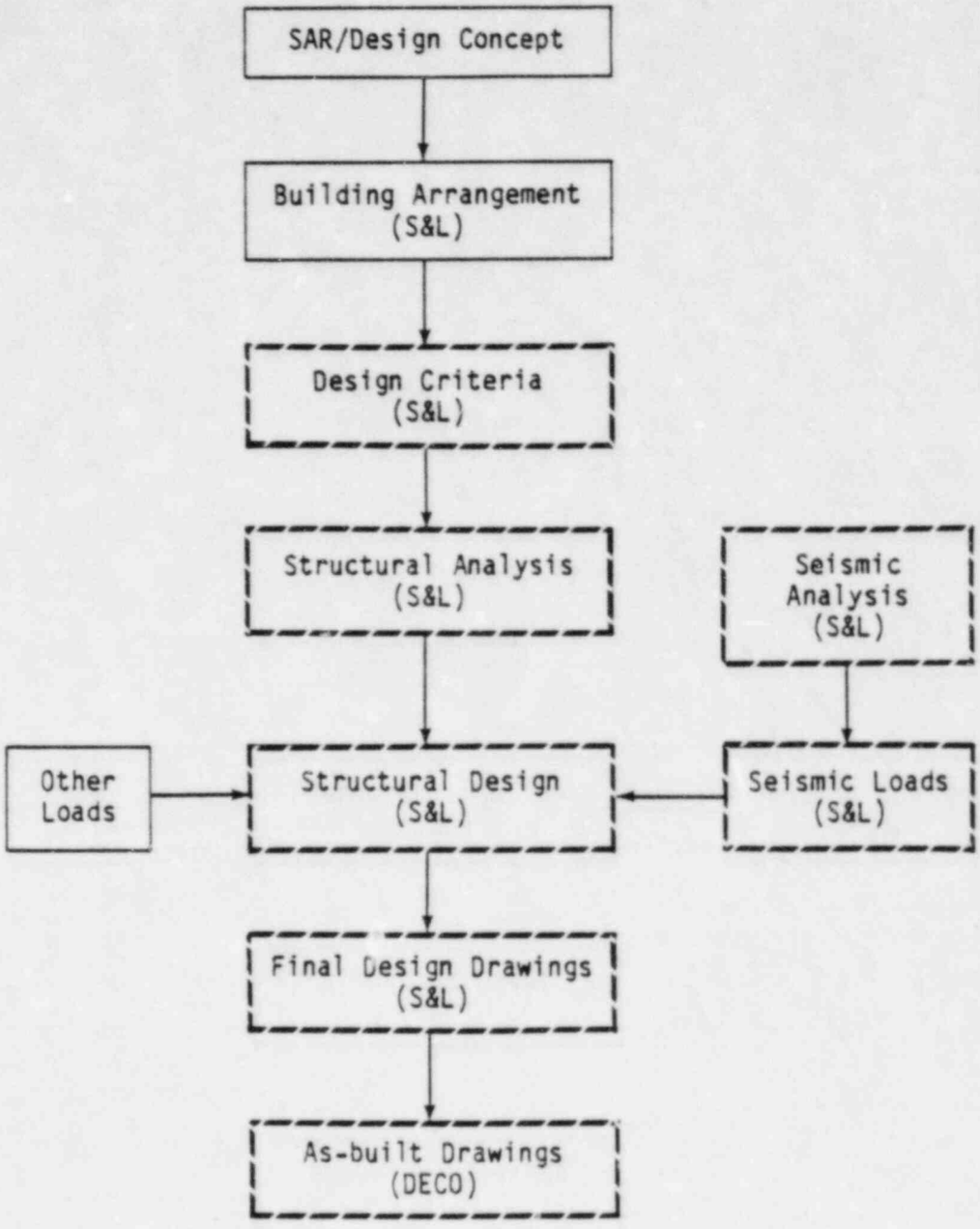


EXHIBIT 4.10

RESPONSIBILITY MATRIX
(COOLING WATER FDN)

		DECO	S&L
1)	Conceptual Design	X	
2)	Design Criteria	X	X
3)	Building Arrangement		X
4)	Seismic Analysis		X
5)	Structural Analysis		X
6)	Input Loads		
	a) Ground Spectra	X	
	b) Other Loads		X
	c) Equipment Evaluation		
7)	Structural Design		X
8)	Final Drawings		
9)	Purchase Spec.	X	X
10)	As-Built Dwgs	X	

