PROJECT QUALITY ASSURANCE PLAN FOR MIDLAND INDEPENDENT DESIGN CONSTRUCTION AND VERIFICATION PROGRAM CONSUMERS POWER COMPANY PROJECT 3201

Prepared by:

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Verified by:

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Approved by:

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Principal-in-Charge
Vice President
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Approved by:

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Executive Vice President
TERA Corporation

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TERA CORPORATION

Midland Independent Design
Construction & Verification

DOCUMENT REVISION RECORD

REV	DATE	DESCRIPTION OF CHANGES
1	1/17/83	Changes made reflect omission of required graphics - no substantive changes in content made. Effected pages: PQAP - pg. 19; PI-Document Control Cover Sheet - pg. 3; PI-Engineering Eval. Prep. & Control - pg. 3

POLICY STATEMENT

In conjunction with the corporate Quality Assurance Program, this Project Quality Assurance Plan has been prepared to establish the measures necessary to provide adequate confidence in and assurance of the quality of services to be provided for Consumers Power Company in the performance of activities involved in the conduct of the Midland Independent Design and Construction Verification Program. To that end, the quality assurance/quality control methods, procedures, and instructions established herein shall be implemented, as applicable, by those individuals assigned responsibility for the activities requiring quality assurance and control as identified herein. Any deviations, exceptions, or other nonconformances shall be brought to my attention for resolution.

Howard A. Levin
Project Manager
Midland Independent Design and
Construction Verification Program

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APPENDICES

1. GENERAL

1.1 Purpose

The Project Quality Assurance Plan (PQAP) establishes, describes, and defines the documented, auditable, control measures to be implemented to ensure accurate engineering evaluations, correct calculational procedure and analysis, and correct data application for the Midland Independent Design and Construction Verification Program (IDCV) for Consumers Power Company (CPC).

1.2 Scope

Quality Assurance (QA) requirements shall be applied to engineering design and construction evaluations, analyses, computer analyses, calculation preparation, documentation and the development of findings and final reports. The specific activities to which the PQAP applies and the method of program application are as follows.

1.2.1 Engineering Evaluations

Engineering evaluations required for project review activities associated with design and construction verification shall be controlled through the use of Engineering Evaluation Cover Sheets (see Project Instruction PI-3201-001). Engineering evaluations shall be performed by technically qualified individuals, and will be reviewed by an individual

having qualifications at least sufficient to perform the evaluation. The Engineering Evaluation Cover Sheet shall include a document control number and shall also identify the specific source of technical data and references for information used in the evaluation. Where calculations are required to be performed to support the engineering evaluation, these shall be controlled in accordance with Section 1.2.3.

Engineering evaluations shall be maintained in files at the Bethesda, Maryland offices of TERA for the duration of the project.

1.2.2 Document and Report Preparation

Documents such as open, confirmed and resolved item reports, finding reports, draft and final reports that are prepared in the course of this project shall be controlled in accordance with Project Instruction PI-3201-002 through the use of Document Control Cover Sheets. These documents shall be prepared by technically qualified individuals and shall be reviewed by another individual familiar with the project. This review may be performed by the Project Manager. The Document Control Cover Sheet shall have a document control number and shall also identify the sources of information for development of these documents.

Documents and reports prepared during this project shall be maintained in files at the Bethesda, Maryland offices of TERA for the duration of the project.

1.2.3 Calculations, Analyses and Computer Analyses

(1) Final calculations, analyses and computer analyses that are performed for purposes of confirmatory evaluation of the Midland design or design bases shall be prepared and controlled in accordance with ECP-5.2, "Calculation Preparation and Control."

(2) Calculations shall be controlled through the use of calculation cover sheets as described in ECP-5.2.

(3) Final calculations shall be kept at the Bethesda, Maryland offices of TERA for the duration of the project.

1.2.4 Source/Reference Material

Source or reference material obtained from Consumers Power Company or other organizations used in performing the engineering evaluations, calculations, analyses, computer analyses or document preparation for this project shall be maintained in a file at the Bethesda, Maryland offices of TERA for the duration of the project. Control of this material shall be provided by use of file registers that list the

information contained in that file, including date or revision. These files require use of signout sheets for material removed from the file.

1.3 Implementation

1.3.1 This Project Quality Assurance Plan is to be implemented, as applicable, by all individuals assigned responsibility for performance of technical, managerial, and administrative functions related to the Quality Assured Activities identified previously.

1.3.2 The first issue, Revision 0, is effective and shall be implemented on date of issue. All activities are to be in compliance from that date.

1.3.3 Revisions shall be implemented within ten (10) working days of the date of issue of the revision.

2. ORGANIZATION

2.1 Project Organization

Figure 1 provides the organizational chart for the subject Project. Technical and administrative personnel (not shown) will receive assignments directly from the Project Manager (PM). The Project

Manager will serve as the point of contact with Consumers Power Company. The Project Quality Assurance Engineers will report directly to the Executive Vice President, but will work with the Project Manager in resolving deficiencies or making recommendations.

2.2 Authority and Responsibility

2.2.1 The Principal-in-Charge (PIC) is responsible for helping establish the general philosophy of review, setting forth guidance to the Project Manager and the Lead Technical Reviewers (LTR), assisting as an interface with the Senior Review Team (SRT), NRC and Consumers Power Company and reviewing/concurring in all final reports issued to Consumers Power Company.

2.2.2 The Project Manager is responsible for planning and direct supervision of all in-house activities undertaken as required to fulfill the contract requirements. All documentation, correspondence, reports, calculations, etc., issued to Consumers Power Company are to be issued under his signature or otherwise receive his approval as required by the applicable Engineering Control Procedure or Project Instruction.

2.2.3 The Project Manager is responsible for planning and overall management of all outside activities performed by Asso-

ciates, but may delegate responsibility for supervision to other individuals within the project. This delegation of authority and responsibility is documented by issuance of a Project Instruction. Documentation may be issued to the subcontractor or associate under the signature of the designated individual, but shall receive prior approval of the Project Manager.

2.2.4 As requested by the PIC, the Senior Review Team (SRT) is responsible for the review of Open, Confirmed or Resolved (OCR) Items, findings and final reports to assess the technical validity and significance of project team conclusions and the proper classification of OCRs and findings. The SRT may at any time recommend to the Principal-in-Charge that the Project Manager expand the scope of review, provide clarification or reassess elements of the review.

2.2.5 The Lead Technical Reviewers (LTR) are responsible for management and implementation of all review activities within their discipline of review, including supervision of individuals on the project team and outside activities performed by Associates. The LTRs report to the Project Manager. The LTRs are responsible for the classification of OCRs and findings, the preparation of finding reports and finding resolution reports.

2.2.3 The Project Quality Assurance Engineer is responsible for verification of the implementation of the PQAP and will perform audits of applicable procedures and instructions implementation in accordance with Section 6.3 and ECP-5.6.

2.2.7 Lines of communication for identified deficiencies shall be in accordance with ECP 5.15, "Corrective Action Procedure."