EXHIBIT 4.11

VERTICAL REVIEW
ELECTRICAL DISCIPLINE

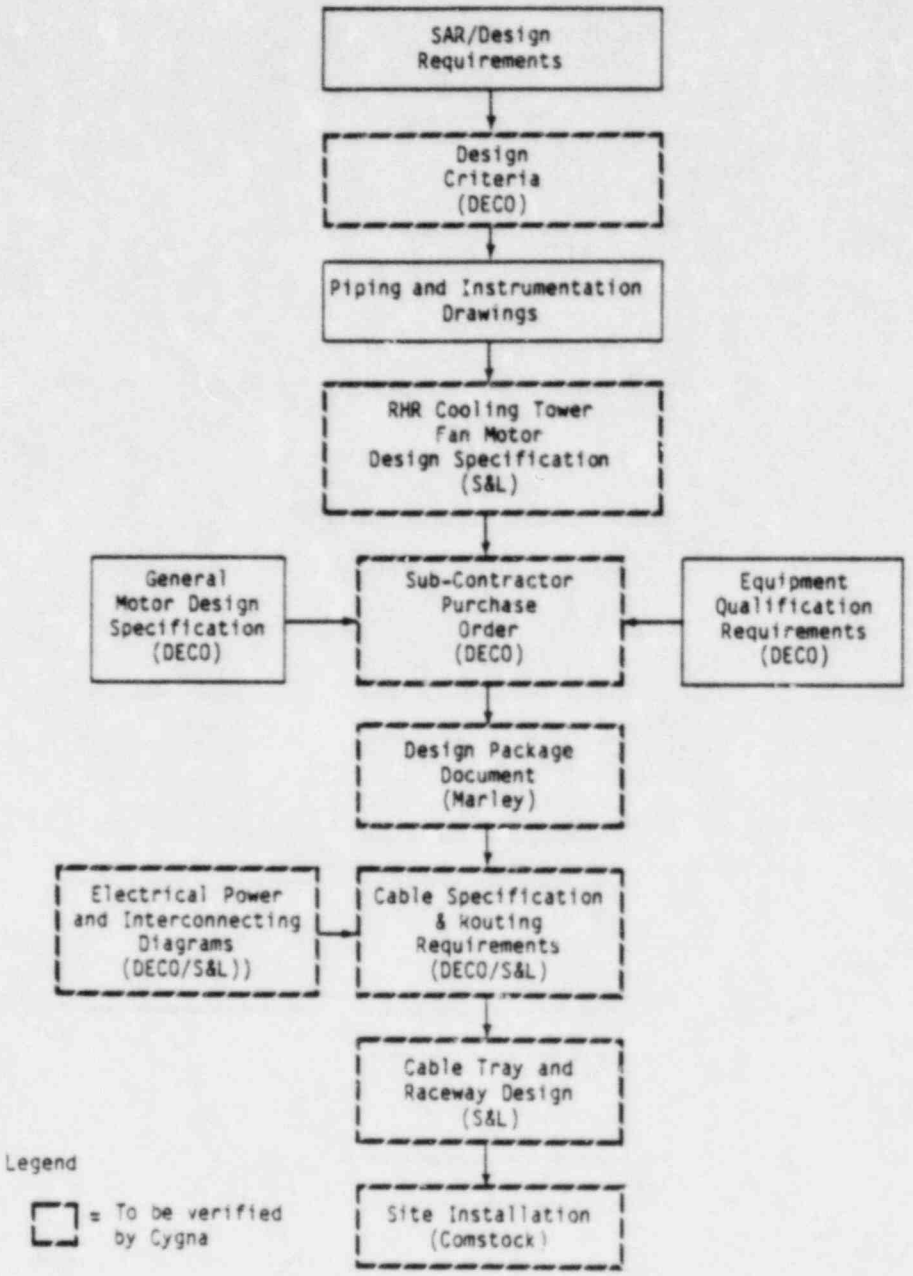
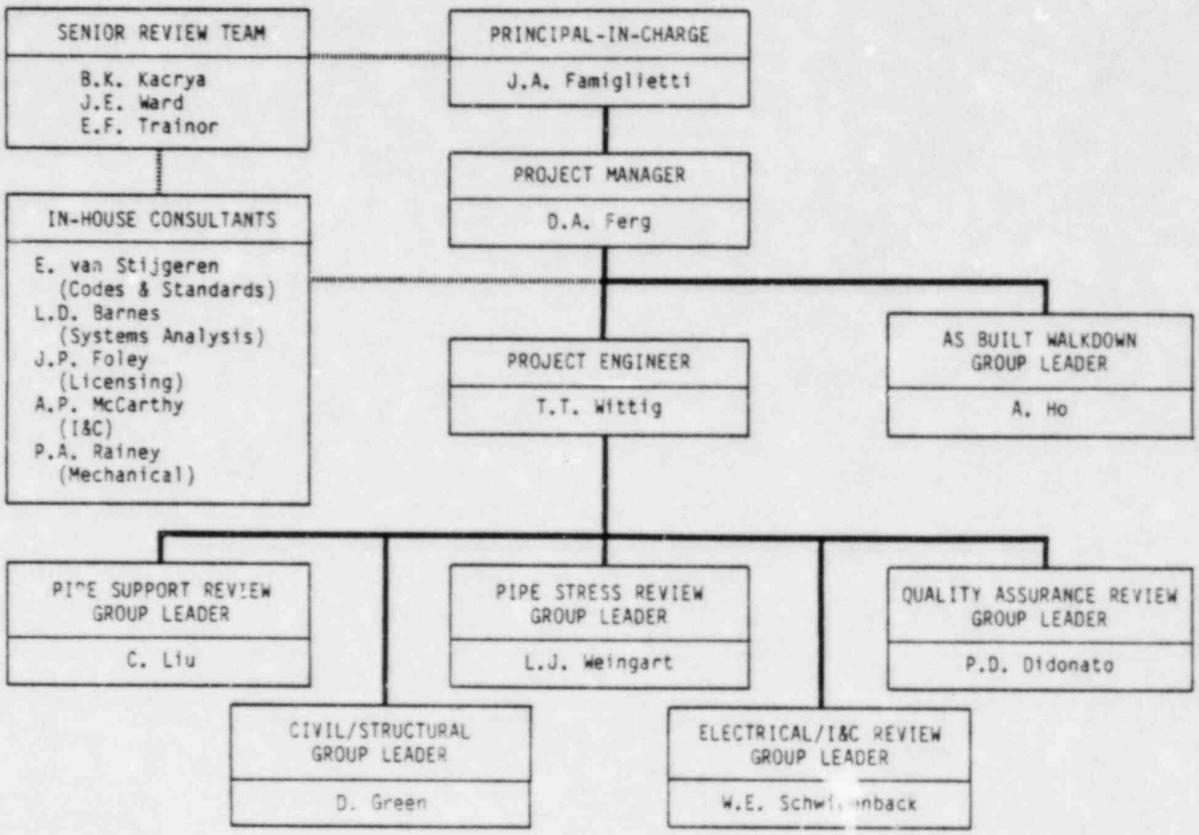


EXHIBIT 5.1
PROJECT ORGANIZATION



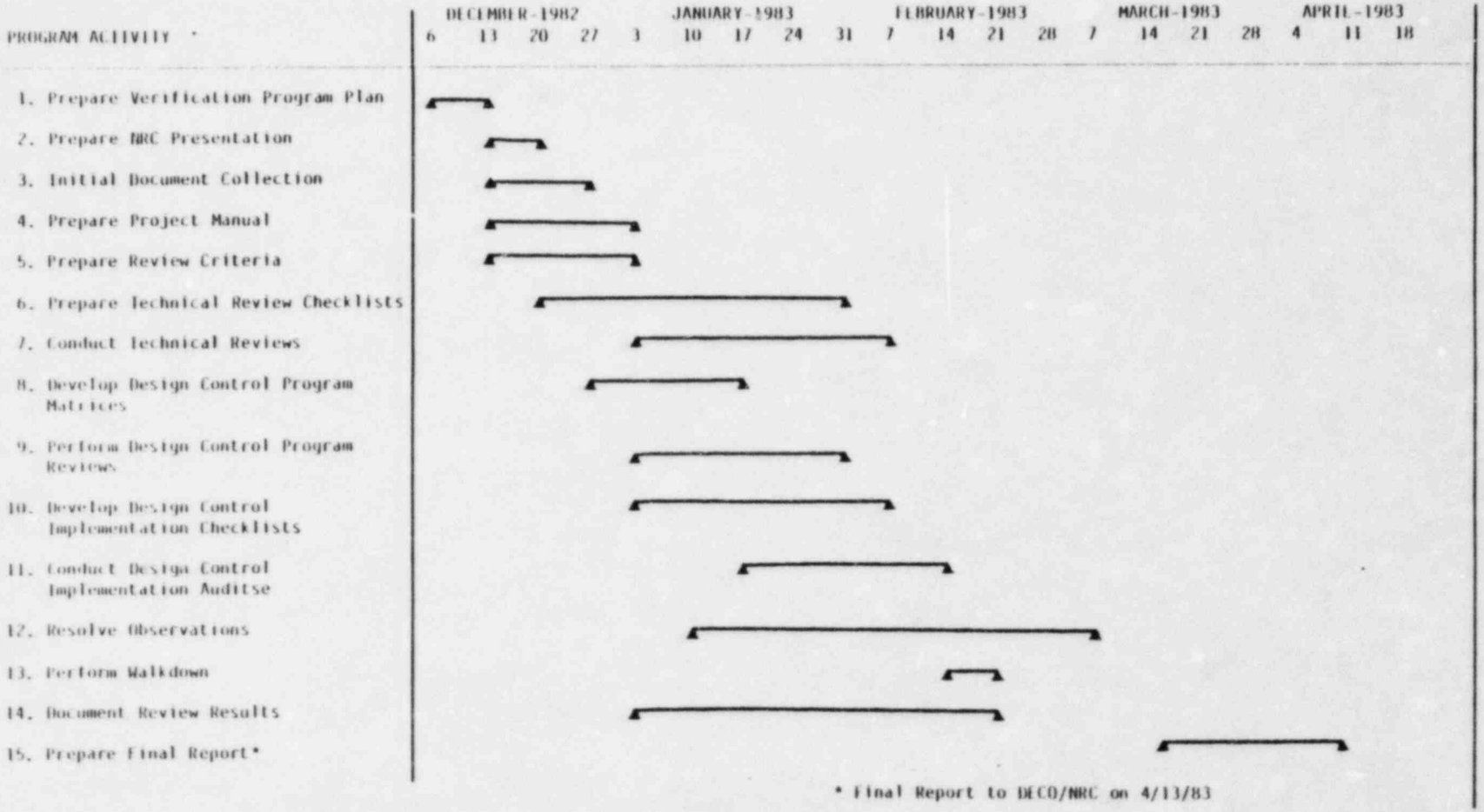
LEGEND

Project Direction

Consultation

EXHIBIT 8.1

SCHEDULE - INDEPENDENT DESIGN VERIFICATION PROGRAM
FOR FERMI 2



APPENDIX A

CYGNA

Potential Finding Report

PFR No.	Revision No.
	Sheet 1 of

I Description

Requirement

Reference Documents

Extent

Isolated	Extensive	Other (Specify)

Detroit Edison Company; 83021
Independent Design Review Program

CYGNA

Potential Finding Report

PFR No.

Revision No.

Sheet 2 of

Design Impact

Potential Safety Impact

Originated By Cognizant Group Leader — Date

Approved By Project Engineer — Date

CYGNA

Potential Finding Report

PFR No.

Revision No.

Sheet 3 of

II Senior Review Yes No

Further Review Required

Valid Observation

Potential Safety Impact

Comments

Approved By Cognizant Senior Reviewer Date

III Project Manager

Comments

Approved By Project Manager Date

Observation Log

Observation No.	Description	Classification								Rev. No.	Date
		Valid		Potential Finding		Definite Potential Finding		Open			
		Y	N	Y	N	Y	N	Y	N	Remarks	

Independent Design Review Checklist

Reviewer

Checklist No.

Problem No.

Date

Item	Satisfactory	Comments

Observation Record

Checklist No.	Revision No.
Observation No.	Sheet of
Originated By	Date
Reviewed By	Date

CYGNA

Observation Record Review
Attachment A

Checklist No.	Revision No.
Observation No.	Sheet of

	Yes	No
Valid Observation		
Potential Finding		
(PFR No.)		
Closed		

Comments

Approved By Project Manager Date

APPENDIX B

BEN K. KACYRA

EDUCATION:

M.S., Structural Engineering,
University of Illinois, Urbana, IL
B.S., Civil Engineering
University of Illinois, Urbana, IL

PROFESSIONAL REGISTRATION:

Registered Civil Engineer, California
Registered Structural Engineer,
California
Registered Structural Engineer, Ohio

PROFESSIONAL AFFILIATIONS:

Member, American Nuclear Society
Member, Earthquake Engineering Research Institute
Member, Seismological Society of America
Member, American Society of Civil Engineers
Member, American Concrete Institute
Member, Structural Engineers Association of California
Expert Examiner, Structural Examination, California State Board of Registration for Professional Engineers

PROFESSIONAL EXPERIENCE:

Mr. Kacyra has been practicing structural engineering for more than eighteen years, more than twelve of which have been in the field of structural analysis and earthquake engineering. His major expertise is in the fields of structural criteria development and seismic risk analysis. He has also gained broad experience in the development and application of advanced analytical techniques essential in the achievement of imaginative engineering designs.

As Chief Executive Officer of CYGNA since 1973, he has been personally involved in all Cygna projects. His work includes problem definition, determination of criteria, establishment of procedures and evaluation of results.

Some of the significant projects he has worked on as Principal-in-Charge during the past two years are:

- Seismic evaluation of the Yankee Rowe Nuclear Station in response to the NRC Systematic Evaluation Program (SEP).

This project requires a wide spectrum of involvement from cost evaluation, criteria development, and analysis, to implementation of design fixes.

- Methodology for structural performance criteria determination for thermal electric generation and transmission facilities, for California Energy Resources Conservation and Development Commission.

- Feasibility of a rational approach to damage mitigation in existing structures exposed to earthquakes, for the National Science Foundation.

- Seismic requalification of the Humboldt Bay Nuclear Power Plant structures and equipment systems which included the development of fixes for the structures and equipment.

- Structural engineering and seismic risk analysis on a $80,000,000 federal complex in Anchorage, Alaska.

- Seismic design criteria and structural review of the Yerba Buena Convention Center, San Francisco.

PUBLICATIONS:

"Seismic Risk Analysis Optimizes Life Cycle Costs," presented at the ASCE National Structural Engineering Conference, Madison, Wisconsin, August 1976.

"Dynamic Response of a Four Storied Building to Changes in Its Configuration," ASCE/SEAONC New Earthquake Design Provisions Seminar, November 1975.

"Application of Dynamic Analysis," with Sanford Tandowsky, ASCE/SEAONC New Earthquake Design Provisions Seminar, November 1975.

"Computer Methods vs. Hand Methods in the Lateral Analysis of Multistory Shear Wall Buildings," with Ashraf Habibullah, presented to the Advisory Board of the California State Office of Architecture and Construction, November 1975.

"Behaviour of Structures Under Earthquake Motion," presented at the Seminar of the Hospital Council of Northern California, December 1974.

Reports to the Seismology Committee of SEAONC:

"Report of the Overturning and Load Factor Subcommittee," 1970.

"Report of the Overturning Subcommittee," 1971.

"Report of the Vertical Acceleration Subcommittee," 1972.

"In-Situ Testing for Seismic Evaluation of Humboldt Bay Nuclear Power Plant for Pacific Gas and Electric Company," with N. Chauhan, Transactions of the Fourth International Conference on Structural Mechanics in Reactor Technology, San Francisco, California, August 1977.

"Seismic Evaluation and Modification of the Humboldt Nuclear Power Plant, Unit 3," with N. Chauhan et al, accepted for presentation at the Third ASCE Specialty Conference on Structural Design of Nuclear Plant Facilities, Boston, Massachusetts, April 1979.

"A Methodology for the Determination of Seismic Resistant Design Criteria," with J. Vallenas, presented at the Second U.S. National Conference on Earthquake Engineering, Stanford, California, August 1979.

JOHN E. WARD

EDUCATION:

M.S., Nuclear Physics,
University of California, Berkeley, CA
B.S., Naval Engineering,
U.S. Naval Academy,

PROFESSIONAL REGISTRATION:

Registered Professional Mechanical Engineer, California
Registered Professional Nuclear Engineer, California

PROFESSIONAL AFFILIATIONS:

Member, American Nuclear Society
Member, American Society of Mechanical Engineers
Member, Atomic Industrial Forum
Member, California Society of Professional Engineers
Member, National Society of Professional Engineers
Institutional Representative to the Pacific Coast Electrical Association
Institutional Representative to the North West Electric Light and Power Association
Institutional Representative to the Rocky Mountain Electric Association
Chairman, Reactor Licensing and Safety Committee, AIF

PROFESSIONAL EXPERIENCE:

Mr. Ward is the Chairman and Chief Executive Officer of Cygna Energy Services responsible for the overall operation and performance of the Company.