3. PERSONNEL QUALIFICATIONS AND CONTROL

3.1 Management Personnel

3.1.1 Principal-in-Charge - John W. Beck

Mr. Beck has broad experience in operations, systems, engineering, environmental, and licensing areas of the nuclear power industry. He is an officer of TERA Corporation. A copy of his resume is presented in Appendix C and provides documentary evidence of his qualifications.

3.1.2 Project Manager - Howard A. Levin

Mr. Levin has broad experience in the areas of nuclear plant engineering and licensing as well as managing engineering projects, has been selected by the Executive Vice President as Project Manager for the subject project. A copy of his

resume is presented in Appendix C and provides documentary evidence of his qualifications.

3.1.3 Project Quality Assurance Engineer - Charles E. Lemon, P.E.

Mr. Lemon has brood experience and is highly qualified in the area of nuclear power plant quality assurance and has been selected by the Executive Vice President as Project Quality Assurance Engineer for the subject contract. A copy of his resume is presented in Appendix C and provides documentary evidence of his qualifications.

3.1.4 Lead Technical Reviewers

The Lead Technical Reviewers (LTR) have been selected based upon their unique technical and management qualifications for the project. The following lists the LTRs along with a short description of their areas of expertise. Copies of their resumes are presented in Appendix C, providing documentary evidence of their qualifications.

Lead Technical Reviewer	Functional Areas of Expertise
Curt Staley Structural Review and Construction Verification	Nuclear power plant structural, mechanical design, construction project management and control

Lead Technical Reviewer	Functional Areas of Expertise
Frank Dougherty Mechanical Review	Nuclear power plant mechanical design, safety and reliability analysis, system design/criteria development
Richard Snaider Systems Review	Nuclear power plant operations, maintenance and design, systems engineering, licensing project management, mechanical engineering
Lionel Bates Electrical Review	Nuclear power plant electrical, instrumentation and control systems design, equipment qualification, plant operations and maintenance

3.1.5 Senior Review Team

The Senior Review Team (SRT) has been selected based upon their many years of experience in the nuclear industry, broad areas of personal knowledge, and specific nuclear design review expertise. The following lists the SRT members along with a short description of their areas of expertise. Copies of their resumes are presented in Appendix C providing documentary evidence of their qualification.

SRT Member	Functional Areas of Expertise
Donald Davis	Nuclear safety and licensing, plant and reactor systems, thermal-hydraulic analysis, accident analysis

SRT Member	Functional Areas of Expertise
William J. Hall	Engineering analysis and design, structural engineering, structural mechanics and dynamics, soil mechanics, fracture mechanics, engineering criteria development for major projects
Robert Wilson	Nuclear power plant operations, engineering and design, licensing project management

3.1.6 LTRs are controlled and their performance evaluated under direct supervision of the Project Manager who provides input to the Principal-in-Charge for his review and concurrence.

3.1.7 Management control is provided by the Executive Vice President through review of project reports, audit findings, and evaluations conducted in the normal course of business.

3.2 Project Personnel

3.2.1 Staff technical and administrative personnel are selected by the Project Manager or LTRs as required, based on their qualifications and areas of expertise, to perform and/or coordinate the performance of activities undertaken in fulfillment of contract requirements.

3.2.2 The following lists the various TERA technical personnel that may participate in this project and the functional areas where each will provide input to the project. This listing shall in no way restrict the personnel used by TERA to complete this project. The Project Manager or LTRs may assign personnel in addition to those listed below; however, these other personnel must have qualifications that are adequate to the extent required for performing the specific task.

Technical Reviewer	Functional Areas of Expertise
Robert Cudlin	Nuclear safety and licensing, reactor safeguards, plant and containment systems, equipment qualification
Henry George	Quality assurance, training, nuclear plant systems procedures, project management
Joseph Mortore	Nuclear power plant structural, mechanical design and construction, equipment qualification, operating reactor safety, licensing, project management
Robert Snyder	Nuclear power plant design and construction, project management, start-up and operations
Michael Aycock	Nuclear power plant systems, operating procedures, licensing and project management

Technical Reviewer	Functional Areas of Expertise
Christian Mortgat	Engineering mechanics, earthquake engineering
Yorma Arros	Engineering mechanics
Kenneth Campbell	Soil mechanics, earthquake engineering
Norman Berube	Design and analysis of mechanical systems, thermal-hydraulics, heat transfer, engineering, analyses
Frederick Berthrong	Engineering project management, planning, scheduling and field engineering
Leonard Stout	Design, construction, start-up and operations project control, schedule and cost control systems
Susan Sly	Civil/mechanical design and construction, installation and inspection
Richard MacDonald	Engineering, construction, operation, maintenance and project management systems, nuclear plant start-up and operations
Sidney Brown	Engineering and construction management, cost and scheduling, quality control, field engineering

Technical Reviewer	Functional Areas of Expertise
Donald Tulodieski	Project management/control, start-up testing, engineering
Richard Keller	Electrical, instrumentation, and control systems design, nuclear power plant operational analysis, plant protection systems/ engineered safety features evaluation, probabilistic risk assessment
Gary Smith	Civil engineering, design and analysis, hydraulics, project management

3.2.3 Staff personnel are controlled and their performance evaluated under direct supervision of the LTRs who provide input to the PM for his review and concurrence.

3.3 Associates

3.3.1 Associates are selected by the LTRs and Project Manager as required to perform activities requiring specific detailed, state-of-the-art knowledge of selected scientific and engineering specialties.

3.3.2 Associates are controlled by direct supervision of the LTRs with assistance as required by other staff personnel.

3.3.3 The following lists the various TERA associate personnel that are expected to participate in this project and the functional areas where each will provide input to the project. This listing shall in no way restrict the personnel used by TERA to complete this project. The LTRs or Project Manager may assign personnel in addition to those listed below; however, these other personnel must have qualifications that are adequate to the extent required for performing the specific task.

Associate	Functional Areas
Monte Wise	Engineering and project management, preservice/inservice inspection, NDE, nuclear power plant operations and management, quality assurance
Mehmet Celebi	Nuclear power plant structural, mechanical design and construction
Stan Fabic	Thermal-hydraulic and hydo-elastic analysis, computer methods development (authored BLODWN-2, WHAM, GASRAD, MULTIFLEX), pipe rupture analysis, containment analysis
Albert Martore	Engineering, specification, construction fabrication, construction management and control, scheduling, supervision, inspection

Associate	Functional Areas
John Angelo	Design, operation, maintenance, installation, testing and inspection of power plant systems and components, nuclear safety and licensing
Joseph Penzien	Structural engineering, earthquake engineering, reinforced concrete response
Daniele Veneziano	Engineering statistical analysis, probabilistic analysis, civil engineering
Martin Jones	Nuclear power plant construction management, quality control, training, start-up, eiectrical engineering
Lenny Laakso	Structural/mechanical analysis and design of nuclear power plant buildings and equipment, specifications, planning and scheduling

4. ADMINISTRATIVE CONTROL

4.1 Subject File

The following numbers shall be used as subject file numbers to identify controlled documents in that file. Documents in a file shall have an I.D. number that includes the subject file number followed by a unique sequence number (001-999).