Prior to joining Cygna, Mr. Ward held the position of Vice President at Sargent and Lundy. In this capacity, Mr. Ward was responsible for Sargent and Lundy's Los Angeles office, as well as for business development on a firmwide basis for the organization. Mr. Ward played an active role in the nuclear industry by chairing the Atomic Industrial Forum's Committee on Reactor Licensing and Safety. In this capacity, he was instrumental in the development of several NRC/Industry task force approaches to solving licensing issues. This work resulted in his being named the first recipient of the AIF's Clyde A. Lilly Award. This award, named for the former AIF Chairman of the Board, is given annually to an individual who is judged to have made an

"outstanding contribution to the technical development, regulatory climate or public acceptance of nuclear energy. The quality of such service is measured by: leadership demonstrated by formulating, reconciling and advancing industry position on nuclear policy, time and effort devoted to Forum programs, and effectiveness in bringing issues key to nuclear development closer to resolution."

In 1973, Mr. Ward was named General Manager of Sargent and Lundy's Los Angeles affiliate, S&L Engineers, when it was first established. He was active in establishing the facilities and procedures for this new affiliate, as well as engaging the principal staff. He was responsible for directing the administrative and engineering program, as well as business development in the western United States.

In 1968, Mr. Ward joined Sargent and Lundy as a Nuclear Project Engineer. As a Nuclear Project Engineer his principal responsibilities included the Zion Nuclear Station and the William H. Zimmer Nuclear Station.

In 1967, Mr. Ward joined the Commonwealth Edison Company in Chicago as Project Engineer on their Zion Station.

Prior to joining Commonwealth Edison, Mr. Ward spent 15 years in the Navy. His primary experience involved command-at-sea, as well as administrative assignments in the areas of practical research, development, and test and evaluation procedures for surface weapons systems.

JOSEPH A. FAMIGLIETTI, JR.

EDUCATION:

M.S., Structural Engineering
Cornell University, Ithaca, New York
B.S., Civil Engineering
University of Notre Dame, South Bend, Indiana

PROFESSIONAL AFFILIATIONS:

Member, American Society of Civil Engineers

PROFESSIONAL EXPERIENCE:

Mr. Famiglietti has over 13 years of experience in structural analysis and design, as well as project management of nuclear and conventional power plant projects. He is currently the Vice-President and General Manager in charge of operations at Cygna's Chicago office. His scope of responsibility includes management direction of the Chicago Area Office in all technical, administrative and contractual matters.

Prior to this assignment, Mr. Famiglietti was Manager of Projects for Cygna's Boston office, responsible for staffing, development of project plans, schedules and controls, and ensuring the overall technical adequacy of the work performed.

Prior to joining Cygna, Mr. Famiglietti held the position of Principal Civil Engineer and Civil/Structural Group Leader in Boston Edison Company's Nuclear Engineering Department. In this capacity he was responsible for the technical direction of all civil/structural related work on Pilgrim 1 and Pilgrim 2.

During his seven years at Edison, Mr. Famiglietti served as Project Manager for several large Pilgrim 1 projects, including the installation of a security system to meet the requirements of 10CFR73.55, and the design and construction of new service and office facilities for the Pilgrim site. He also served as Project Engineer responsible for the implementation of NRC I&E Bulletins 79-02, 79-07, and 79-14.

JOSEPH A. FAMIGLIETTI, JR.
(continued)

In support of the Pilgrim 2 application, Mr. Famiglietti managed an extensive study of the geology and seismicity of the New England region, as well as a study on the liquifaction potential of the soil at the Pilgrim site. The results of both studies were successfully presented to the Nuclear Regulatory Commission. He was also responsible for the preparation, presentation, and defense of these results before the ACRS and formal testimony before the ASLB.

Previous power plant experience included employment by United Engineers and Constructors, Inc., where Mr. Famiglietti served as a Structural Engineer on various fossil power plant projects. His responsibilities included the design and analysis of structural steel framing members and duct work. He also developed computer programs for the analysis of steel base plates and beams under axial loads.

PUBLICATIONS: "Behavior of Concrete Hyperbolic Paraboloid Umbrella Shells" by R.N. White, K.C. Cheung, and J.A. Famiglietti. Presented at American Soceity of Civil Engineers National Structural Engineering Meeting, Portland, Oregon, April 6, 1970.

DAVID A. FERG

EDUCATION:

Ph.D., Nuclear Engineering (Electrical Engineering Minor), University of Arizona
B.S., Electrical Engineering, Valparaiso University

PROFESSIONAL LICENSES:

SRO License, Westinghouse Nuclear Training Reactor

PROFESSIONAL ACTIVITIES:

Member, Tau Beta Pi Honorary Engineering Society

PROFESSIONAL EXPERIENCE:

Dr. Ferg has over 11 years experience in the nuclear power industry. As a Project Manager with Cygna, he is responsible for planning and scheduling, budgeting and manning of those projects under his control. Dr. Ferg recently completed an assignment on a Public Service Indiana self-initiated INPO evaluation of Marble Hill and serves as Project Manager for engineering work underway with Commonwealth Edison.

Prior to joining Cygna, Dr. Ferg spent nine years with Westinghouse Electric Corporation in positions of increasing responsibility. His last position with Westinghouse was Manager of Computer Systems at the Nuclear Training Center (NTC) in Zion, Illinois. In this position, his responsibilities included the development and upgrading of the Zion and SNUPPS I plant simulator systems, management and development of a third simulator system, and development of a computer-aided project monitoring system. While at the WNTC, Dr. Ferg assisted in the development of course material and training aids and presentation of this material to various classes.

Prior to his assignment at the WNTC, Dr. Ferg was a Senior Project Engineer at the Comanche Peak Steam Electric Station. His responsibilities included the technical interface and licensing coordination between the Utility, the A/E, the NSS Supplier and the Constructor. He was also involved in the initiation of a program for the environmental qualification of electrical equipment at Comanche Peak.

DAVID A. FERG
(Continued)

During his employment at Westinghouse, Dr. Ferg assisted in the preparation of testimony for ASLB hearings on Beaver Valley, Prairie Island, Catawba, and Jamesport. He also participated in a task force established to show compliance with the August 1973 Appendix K Acceptance Criteria for Emergency Core Cooling Systems.

Dr. Ferg was an original member of Westinghouse's Campus America program which involved numerous public debates, interviews and speeches. In June/July 1979, he testified before the President's Commission in Manila, Philippines on the safety implications of the TMI accident on the Napot Point Nuclear Plant.

SCHOLARSHIPS AND AWARDS:

National Science Foundation Traineeship, University of Arizona, 1965-66, 1966-67, 1967-68, 1968-69

A. Sturm and Sons Memorial Scholarship, Valparaiso University, 1963-64, 1964-65

TED T. WITTIG

EDUCATION: B.S., Civil/Structural Engineering,
Michigan Technological University,
Houghton, MI

PROFESSIONAL REGISTRATION: Civil Engineer, California

PROFESSIONAL EXPERIENCE:

Mr. Wittig has over twelve years of experience in structural engineering, including Containment Building design, structural analysis, equipment qualification, seismic modeling and analysis, licensing, quality, engineering and PSAR preparation. As Manager of Projects in the San Francisco Office, Mr. Wittig is directly responsible for all project management and engineering activities on projects at this Office. In addition, Mr. Wittig acted as project manager for the Independent Design Review for Mississippi Power & Light Company.

Prior to joining Cygna, he was employed by a major architect/engineer. As the Civil/ Structural Group Supervisor and Assistant Project Engineer for an LMFBR Study, he was responsible for the conceptual analysis and design of all structures. Prior to that he acted as liaison between the home office and client, and served as technical reviewer on the client's staff.

Mr. Wittig also functioned as the civil licensing engineer responsible for the PSAR for a commercial PWR nuclear power plant. In this assignment, he was additionally responsible for the civil/structural design criteria, soil-structure interaction seismic analysis, the seismic specification for mechanical equipment, tornado and turbine missile impact studies, and liquefaction study, as well as design and analysis for the circulating water system intake structures. The licensing, quality control, seismic and missile impact tasks required frequent interfacing with other disciplines during the design of safety systems.

Mr. Wittig's previous experience has included design of roads, railroads, and structures for a major project, including Containment Building shell and base-mat design

TED T. WITTIG
(continued)

using the axisymmetric finite element program FINEL. This experience also included seismic modeling and analysis for the Reactor Containment Building plus analysis and design of the reactor cavity, reactor, and guard vessel support structures.

PAUL D. DIDONATO

EDUCATION:

B.S., Business Administration, Industrial Technology, Northeastern University, Boston, MA
A.S., Civil and Highway Engineering Technology, Wentworth Institute of Technology, Boston, MA

PROFESSIONAL AFFILIATIONS:

Member, American Society for Quality Control

PROFESSIONAL EXPERIENCE:

Mr. DiDonato has over eight years of experience in the nuclear industry. Presently, he is assigned as the Quality Assurance Operations Supervisor, Western Region, and is responsible for the implementation of the Cygna Quality Assurance Program for all West coast Regional offices including San Francisco, San Diego, and Richland. Mr. DiDonato acted as Quality Assurance Review Group Leader for the Independent Design Review for Mississippi Power and Light Company. Prior to his assignment on the West coast, Mr. DiDonato was assigned as a Project Quality Assurance Engineer in Cygna's Boston Regional office. He was responsible for the quality assurance implementation of all Boston office based nuclear projects, in addition to interfacing with client QA organizations.

Prior to joining Cygna, Mr. DiDonato was a member of the Quality Assurance Department of a major East coast A/E. His initial responsibilities included the development and presentation of Quality Assurance training programs. He specialized in the requirements of ASME III Division 1, Industry Auditing Standards and Regulatory Guides, as they relate to nuclear power plant construction.

Mr. DiDonato was subsequently promoted to the position of Engineer in the Quality Assurance Auditing Division. In that capacity, he was responsbile for the preparation and conduct of headquarters, site and sub-contractor quality assurance audits during pre-construction and construction phases of all active nuclear power plant projects. Mr. DiDonato was subsequently promoted to the positions of Quality Assurance Engineer and Lead Auditor. In the latter capacity, he assumed the responsibilities of a lead auditor for audits conducted in accordance with ANSI N45.2.23.

PAUL D. DIDONATO
(continued)

Mr. DiDonato's additional responsibilities included the coordination of all audit activities performed at the Shoreham Nuclear Power Station, annual trend analysis of quality activities, preparation/revision of audit procedures, and conduct of seminars for the purpose of auditor certification.

DON GREEN

EDUCATION:

M.S., Civil Engineering,
New Mexico State University,
Las Cruces, NM
B.S., Civil Engineering,
New Mexico State University,
Las Cruces, NM

PROFESSIONAL EXPERIENCE:

Mr. Green has more than twenty years of experience in the structural engineering field. His experience has been divided between teaching Civil Engineering at the University level and doing structural analysis and design in the aerospace and nuclear field.

Mr. Green is currently a Project Manager at Cygna Energy Services. He also has overall responsibility for the computer program verification activities within Cygna.

Mr. Green's previous industry experience includes:

- Engineering Specialist at Bechtel, San Francisco, CA; experience in analysis and design of nuclear power plants, including structures, components, equipment and their supports, as well as computer application.

- Senior Research Engineer at the Boeing Company, Renton, WA; experience in fatigue and fail-safe analysis of aircraft structures, computer applications.

- Research Engineer at the Naval Civil Engineering Laboratory, Port Hueneme, CA; experience in structural dynamics, structural design, materials and photo-elastic analysis.

  Additional experience in computer applications at the Air Force Flight Dynamics Laboratory, University of Arizona and University of Hawaii.

Mr. Green's previous teaching experience includes:

- Assistant Professor, Engineering Department, Arkansas Tech, Russellville, AR

DON GREEN
(continued)

- Peace Corp Volunteer (teacher), Building Department, Takoradi Polytechnic, Takoradi, Ghana

- Assistant Professor, Civil Engineering Department, University of Hawaii, Honolulu, HA

- Teaching Assistant, Civil Engineering Department, University of Arizona, Tucson, AZ

- Teaching Assistant, Civil Engineering Department. New Mexico State University, Las Cruces, NM

PUBLICATIONS:

"Experimental Analysis of a Constant Stress Beam," Master's Thesis, New Mexico State University, 1973.

"Stress-Displacement Fields and Plate Flexibility Characteristics in Simulated Multiple-Fastener Joints," Boeing Document D6-24419, The Boeing Company, 1970.

"Summary and Discussion of the Replies to the Questionnaire Sent to the Naval Shore Establishment on the Use of Camels," T.N. 424, U.S. Naval Civil Engineering Laboratory, 1961.

"Foamed Plastics and Other Selected Insulating Materials," T.R. 101, U.S. Naval Civil Engineering Laboratory, 1960.

Co-authored:

"Design of Concrete Containments for Tangential Shear Loads," 4th International Conference on Structural Mechanics in Reactor Technology, San Francisco, CA, 1977.

"Blast Loadings on Eight-Foot Aluminum Beams," T.R. 148, U.S. Naval Civil Engineering Laboratory, 1961.

ALAN D. HO

EDUCATION:

M.S., Structural Engineering
Massachusetts Institute of Technology
B. Architecture (Structures)
University of Illinois, Chicago Circle

PROFESSIONAL ACTIVITIES:

Member, American Concrete Institute
Member, American Society of Civil Engineers
Member, Sigma Xi, M.I.T. Chapter, Scientific Research Society

EXPERIENCE:

Mr. Ho has nearly four years experience in the nuclear power industry. At Cygna, his project assignments include the seismic analysis of the CRD system for LaSalle Unit 2 and qualification of a 42" containment purge butterfly valve for Zion Station, Units 1 and 2.

Prior to joining Cygna, Mr. Ho was employed by Sargent & Lundy. His responsibilities included design and analysis of structural steel framing systems, analysis of structures subject to missile impact and fintie element analyses of various concrete and steel structures subjected to seismic and hydrodynamic loads. In addition, he has provided structural consultation for design and construction of Control Rod Drive Hydraulic System supports for the Clinton Nuclear Power Station and performed the Ultimate Capacity Study for a Mark II containment.

Mr. Ho's experience also includes a teaching engagement at the University of Illinois, Chicago Campus. As Adjunct Assistant Professor, he was responsible for supervising undergraduate thesis students studying the dynamic behavior of buildings.