File Number	Subject File
3201-001	Engineering Evaluations
3201-002	Documents and Reports
3201-003	Calculations, Analyses, Computer Analyses
3201-004	PQAP
3201-005	Quality Assurance Documents
3201-006	Personnel Qualifications
3201-007	Correspondence File
3201-008	Open, Confirmed and Resolved Item Reports, Finding Reports, Finding Resolution Reports
3201-009	Engineering Program Plan
3201-010	External Communications (Contact Log Sheets)
3201-011	Source Documents

4.2 Engineering Evaluations

Engineering evaluations are controlled in compliance with the requirements of Project Instruction PI-3201-001, "Engineering Evaluation Preparation and Control."

4.3 Documents and Reports

Documents and reports are controlled in compliance with the requirements of Project Instruction PI-3201-002, "Document Control Cover Sheet."

4.4 Calculations, Analyses, Computer Analyses

Calculations, Analyses and Computer Analyses are controlled in compliance with the requirements of ECP-5.2, Calculation Preparation and Control. The Project identifier is the Project No. as listed on the cover sheet previously.

4.5 PQAP

The PQAP is controlled in compliance with ECP-5.5, Project QA Plan Preparation and Control. For this project, the PQAP Register, Attachment A, will be maintained by the Project Manager.

4.6 Quality Assurance Documents

Quality Assurance Audit reports, responses, follow-up documents, etc., are controlled in compliance with ECP-5.6, "Quality Assurance Audits."

4.7 Engineering Control Procedures

Engineering Control Procedures (other than those identified in Section 5) and revisions are controlled by revision of the PQAP as required to effect their implementation at the direction of the Project Manager.

4.8 Open, Confirmed and Resolved Item Reports, Finding Reports and Finding Resolution Reports

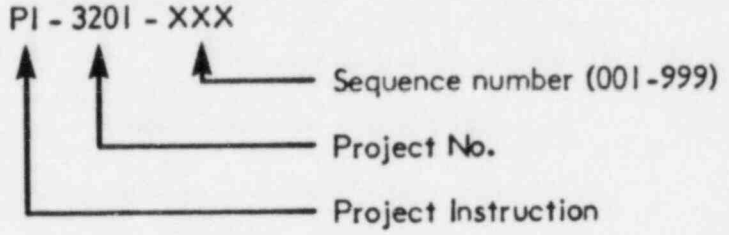
Open, Confirmed and Resolved Item Reports, Finding Reports and Finding Resolution Reports are controlled in compliance with the requirements of Project Instruction PI-3201-008; Preparation of Open, Confirmed and Resolved Item Reports, Finding Reports and Finding Resolution Reports."

4.9 Correspondence and Personnel Qualifications

Correspondence, including letters and memos shall be routed to appropriate personnel indexed using the appropriate correspondence file register (Attachment B-1 (TERA to CPC, NRC), B-2 (CPC to TERA), B-3 (NRC to CPC), B-4 (Misc.), B-5 (CPC to Bechtel), B-6 (NRC to Bechtel), B-7 (Bechtel to CPC), B-8 (CPC to NRC), B-9 (Bechtel to TERA) and filed in the appropriate project controlled subject file number 3201-007. The document file control stamp, example shown on Attachment C, shall be used to identify project related correspondence and other documents not covered by specific procedures, such as Personnel qualification related records, file 3201-006.

4.10 Project Instructions

Project Instructions are issued by the Project Manager as required and are controlled by assignment of a sequence identification number in the following format:



1

and by revison of the PQAP as required to effect their implementation.

4.11 External Communications

Records of telephone conversations and meetings between IDCV project personnel and external parties are controlled in compliance with the requirements of Project Instrument PI-3201-010; External Communications: Preparation of Contact Log Sheets.

5. PROCEDURES AND INSTRUCTIONS

5.1 Engineering Control Procedures

The following ECP's are hereby implemented for the subject project:

(1) ECP-5.2, "Calculation Preparation and Control"

(2) ECP-5.5, "Project QA Plan Preparation and Control"

(3) ECP-5.6, "Quality Assurance Audits"

(4) ECP-5.15, "Corrective Action Procedure"

A copy of the implemented revision for each applicable ECP is attached, Appendix A.

5.2 Project Instructions

5.2.1 Purpose

Project Instructions are prepared, under direction of the Project Manager, for the control of special activities not covered by any of the standard ECPs, or to clarify, expand, or otherwise supplement the standard procedures to provide more appropriate control for a specific activity.

5.2.3 Format

Project Instructions are prepared by the Project Manager or his designated representative. The Project Instruction consists of a form page cover sheet(s) including statement of purpose, method of implementation, and exception procedure.

The working document(s) being implemented by the Project Instruction is listed as an attachment to the Project Instruction cover sheet.

5.2.4 Verification and Approval

(1) Project Instructions not related to an implemented ECP require the review and approval of the Project Manager only.

(2) Project Instructions related to an implemented ECP are reviewed by the PQAE prior to issue. This review is noted by the PQAE's initials in the "Approved By:" block of the form.

5.2.5 Document Control

Project Instructions are identified as in Paragraph 4.10 previously and issued as a revised appendix to all holders of controlled copies of the PQAP.

5.2.6 Project Instructions

The following Project Instructions are hereby implemented for this project.

(1) PI-3201-001, "Engineering Evaluation Preparation and Control."

(2) PI-3201-001QA, "Audit Checklist for Engineering Evaluation Preparation and Control."

(3) PI-3201-002, "Document Control Cover Sheet."

(4) PI-3201-0902QA, "Audit Checklist for Document Control Cover Sheet"

(5) PI-3201-008, "Preparation of Open, Confirmed and Resolved Item Reports, Finding Reports, and Finding Resolution Reports."

(6) PI-3201-009, "Engineering Program Plan."

(7) PI-3201-010, "External Communications: Preparation of Contact Log Sheets."

Copies of the implemented revisions of these project instructions is attached, Appendix B.

6. QUALITY ASSURANCE

6.1 Records

All quality assurance checklists, audit reports and records documenting activities related to the Quality Assured Activities of Section 1.2

herein are retained and controlled as specified herein and in accordance with the pertinent requirements of the applicable Engineering Control Procedure and Project Instructions.

6.2 Corrective Action

For significant conditions adverse to quality, corrective action taken is documented and resolved in accordance with Engineering Control Procedure ECP-5.15, "Corrective Action Procedure."

6.3 Audits

Quality assurance audits of project operations are conducted by the PQAE in accordance with ECP-5.6, "Quality Assurance Audits." For this project, an audit shall be performed within 30 days of completion.