PUBLICATIONS:

Curriculum Materials for Structural Engineering Courses, with R.W. Gerstner, Department of Architecture, University of Illinois, Chicago Campus, University of Illinois Press.

CHUAN LIU

EDUCATION:

M.S., Civil Engineering
San Jose State University
B.S., Civil Engineering
Chung-Yuan College, Taipei, Taiwan

PROFESSIONAL REGISTRATION:

Registered Civil Engineer, California

PROFESSIONAL EXPERIENCE:

Mr. Liu has more than a decade of engineering experience, half of which has been directly related to the nuclear power industry. Mr. Liu has been responsible for the seismic evaluation and rehabilitation of nuclear power plant structures. He has acted as a pipe support group leader responsible for hanger design and review, and he has been a field taskforce team supervisor, responsible for analyzing structural problems encountered at job sites. In addition, Mr. Liu acted as Pipe Support Review Group Leader for the Independent Design Review for Mississippi Power and Light Company.

Some of the projects in which Mr. Liu has been involved have included:

- Grand Gulf Nuclear Power Plant
- Palo Verde Nuclear Power Plant
- Diablo Canyon Nuclear Power Plant
- Vermont Yankee Power Plant
- La Salle Nuclear Power Plant
- Arkansas Nuclear Power Plant
- Peach Bottom Nuclear Power Plant
- Limerick Nuclear Power Plant

Prior to joining Cygna Mr. Liu worked for several consulting firms. During these engagements his experience included structural analysis of highrise structures, masonry and precast concrete and wood structures, dynamic analysis of power plant systems and buildings and structural design of sewage treatment plants.

WAYNE E. SCHWEIDENBACK

EDUCATION:

B.S., Electrical Engineering
Worcester Polytechnic Institute, Worcester, MA
Graduate work, Electrical Engineering
Northeastern University, Boston, MA

PROFESSIONAL REGISTRATION:

Engineer in Training, Massachusetts

PROFESSIONAL ACTIVITIES:

Member, Institute of Electrical and Electronic Engineers

PROFESSIONAL EXPERIENCE:

Mr. Schweidenback has over eight years experience in electrical engineering and design. He is presently an Electrical Engineer with Cygna. In this capacity, he is responsible for the preparation of electrical specifications, as well as identifying and revising documents such as wiring diagrams, one-line diagrams, elementaries, and computerized cable schedules.

Before joining Cygna, Mr. Schweidenback was an Electrical Engineer in the Thermal Power Division of Chas. T. Main, Inc. In this position he was involved in the electrical system design of a 60 MW cogeneration facility for a major refinery. The project consisted of two waste heat boilers, providing electricity and steam for refinery use.

Mr. Schweidenback has also worked at Stone & Webster Engineering Corporation, where he was assigned to the Millstone 3 Nuclear Power Plant. He was the Electrical Control Engineer, responsible for the preparation of elementary wiring diagrams, protective relaying, and switchgear application design. He was also responsible for the design of turbine generator systems, diesel generator and nuclear reactor safeguards systems, the protective relay panel, and main control board.

WAYNE E. SCHWEIDENBACK
(continued)

Other projects for Stone & Webster included work on the River Bend 1 Station where he was responsible for the design of HVAC and electrical distribution panels. He also worked on-site at the Presque Isle Station coal-fired installations, where his duties included supervision of control circuit checkout and operational tests.

LEE J. WEINGART

EDUCATION:

B.S., Engineering
San Francisco State University, San Francisco, CA
Undergraduate studies, Mechanical Engineering
Drexel University, Philadelphia, PA
Undergraduate studies, Communications
Temple University, Philadelphia, PA

PROFESSIONAL REGISTRATION:

Registered Mechanical Engineer, California

PROFESSIONAL AFFILIATIONS:

Associate Member, American Society of Mechanical Engineers

PROFESSIONAL EXPERIENCE:

Mr. Weingart has over nine years of experience with particular emphasis in the analysis of piping systems and pipe support structures. He is presently assigned as a Senior Lead Engineer in our San Francisco office responsible for a broad range of engineering activities in the Piping Division. He is currently acting as a Project Engineer for the Reactor Experiment Project as well as Pipe Stress Group leader in Susquehanna Wetwell Piping, Pilgrim, and Yankee Rowe Projects. In addition, Mr. Weingart acted as Project Engineer and Piping Analysis Review Group Leader for the Independent Design Review for Mississippi Power and Light Company.

Formerly employed as a Senior Engineer by a West coast consulting engineering firm. Mr. Weingart was instrumental in computerizing standard calculations, modeling, and analysis. He created FORTRAN programs to facilitate use of the SAGS program for computer modeling of pipe support structures, and performed static and nonlinear analysis of baseplates using STARDYNE.

As a Structural Analyst for a computer services and consulting firm specializing in structural engineering, Mr. Weingart was actively involved in customer support services in structural applications using ANSYS, EAC/EASE2, NASTRAN, SDRC/SAGS, STARDYNE and STRUDL, and in piping applications using DIS/ADLPIPE, NUPIPE and PIPESD. The capabilities of

these finite element programs include linear and nonlinear static, dynamic, and heat transfer analyses of structures and piping systems. Mr. Weingart also served as the primary West coast analyst for piping graphics applications, in addition to organizing and participating (instructor) in training seminars for customers.

Prior to the above, Mr. Weingart served as an Engineer for a major west coast architect/ engineer where as part of an overall Equipment Qualification effort, he located and sized the instrumentation required to verify dynamic transient analyses which he performed (using available computer programs such as STARDYNE and ANSYS) for both nuclear and fossil fuel power plant piping systems to determine restraint sizes and locations, and to assure system acceptability within code limits (ASME B&PV Section III and B31.1). He also performed thermal flexibility, weight and seismic calculations for both small and large piping. He was also responsible for training new employees in analysis objectives and techniques, and coordinated their activities.

LENNOX D. BARNES

EDUCATION:

M.S., Nuclear Engineering,
University of California, Berkeley, CA
B.S., Mechanical Engineering
University of New Hampshire

PROFESSIONAL REGISTRATION:

Registered Professional Engineer, Massachusetts
Registered Professional Engineer, California
Registered Professional Engineer, New York
NRC Senior BWR Operator's License

PROFESSIONAL AFFILIATIONS:

Member, American Society of Mechanical Engineers

PROFESSIONAL EXPERIENCE:

Mr. Barnes has over fifteen years experience in the nuclear industry, including all levels of responsibility for plant engineering, design, licensing, start-up and plant operation.

He is currently the Manager of the Systems Engineering Division in the Boston office of Cygna, responsible for all engineering activities associated with the electrical, mechanical, nuclear, and instrumentation and control disciplines. Concurrently, Mr. Barnes acts as Project Manager on various projects within his division. In this capacity, he is directly responsible for manpower planning, technical direction, project execution, fiscal performance, and serves as the management representative to the client.

Prior to joining Cygna, Mr. Barnes was the Assistant Chief Engineer of the Engineering Assurance Division of Stone & Webster Engineering Corporation. In this position he directed the development and implementation of engineering quality standards which applied to all project activities.