PROJECT ORGANIZATION

MIDLAND INDEPENDENT DESIGN AND CONSTRUCTION VERIFICATION

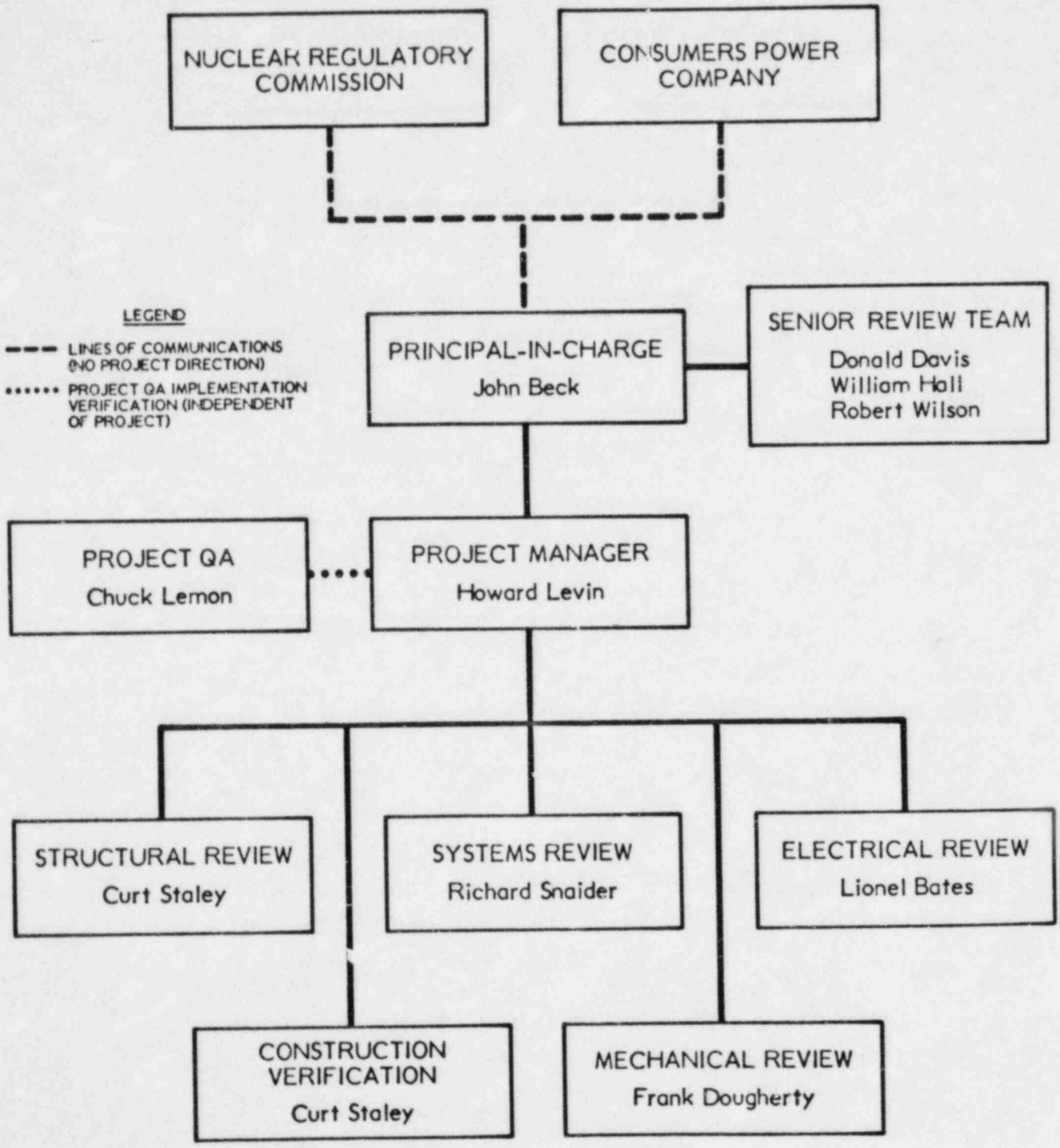


FIGURE I

PQAP REGISTER

PROJECT NO. 3201
PAGE 1 of 1

PQAP TITLE - Project Quality Assurance for Midland IDCV Program for Consumers Power Company

Subject File No. - 3201-004

Revision and Date	PQAP Sequence Number	Distribution	R.A.*
Rev. - Date -			
Rev. - Date -			
Rev. - Date -			
Rev. - Date -			

* - Receipt Acknowledged (Use Checkmark)

TERA CORPORATION

CORRESPONDENCE FILE

PROJ. NO. 3201

PAGE 1 of 1

PROJECT - Consumers Power Company
Midland Independent Design and
Construction Verification

SUBJECT FILE NO. - 3201-007 (TERA to CPC, NRC)

Sequence No.	Date	From	To	Subject

CORRESPONDENCE FILE

PROJ. NO. 3201
PAGE 1 of 1

PROJECT - Consumers Power Company Midland Independent Design and Construction Verification

SUBJECT FILE NO. - 3201-007 (CPC to TERA)

Sequence No.	Date	From	To	Subject

ATTACHMENT B-3
PQAP-3201

CORRESPONDENCE FILE

PROJ. NO. 3201

PAGE 1 of 1

PROJECT - Consumers Power Company Midland Independent Design and Construction Verification

SUBJECT FILE NO. - 3201-007 (NRC to CPC)

Sequence No.	Date	From	To	Subject

CORRESPONDENCE FILE

PROJ. NO. 3201

PAGE 1 of 1

PROJECT - Consumers Power Company Midland Independent Design and Construction Verification

SUBJECT FILE NO. - 3201-007 (Misc.)

Sequence No.	Date	From	To	Subject

CORRESPONDENCE FILE

PROJ. NO. 3201

PAGE 1 of 1

PROJECT - Consumers Power Company Midland Independent Design and Construction Verification

SUBJECT FILE NO. - 3201-007 (CPC to Bechtel)

Sequence No.	Date	From	To	Subject

CORRESPONDENCE FILE

PROJ. NO. 3201
PAGE 1 of 1

PROJECT - Consumers Power Company Midland Independent Design and Construction Verification

SUBJECT FILE NO. - 3201-007 (NRC to Bechtel)

Sequence No.	Date	From	To	Subject

ATTACHMENT B-7
PQAP-3201

CORRESPONDENCE FILE

PROJ. NO. 3201

PAGE 1 of 1

PROJECT - Consumers Power Company Midland Independent Design and Verification Construction

SUBJECT FILE NO. - 3201-007 (Bechtel to CPC)

Sequence No.	Date	From	To	Subject

CORRESPONDENCE FILE

PROJ. NO. 3201

PAGE 1 of 1

PROJECT - Consumers Power Company Midland Independent Design and Construction Verification

SUBJECT FILE NO. - 3201-007 (CPC to NRC)

Sequence No.	Date	From	To	Subject

CORRESPONDENCE FILE

PROJ. NO. 3201

PAGE 1 of 1

PROJECT - Consumers Power Company Midland Independent Design and Construction Verification

SUBJECT FILE NO. - 3201-007 (Bechtel to TERA)

Sequence No.	Date	From	To	Subject

CORRESPONDENCE CONTROL

I.D. NO. CC- _____ - _____

APPENDIX A

ENGINEERING CONTROL PROCEDURES

ENGINEERING CONTROL PROCEDURE

ECP-5.2	SUBJECT: CALCULATION PREPARATION AND CONTROL
REV: 2 DATE: 7/1/81	
PAGE 1 OF 4	PREPARED BY: APPROVED BY:

1. PURPOSE

This procedure shall be followed in the preparation and control of calculations, when required by the PQAP. Calculations are to be prepared as required to establish or verify designs, design parameters, design criteria, reduce data, establish performance and economic parameters, and otherwise provide quantitative information in accordance with accepted analytical and mathematical methods.

2. PREPARATION

2.1 Each calculation shall be prepared following accepted engineering practice and shall include problem statement, assumptions, basic criteria, data and references, applicable codes, standards, major equation sources and the source of derivation of any uncommon equations introduced in the calculation.

2.2 References shall be listed and identified sufficiently to allow easy recovery. Title, author, copyright date, edition, etc., shall be included as necessary identification information.

2.3 Calculations shall be complete and orderly and shall include sufficient sketches, notes and explanatory information to allow any person not familiar with the work, but technically qualified, to understand it without extensive additional inquiry and research.

2.4 All final calculations shall be made on standard quarule sheets and stamped in the lower right corner with the calculations stamp, Attachment B, with all required information completed by the originator to the maximum extent possible. A calculation cover sheet,

Attachment A, shall also be prepared as completely as possible and attached as sheet 1 of each final calculation prior to verification and approval. Computer calculations shall be identified by a calculation cover sheet with attachments as necessary to define the calculation being performed, the assumptions and input data used, basic mathematical models applied and references as appropriate.

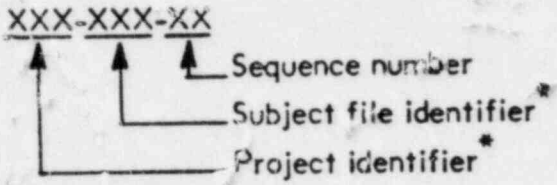
3. VERIFICATION AND APPROVAL

3.1 Calculations shall be designated as preliminary until verified by checking and signed by the Project Manager or his designated representative, or until it determined that such review and approval is not required. Preliminary calculations not upgraded to final calculation status shall be maintained in a separate file for reference purposes by the Project Manager or his designated representative. Each final calculation shall be checked by an individual who has qualifications at least sufficient to originate the calculation. The checker shall not be the originator or the originator's immediate superior. After checking, which may include alternate or simplified calculative techniques, the checker shall sign and date the calculation cover sheet and each calculation sheet. Any comments shall be resolved with the originator prior to signoff. The calculation shall then be passed to the Project Manager or his designated representative for signature. The Project Manager or his designated representative will sign only the cover sheet.

4. DOCUMENT CONTROL

4.1 Identification

After all approvals have been obtained, the final calculation shall be assigned a control identification number by the Project Manager or his designated representative in the following format:



*Project and subject file identifers are established in the PQAP.

4.2 Retention

The final calculation shall be indexed, Attachment C, and filed in the appropriate project calculation binder. Distribution shall not be made unless specific written instructions are issued to the contrary. All final calculations shall be maintained by the Project Manager, or his designated representative.

5. REVISIONS

5.1 Revisions to final calculations shall be made, verified and approved in the same manner as the original calculation.

5.2 Superseded final calculations shall be so identified and transferred to a superseded calculation binder. The calculation index shall note this action by completing the appropriate blanks on the calculation index sheets for the superseded calculation.

6. QA AUDIT CHECKLIST

6.1 Audits of the implementation of this procedure shall be conducted by the PQAE using Audit Checklist ECP-5.2QA, Attachment D.

CALCULATION COVER SHEET

TITLE _____ CONT. ID. NO. _____

PROJECT _____ NO. OF SHTS. _____

SUPERCEDES CALC. NO.

REV. NO.	REVISION	ORIGINATOR	DATE	VERIFIED BY	DATE	APPROVED BY	DATE

SUBJECT

PURPOSE

SOURCES OF DATA, FORMULAE AND REFERENCES

(References may be listed on a separate sheet)

TERA CORPORATION

CONTROL ID NO.
PREPARED BY/DATE
VERIFIED BY/DATE
PAGE ____ OF ____

CALCULATION INDEX

CALCULATION CONT. ID. NO	TITLE	DATE	SUPERCEDED BY	DATE

ENGINEERING CONTROL PROCEDURE

ECP-5.2QA	SUBJECT: AUDIT CHECKLIST FOR CALCULATION PREPARATION AND CONTROL
REV: 1 DATE: 7/1/81	
PAGE 1 OF 3	PREPARED BY: APPROVED BY:

1. PURPOSE

This checklist shall be used by the PQAE to verify the implementation of ECP-5.2, Calculation Preparation and Control, for those calculations directly related to Quality Assured Activities as identified in the PQAP. It shall not be used for any other categories of calculations or types of activities unless instructions to the contrary are established by the PQAP.

2. CHECKLIST

2.1	References?	_____
2.2	Calculation cover sheet and each page properly prepared and indentified	_____
2.3	Verification and approval signatures or initials?	_____
2.4	Control and identification number per PQAP?	_____
2.5	Calculation indexed and filed in loose leaf binder?	_____
2.6	Revisions processed in same manner as original?	_____
2.7	Superseded calculations identified on index sheet and filed in separate binder?	_____

ENGINEERING CONTROL PROCEDURE	
ECP-5.2QA	SUBJECT: AUDIT CHECKLIST FOR CALCULATION PREPARATION AND CONTROL
REV. 1 DATE 7/1/81	
PAGE 2 OF 3	PREPARED BY: APPROVED BY:

3. COMMENTS

3.1 Identify calculation(s) used in preparing this checklist, state specific cause of any unsatisfactory ratings, and recommend corrective action, if any.

3.2 Prepared by:_____ Date:_____

ENGINEERING CONTROL PROCEDURE	
ECP-5.2QA	SUBJECT: AUDIT CHECKLIST FOR CALCULATION PREPARATION AND CONTROL
REV: 1 DATE 7/1/81	
PAGE 3 OF 3	PREPARED BY: APPROVED BY:

4. FOLLOWUP

4.1 Recommended corrective action of item 3.1 satisfactorily implemented? _____

4.2 If not, state other action taken to resolve the deficiency, or state rationale justifying no corrective action taken, and if this item is open or closed.

4.3 Prepared by:_____ Date:_____

ENGINEERING CONTROL PROCEDURE

ECP-5.3	SUBJECT: DRAWING PREPARATION AND CONTROL
REV: 1 DATE: 7/1/81	
PAGE 1 OF 5	PREPARED BY: APPROVED BY:

1. PURPOSE

This procedure shall be followed for the preparation and control of drawings, when required by the PQAP. Drawings are prepared as reqired to graphically and/or pictorially describe physical location, size, geometric configuration, summarize data or other technical parameters and characteristics, and include maps, figures, charts, tables and similar documents.

2. PREPARATION

2.1 Each drawing shall be prepared following accepted engineering and drafting practice, under the direction of the Project Manager or his designated representative by the drafting department.

2.2 Each drawing shall include a title block which provides necessary descriptive information such as drawing title, job number and/or name, client name, physical scale, if applicable, legend and other pertinent information as established by the Project Manager for each drawing or drawing type.

2. For figures, tables and similar report related drawings;

Figure XX.X.X
- Report text cross-reference
- Type, as established by report text (chart, table, graph, etc.)

3. For maps and geological drawings developed from maps;

Map XX
- Sequence number (01-99)

Each drawing shall also include the date of issue, as determined by the Project Manager. The date shall appear directly below the title block, shall not be identified as "Date", and shall be in the following format:

X XX XX
- day of month issued
- month issued
- last digit of year issued

example: November 23, 1974 = 41123

4.2 Retention

The drawing shall be indexed, Attachment B, and the original drawing retained by the drafting department in suitable metal flat or tube files to prevent damage and deterioration. The recorded copy shall be returned to the Project Manager or his designated representative for filing in the appropriate subject file.