In a previous assignment, Mr. Barnes served as Project Engineer for the James A. FitzPatrick Nuclear Power Plant. In this capacity he was directly responsible for the engineering design and licensing activities associated with retrofit packages. He was also responsible for maintaining liaison with the client.

LENNOX D. BARNES
(continued)

His experience also includes assignments with the General Electric Company in their Nuclear Energy Division. He has supervised the construction, start-up testing, and initial operation of BWR reactors including the Peachbottom Nuclear Power Plant. At the Dresden Nuclear Power Station Unit 2, he was assigned as Shift Supervisor, responsible for monitoring all activities during a refueling outage. Other responsibilities included fuel loading, CRD replacement, field design changes, and operational testing.

Prior to his General Electric employment, Mr. Barnes spent six years in the U.S. Navy Submarine Program.

JAMES P. FOLEY

EDUCATION:

B.S., Nuclear Engineering, Lowell Technological Institute, Lowell, MA
Graduate courses in advanced mathematics and mechanical engineering, Northeastern University, Boston, MA
Nuclear Reactor Safety Course, Massachusetts Institute of Technology, Cambridge, MA

PROFESSIONAL REGISTRATION:

Engineering in Training, Massachusetts

PROFESSIONAL ACTIVITIES:

Member AIF Subcommittee on Systems Interaction

PROFESSIONAL EXPERIENCE:

Mr. Foley has over 13 years experience in the nuclear industry, including assignments in engineering, design, licensing, and safety evaluations of both BWR and PWR nuclear plants.

His present assignment includes responsibility for developing the technical content of an integrated approach for managing extensive analysis or modification programs such as those required by the TMI Action Plan or the Systematic Evaluation Program. This involves determining the necessary steps for performing the various tasks, identifying relationships among the tasks, developing alternative approaches to the resolution of problems, and determining resource requirements for these programs.

He is also resonsible for providing liason between Cygna's systems and analytical experts, and continues to participate in developing Cygna's programs involving probabilistic risk assessment and systems interactions analyses.

He was Project Engineer on the Control Room Habitability Study on the Robert E. Ginna Nuclear Power Plant. This study included evaluating radiological and toxic gas hazards to control room operators and recommending modifications to the control room heating, ventilating, and air conditioning systems.

JAMES P. FOLEY
(continued)

Prior to joining Cygna, Mr. Foley held various positions with Stone & Webster Engineering Corporation. Most recently, he was a Senior Licensing Engineer responsible for performance of the fire hazards analysis for the James A. FitzPatrick Nuclear Power Plant, including the safe shutdown analysis and modifications for fire suppression and protection systems. Modifications resulting from this analysis were implemented to the NRC's "defense in depth" approach to fire protection. He also had responsibility for following and developing corporate recommendations on several licensing issues, including systems interactions analysis, foreign licensing, BWR pool swell, and determination of safety classes for BWR systems.

Mr. Foley previously served as plant arrangement coordinator for the Conceptual Engineering Group. In this capacity, he was the coordinator for the early conceptual design effort of several BWR and PWR units, including Nine Mile Point 2, River Bend 1 and 2, Montague, and Green County Nuclear Power Plants. He has also performed various tasks relative to radiation protection and radwaste management including development of computer codes for shielding analysis. In addition, he has acted as Nuclear Engineer on a large PWR project responsible for solid, gaseous, and radioactive waste systems.

A. PATRICK McCARTHY

EDUCATION

B.S., Marine Engineering,
Maine Maritime Academy

PROFESSIONAL LICENSE:

3rd Assistant Engineer,
Issued by U.S. Coast Guard

PROFESSIONAL AFFILIATIONS:

Senior Member, Instrument Society of America
Member, ISA SP67.10 Committee, Sample Line Piping and Tubing Standards for Use in Nuclear Power Plants

PROFESSIONAL EXPERIENCE:

Mr. McCarthy has over fourteen years of experience including engineering, design, licensing, and operation of power plants. Mr. McCarthy is the Supervisor of Instrumentation and Controls and a Project Manager in our Boston office.

While with Cygna, Mr. McCarthy has been assigned as Project Manager of an Appendix R Fire Hazards Evaluation for a Radwaste Incineration System and the seismic qualification of a series of vacuum pumps to be used in processing uranium fuel.

Prior to joining Cygna Mr. McCarthy was employed by a major East coast architect/ engineer for seven years, and held positions of increasing responsibility within the Controls System Division. His last assignment was as the Lead Control Engineer on the Millstone 3 Project, an 1150 MWe PWR currently under construction for Northeast Utilities. As a Lead Control Engineer, Mr. McCarthy, with his staff of principal and support engineers, was responsible for all aspects of engineering, design, procurement, licensing, and field construction support activities relating to instrumentation and controls for the project.

During this time, Mr. McCarthy also held the positions of both Principal and Support Instrumentation Applications Engineer, on the Shoreham Nuclear Project, an 820 MWe BWR, currently under construction for the Long Island Lighting Company.

A. PATRICK McCARTHY
(continued)

As both of the above plants were under construction, the area of equipment qualification was continuously changing due to revisions in NRC guidelines. As a result, much time was spent working with vendors to qualify their equipment to plant specific environmental and seismic profiles.

In addition, he held the position as Controls Systems Division Specialist for safety and relief valves and installation of instrumentation and tubing on a company-wide basis.

Prior to Mr. McCarthy's employment with the architect/engineering company, he worked for an industrial equipment engineering firm. Mr. McCarthy was employed by the Crosby Valve and Gage Company. Mr. McCarthy was initially hired as a Field Service Engineer and ultimately attained the position of Project Engineer and as a Field Service Engineer, Mr. McCarthy was responsible for all phases of safety and relief valve design, fabrication, test, and installation including the assurance of compliance to the ASME Boiler and Pressure Vessel Code - Section III and other applicable codes, the resolution of fabrication problems, the specification of appropriate non-destructive testing, research and development of new product lines, and trouble-shooting of field-related problems.

Prior to the above, Mr. McCarthy sailed for Grace Lines as a Third and Second Assistance Engineer.

PAUL A. RAINEY

EDUCATION:

M.B.A., (in-progress)
Clark University, Worcester, MA
B.S., Nuclear Engineering
Lowell Technological Institute,
Lowell, MA
A.S., Nuclear Engineering
Wentworth Institute of Technology,
Boston, MA
Knolls Atomic Power Laboratory Nuclear Power School and Prototype Training

PROFESSIONAL REGISTRATION:

Professional Engineer, Massachusetts

EXPERIENCE:

Mr. Rainey has over 13 years of experience in the nuclear power industry including responsibilities in design, licensing, operation, construction, and testing. He is currently an Associate of Cygna and is the Power Systems Supervisor.

Most recently he was responsible for the development of a plant-specific training module for the Power Authority of the State of New York's Engineering Training Program. He also helped prepare a response to the NRC for the Yankee Atomic Electric Company, covering SEP topics III-5.A and III-5.B on the effects of High Energy Line Breaks Inside and Outside Containment.

Prior to joining Cygna, Mr. Rainey was a Supervising Engineer with Public Service of Indiana. In this capacity he supervised several engineers involved in the design, procurement and construction of Mechanical Balance of Plant Systems at the Marble Hill Nuclear Power Plant. He was also responsible for all Balance of Plant systems and components, as well as the development of a system-functional review program.