The Project Drawing Index sheets, Attachment B, shall be retained by the drafting department in loose leaf binders.

4.3 Distribution

Drawing shall be reproduced and distributed as directed by the Project Manager or his designated representative. Distribution shall be for information only and shall be uncontrolled.

5. REVISIONS

5.1 Revisions to drawings shall be made as required under direction of the Project Manager, or his designated representative.

5.2 Revisions will be reviewed, verified, record copy prepared, indexed, retained and distributed following the same control measures established for initial issue in the preceding sections.

5.3 Only the date code on the drawing shall be updated and recorded in Project Drawing Index under the next sequential revision date number.

5.4 Superseded original drawings shall be identified by the drafting department by writing near the title block "Superseded," and transferred to separate storage files. The Project Manager or his designated representative shall remove superseded or outdated record copies from the subject files, write superseded on the copy, and transfer to a separate superseded record copy file.

6. QA AUDIT CHECKLIST

6.1 Audits of the implementation of this procedure shall be conducted by the PQAE using Audit Checklist ECP-5.3 QA, Attachment C.

RECORD COPY	
DWG. NO.	REV. DATE
DRAWN BY	
APPROVED	DATE
ORIGINATED BY	
APPROVED	DATE
PROJECT MANAGER	
APPROVED	DATE

ECP-5.3

Attachment B

PROJECT DRAWING INDEX

DRAWING NO.	TITLE	REVISION DATE							
		0	1	2	3	4	5	6	7

TERA CORPORATION

ENGINEERING CONTROL PROCEDURE

ECP-5.3QA	SUBJECT: AUDIT CHECKLIST FOR DRAWING PREPARATION AND CONTROL
REV: 1 DATE: 7/1/81	
PAGE 1 OF 3	PREPARED BY: APPROVED BY:

1. PURPOSE

This checklist shall be used by the PQAE to verify the implementation of ECP-5.3, Drawing Preparation and Control, for those drawings directly related to Quality Assured Activities as identified in the PQAP. It shall not be used for any other categories of drawings or types of activities unless instructions to the contrary are established by the PQAP.

2. CHECKLIST

2.1 Drawing includes a title book with descriptive identifying information? _____

2.2 Record copy for the drawing signed, dated, and filed? _____

2.3 Drawing properly identified and date code applied? _____

2.4 Drawing properly indexed and filed in metal file cabinet? _____

2.5 Revisions to drawings processed same as original issue? _____

2.6 Superseded original drawings properly identified and filed separately? _____

2.7 Record copies of superseded drawings properly identified and filed separately? _____

ENGINEERING CONTROL PROCEDURE	
ECP-5.3QA	SUBJECT: AUDIT CHECKLIST FOR DRAWING PREPARATION AND CONTROL
REV: 1 DATE: 7/1/81	
PAGE 2 OF 3	PREPARED BY: APPROVED BY:

3. COMMENTS

3.1 Identify the drawing(s) used in preparing this checklist, state specific cause of any unsatisfactory ratings, and recommended corrective action, if any.

3.2 Prepared by:_____ Date:_____

ENGINEERING CONTROL PROCEDURE	
ECP-5.3QA	SUBJECT: AUDIT CHECKLIST FOR DRAWING PREPARATION AND CONTROL
REV: 1 DATE: 7/1/81	
PAGE 3 OF 3	PREPARED BY: APPROVED BY:

4. FOLLOWUP

4.1 Recommended corrective action of item 3.1 satisfactorily implemented? _____

4.2 If not, state other action taken to resolve the deficiency, or state rationale justifying no corrective action taken, and if this item is open or closed.

4.3 Prepared by: _____ Date: _____

ENGINEERING CONTROL PROCEDURE

ECP- 5.5	SUBJECT: PROJECT QUALITY ASSURANCE PLAN PREPARATION AND CONTROL
REV: 3 DATE: 7/1/81	
PAGE 1 OF 7	PREPARED BY: APPROVED BY:

1.0 GENERAL

1.1 PURPOSE

This Engineering Control Procedure describes and defines the preparation requirements for the Project Quality Assurance Plan (PQAP). The PQAP is required for any TERA project on which the corporate Quality Assurance Program is implemented, either by contract requirement or management decision.

1.2 SCOPE

This Engineering Control Procedure (ECP) describes and defines the preparation requirements for the Project Quality Assurance Plan (PQAP). The PQAP is required for any TERA project on which the corporate Quality Assurance Program is implemented, either by contract requirement or management decision.

1.3 EXCEPTIONS

In the event engineering or scientific areas of endeavor are identified which are not adequately covered by existing ECPs with respect to Quality Assurance and Quality Control, the Project Manager shall advise corporate management and quality assurance personnel such that special procedures and/or instructions may be prepared to augment standard procedures for the project in question. If this action is necessary, consideration shall be given by appropriate personnel to the preparation and implementation of such special procedures as corporate standards, if they are deemed applicable to future projects and the goals of overall corporate quality assurance policy.

2.0 PQAP PREPARATION AND CONTROL

2.1 PQAP FORMAT AND CONTENT REQUIREMENTS

Each PQAP shall follow the organization as defined in the following subsections.

2.1.1 COVER SHEET

The first page of each PQAP shall be a cover sheet which contains a heading identifying the document as the Project Quality Assurance Plan for a specific client, project name and project number. In addition, space shall be provided for signatures of the preparer (Project Manager), the Project Quality Assurance Engineer (PQAE) and the executive management individual to which both parties report with regard to quality assurance activities specified by the PQAP. The cover sheet shall also contain space for identification of control copies, date of issue, and revision number for the PQAP.

2.1.2 POLICY STATEMENT

The Project Manager shall prepare a Policy Statement serving as a management implementation directive for the PQAP on the project in question. This statement is generally free form, but shall, as a minimum, contain text carrying the general policy message as indicated by the sample Policy Statement, Attachment A.

2.1.3 TABLE OF CONTENTS

Following the Policy Statement each PQAP shall contain a Table of Contents identifying section numbers and page numbers for the contents of the PQAP.

Each PQAP shall contain, as a minimum, those sections as shown in the sample Table of Contents, Attachment B.

2.1.4 PROJECT QUALITY ASSURANCE PLAN

Following the Table of Contents, the PQAP shall begin. Each page of the plan shall be prepared on the special header paper shown as Attachment C. The plan number shall correspond to the corporate contract or project designation number with the first revision issue of the document as Rev. 0, and all subsequent revisions in increasing sequential numerical order. Each page of the plan shall be numbered sequentially, excluding appendices and attachments which may apply for any given PQAP. These documents shall be numbered as separate entities. The project title entered on each sheet in the header block space shall be consistent for all pages in the PQAP.

2.2 PQAP DETAILED CONTENTS

The following subsections describe in greater detail the content requirements for a minimum Project Quality Assurance Plan.