Earlier Mr. Rainey was employed by the Yankee Atomic Electric Company as a Senior Systems Engineer. He was responsible for engineering on backfits from initial conceptual design through licensing, procurement, installation, and start-up testing. In this capacity, he acted as

PAUL A. RAINEY
(continued)

both the fluid systems designer and project manager responsible for the coordination of the required disciplines.

Mr. Rainey was a memeber of Yankee's Senior TMI Task Force which was responsible for reviewing the Yankee plants following TMI. He provided the Systems Engineering input for Yankee Rowe's Systematic Evaluation Program, and was Yankee's contact on NRC inspections at Rowe on pipe whip, safe shutdown, and fire hazards analysis.

Some of the backfits Mr. Rainey has experience with include a post-LOCA recirculation system addition, auxiliary feedwater system addition, automation of main steam isolation valves, ECCS accumulation modifications, HPSI system modifications, start-up feedwater regulation, valve modifications, numerous TMI modifications, RHR orifice modifications, and hydrogen recombiner cooler replacement.

Mr. Rainey also worked for Gilbert Associates, Inc., and Stone & Webster Engineering Corporation, where he was responsible for numerous system designs.

PUBLICATIONS: "ECCS Backfits at Yankee Rowe," presented at the 1978 American Nuclear Society Conference.

ERIC VAN STIJGEREN

EDUCATION: B.S., Mechanical Engineering
San Jose State University, CA

PROFESSIONAL REGISTRATION: Registered Mechanical Engineer, State of California

PROFESSIONAL AFFILIATIONS: Member, American Society of Mechanical Engineers
Member, American Nuclear Society

PROFESSIONAL EXPERIENCE: Mr. van Stijgeren has ten years of experience in the design, analysis and installation of piping systems and mechanical equipment for nuclear and fossil power plants.

At Cygna, Mr. van Stijgeren has held several senior management positions. He is currently Project Manager of the Systematic Evaluation Program (SEP) work on Yankee Rowe, having full responsibility for technical, administrative, schedular and budgetary aspects of the project. In addition, Mr. van Stijgeren has been actively involved in the developmental execution of Cygna's pipe stress and pipe support training programs for utility clients.

Prior to joining Cygna, Mr. van Stijgeren held engineering/management positions with a major architect/engineer. His experience on several nuclear and fossil power projects included staff and project supervisory positions. Staff responsibilities consisted of establishing personnel policies for an engineering discipline, providing the projects with manpower and technical standards, monitoring the engineering effort performed on the projects, and coordinating the training and professional development of all engineers in the discipline. Project responsibilities on a two- unit BWR nuclear power plant consisted of coordinating and interfacing with construction and project engineering groups, monitoring manhour budgets and engineering schedules, assuring quality of the project engineering and design effort, issuing purchase specifications for equipment, and participating in client and project management review meetings.

Although Mr. van Stijgeren's expertise is in piping and mechanical engineering, he has had significant involvement in related engineering activities such as quality assurance, civil/structural and planning and scheduling.

During his career, Mr. van Stijgeren has participated in numerous audits of projects, area offices and construction sites. In addition to his design engineering experience, Mr. van Stijgeren has spent a considerable amount of time at various job sites assisting field personnel with construction problems and start-up test programs.

EUGENE F. TRAINOR

EDUCATION:

M.S., Management,
Rensselaer Polytechnical Institute,
Troy, NY
B.S., General Engineering,
U.S. Coast Guard Academy, New London, CN
Naval Nuclear Reactor Testing and Operations,
Mare Island Naval Shipyard, Vallejo, CA
Executive Management,
Center for Management Development,
Northeastern University, Boston, MA
Production, Planning and Control,
Massachusetts Institute of Technology,
Cambridge, MA
Government Contract Law,
Marshall Wythe School of Law,
College of William and Mary,
Williamsburg, VA

PROFESSIONAL REGISTRATION:

Registered Quality Engineer, California
Registered Mechanical Engineer, Massachusetts

PROFESSIONAL AFFILIATION:

Senior Member, American Society for Quality Control
Member, American Society of Mechanical Engineers
Member, ASME Main Committee on Nuclear Quality Assurance
Vice Chairman, Subcommittee on Personnel Qualifications

PROFESSIONAL EXPERIENCE:

Mr. Trainor, Vice President, Quality Assurance, has in excess of 20 years of extensive experience in quality assurance, construction, engineering, and project management of fossil and nuclear power generation projects. Prior to his association with Cygna, he was associated with a major architect/engineer for eight years serving as Manager of their Quality Assurance Department and Chief Engineer of the Engineering Assurance Division. During this period, he developed the first Quality Assurance Program approved by the then Atomic Energy Commission for an engineer-constructor. Additionally, he developed

management systems needed for the effective management of a multi-faceted domestic and international quality assurance organization.

Mr. Trainor was previously associated with the shipbuilding industry in Quincy, Massachusetts, for thirteen years. At that time he was responsible for the establishment of an S5W Submarine Reactor Plant Test Program and the development and management of the DLG(N)25 Nuclear Power Unit installation program. Other assignments held by Mr. Trainor included Project Manager - Special Projects, Process Engineering Manager with responsibilities for manufacturing and industrial engineering, applied research and development and industrial laboratories, and Manager, Nuclear Quality Control, with responsibility for all aspects of quality assurance and control in the design, construction and overhaul of naval Nuclear Power Plants and Facilities.

Prior to his association with the shipbuilding industry, Mr. Trainor was employed by a chemical company complex in Springfield, MA, where he designed and constructed steam generating and chemical processing facilities.

JOHN P. BONNER

EDUCATION: B.S., Electrical Engineering,
Northeastern University, Boston, MA

PROFESSIONAL REGISTRATION: Professional Engineer, Massachusetts

PROFESSIONAL EXPERIENCE:

Mr. Bonner has over ten years of experience in electrical engineering for nuclear and non-nuclear power plants. He is currently a Senior Electrical Engineer with Cygna, responsible for the analysis, design, and specification of electrical systems. He also serves as an Electrical Systems Specialist, to assure compliance with all applicable requirements of industry codes and standards such as IEEE, ANSI, NEC, and NEMA.

Prior to joining Cygna, Mr. Bonner was employed by a major East coast architect/ engineer as Principal Electrical Engineer for all VEPCO projects. In this capacity he was responsible for the coordination of all electrical activities in support of design change packages for station modifications at Surry Power Station Units 1 & 2. Those modifications included the replacement and upgrading of electrical equipment due to an environmental qualification review; addition and modification of plant safety and post accident monitoring systems; plant emergency power degraded voltage modification.

For Unit 2 of the North Anna Nuclear Power Station, Mr. Bonner coordinated the review of electrical equipment environmental qualification per NRC NUREG-0588 and IE Bulletin 79-01. He also provided technical support at the NRC pre-full power license audit of Unit 2. A full power license was issued upon satisfactory completion of the audit.

While assigned to Millstone 3 for the Northeast Utilities Service Company, Mr. Bonner was responsible for the technical supervision of design of raceway, wiring and cable scheduling, and manpower estimating. He also recommended a means by which a reduction of 50% of the isolation relays could be made, and still maintain the

requirements of NRC Regulatory Guide 1.75 in the area of associated circuits.

Other duties at this firm included developing specifications, bid evaluations, and calculations for power systems analysis.