2.2.1 GENERAL

The first section of the PQAP shall be entitled General, and shall contain a statement of the purpose of the plan and identification of the activities requiring specific quality assurance and quality control functions for the project in question. Each section describing an engineering or scientific function requiring quality control measures shall identify applicable ECPs which are mandatory during that operation to provide adequate quality assurance and quality control. The actual ECPs to be implemented, as identified in these sections of the PQAP,

shall be attached as appendices to the plan when issued for a client's review and approval. In addition, any quality assurance related areas not covered by existing procedures shall be identified, and special instructions shall be defined and implemented as required.

The General section of the PQAP shall also contain required statements regarding implementation of the PQAP as to schedule, issue of revisions and their effective date, and those individuals responsible for compliance with the plan for the project in question. Identification of individuals may be by name or function.

2.2.2 ORGANIZATION

A description of the project organization which identifies individuals, their relative responsibility, and lines of authority and communication shall be described in this section. An Organization Chart shall be prepared and attached to the PQAP to clarify this discussion (see sample Organization Chart, Attachment D). The discussion shall center on the authority and responsibility of important project personnel, particularly the Project Manager and Project Quality Assurance Engineer. In addition, general discussions of corrective actions and communication lines between project personnel, corporate management and designated client personnel shall be defined. When applicable, this discussion shall identify any ECPs required to effectively carry out assigned authorities and responsibilities.

2.2.3 PERSONNEL QUALITIFICATIONS AND CONTROL

This section of the PQAP shall contain three major subsections as follows:

1. Management Personnel
2. Project Personnel
3. Associate Personnel

Each section shall introduce, identify and briefly describe the experience and capabilities of important project personnel. These sections should refer to resumes which are to be attached as appendices to the PQAP to further identify, clarify and document the competence and capability of personnel involved on the project. It should be emphasized in this section that discussion of personnel is in no way intended to serve as a qualification statement for acceptability for the project. Technical competence and acceptability of TERA project personnel and associates by the client for the project in question is a contractual issue, and its resolution is concurrent with contract issuance. The information provided in this section is only for the purpose of establishing clearly identified lines of communication and authority between responsible TERA and client personnel.

2.2.4 ADMINISTRATIVE CONTROL

This section of the PQAP shall contain information identifying the procedures and/or instructions which will be implemented to control documentation generated on the project which is subject to quality assurance and control measures. In most cases, ECPs implemented in previous sections associated with quality assured activities will contain control procedures for the documents they generate. However, there may be cases in which special instructions are

required, either by client request or project management decision, to cover special document handling situations. These shall be pointed out specifically in the administrative control section. This section shall also identify and introduce any project instruction, numbering identification scheme or other special administrative features required for adequate control of project documents. At the Project Manager's discretion, this section may also contain information regarding subtask identification within the project for accounting and task scheduling and control functions. Although this information may not be essential from a quality assurance and quality control standpoint, in some cases it may impact critical work areas, and therefore, may be included in the PQAP.

2.2.5 PROCEDURES AND INSTRUCTIONS

This section of the PQAP shall specifically identify each Engineering Control Procedure called out in other sections of the PQAP. This identification shall be by procedure number, title and revision. It shall also identify and refer to the appendices of the PQAP which will contain the current revision of applicable ECPs.

This section of the PQAP shall also contain detailed instructions for the development and implementation of Project Instructions, if required to augment existing procedures. The Project Manager is ultimately responsible for preparation of any required Project Instructions, and the format and methodology of this issuance shall be coordinated with the client.

2.2.6 QUALITY ASSURANCE

This section of the PQAP shall identify the method of implementation of quality assurance functions in a manner specific to the subject project, shall specify

those quality assurance related records subject to retention and control, and shall define the responsibility for and resolution of corrective actions issued as a result of quality assurance audits. Appropriate ECPs and/or Project Instructions shall be identified and implemented for the quality assurance audit functions, corrective action function, and record control function, as required.

This section will also present the project audit schedule. The Project Manager and the Project Quality Assurance Engineer are responsible for developing and maintaining the audit schedule. The audits may be project-wide or by activity as defined in PQAP.

2.3 PQAP CONTROL

The Project Manager is responsible for the preparation of the PQAP and shall retain control of any necessary revision of the PQAP applicable to the project.

The original and each revision of the PQAP shall be verified by the project PQAE prior to issuance.

The original and each revision of the PQAP shall be approved by the Executive Vice President prior to issuance.

Attachment A

POLICY STATEMENT

In conjunction with the corporate Quality Assurance Program, this Project Quality Assurance Plan has been prepared to establish the measures necessary to provide adequate confidence in and assurance of the quality of services to be provided for the _____ Company in the performance of activities involved in the conduct of the _____ _____ Project. To that end, the quality assurance/quality control methods, procedures and instructions established herein shall be implemented, as applicable, by those individuals assigned responsibility for the activities requiring quality assurance and control as identified herein. Any deviations, exceptions, or other non-conformances shall be brought to my attention for resolution.

Project Manager

Attachment B

TABLE OF CONTENTS

TABLE OF CONTENTS (CONT.)

FIGURES

APPENDICES

ENGINEERING CONTROL PROCEDURE		
ECP-	SUBJECT:	
REV: DATE:		
PAGE ____ OF ____	PREPARED BY:	APPROVED BY:

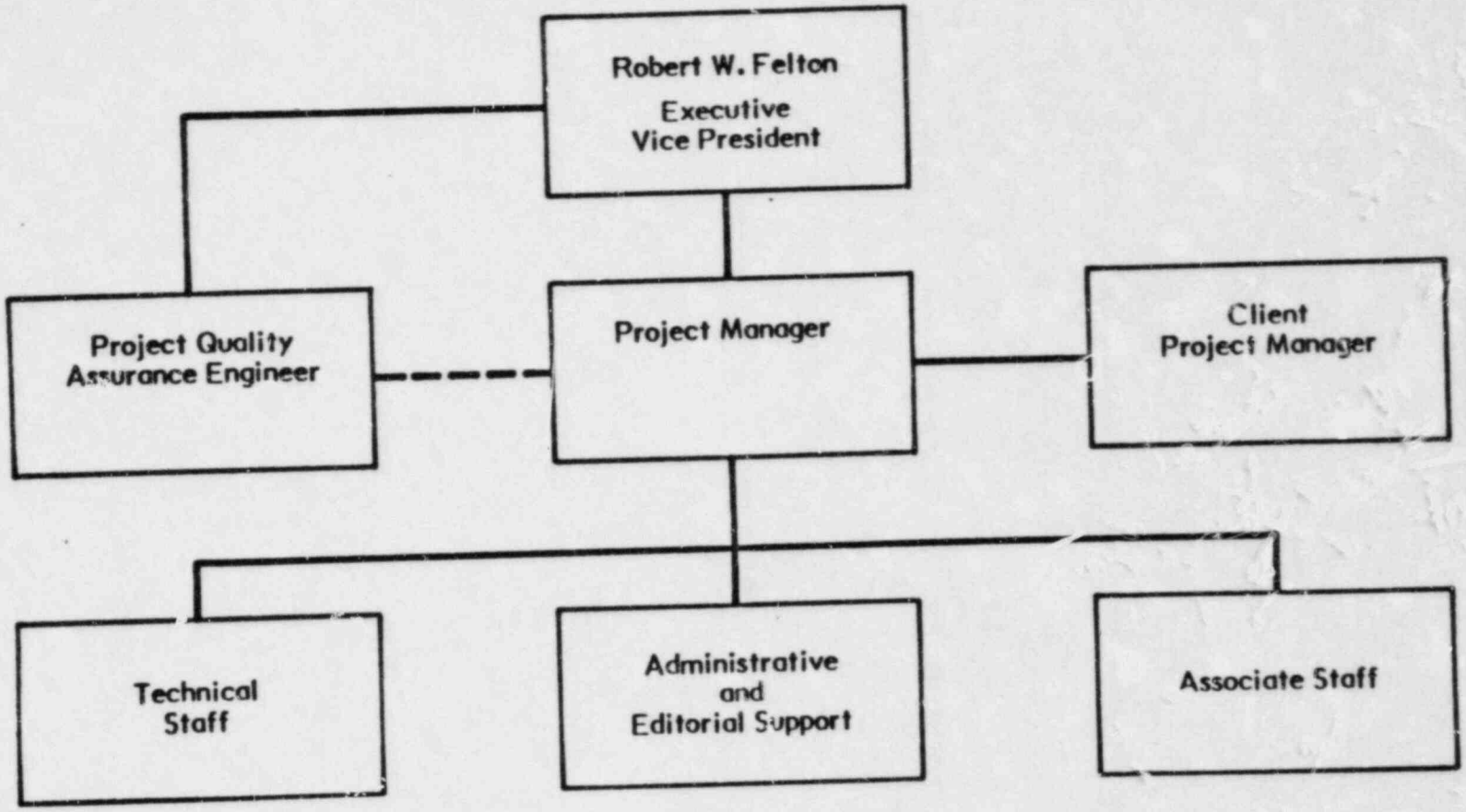


FIGURE 1
PROJECT ORGANIZATION

ENGINEERING CONTROL PROCEDURE

ECP-5.6	SUBJECT: QUALITY ASSURANCE AUDITS
REV. 3 DATE 7/1/81	
PAGE 1 OF 4	PREPARED BY: APPROVED BY:

1. PURPOSE

1.1

This procedure shall be followed for the performance of Quality Assurance Audits when required by the PQAP and in conformance with audit schedules as defined in the PQAP. Quality Assurance Audits are required on those projects which provide a product that relates directly to the design of safety-related structures, systems and components or characteristic evaluations and analyses which affect these safety-related structures, systems and components. The PQAP establishes quality assured activities and the applicability of procedures and instructions to those activities.

1.2

Audits of internal project operations shall be conducted over the duration of the contract to:

(1) Provide objective evidence of compliance with the project requirements as defined by the PQAP.

(2) Determine the adequacy of the PQAP plan.

(3) Verify implementation of recommended corrective action, as required.

2. IMPLEMENTATION

2.1 The PQAE shall schedule, conduct, document, make recommendations and findings, initiate corrective action, and follow-up on Quality Assurance Audits as necessary to verify the implementation of the PQAP as required by the TERA Quality Assurance Program.

3. QA AUDIT CHECKLIST

3.1 Audits of the implementation of procedures specified for implementation in the PQAP shall be conducted by the PQAE using Audit Checklists applicable to those procedures. Specifically, Audit Checklists ECP-5.2QA, "Audit Checklist for Calculation Preparation and Control" and ECP-5.3QA, "Audit Checklist for Drawing Preparation and Control" are identified for use.

4. QUALITY ASSURANCE AUDIT DOCUMENTATION

4.1 The PQAE shall prepare an Audit Report upon completion of each audit, which shall include all Audit Checklists used during the audit, a summary description of the audit and results, and any audit findings requiring corrective action. Audit Findings shall be recorded using the appropriate Audit Finding Form (AFF), Attachment A. The report shall be distributed by memorandum for information and necessary corrective action to appropriate levels of management and the Project Manager, and shall be a controlled document.

5. CORRECTIVE ACTION

5.1 Any and all nonconformances, deviations and audit findings and exceptions requiring corrective action shall be resolved through the issuance of a Corrective Action Memo (CAM). The CAM shall be prepared by the Project Manager in response to the issuance of an Audit Finding, and shall be issued to the PQAE for acceptance. After final acceptance, the PQAE shall return a signed copy of the CAM to the Project Manager for record. Attachment B to this procedure provides a sample Corrective Action Memo.

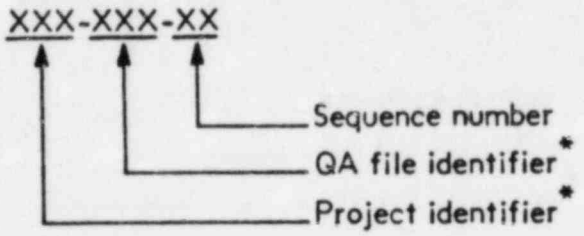
6. FOLLOW-UP ACTIONS

6.1 The Project Manager or his designated representative shall prepare audit finding responses in the form of CAMs as required and shall submit them to the PQAE for acceptance. Upon completion of all action, an Audit Resolution Report shall be issued by the PQAE which shall include all applicable CAMs, a summary of corrective actions taken and all closed out audit findings. Any follow-up action or additional audits to verify audit responses, if required, shall be designated in the Audit Resolution Report and distributed to the Project Manager and appropriate levels of management for information. The Audit Resolution Report is a controlled document.

7. DOCUMENT CONTROL

7.1 IDENTIFICATION

After all resolutions have been obtained, final Audit Reports and Audit Resolution Reports shall be assigned control identification numbers by the PQAE or his designated representative in the following format:



Project and subject and QA file identifiers are established in the PQAP.

7.2 RETENTION

The final reports shall be indexed and filed appropriately in the project Quality Assurance file. Distribution shall not be made unless specific written instructions are issued to the contrary. All final reports shall be maintained by the PQAE, or his designated representative.

ATTACHMENT A

AUDIT FINDING NO. _____ PROJECT _____

REFERENCES

GROUP AUDITED _____

THOSE CONTACTED _____

10 CFR 50, APPENDIX B CRITERIA _____

ISSUED TO _____

AUDIT FINDING (USE AND REFERENCE ADDITIONAL SHEETS AS REQUIRED)

DISCUSSION (USE AND REFERENCE ADDITIONAL SHEETS AS REQUIRED)

RECOMMENDATION (USE AND REFERENCE ADDITIONAL SHEETS AS REQUIRED)

AUDITED BY	_____	_____	_____	DISTRIBUTION
	NAME	TITLE	DATE	
AUDITED BY	_____	_____	_____	
	NAME	TITLE	DATE	
ISSUED BY	_____	_____	_____	
	NAME	TITLE	DATE	

TERA CORPORATION

ATTACHMENT B

AUDIT FINDING - CORRECTIVE ACTION MEMO

PROJECT _____

1. CORRECTIVE ACTION TAKEN TO RESOLVE AUDIT FINDING

(USE AND REFERENCE ADDITIONAL SHEETS IF REQUIRED)

PREPARED BY _____ NAME _____ DATE

ACTION TAKEN BY _____ NAME _____ DATE

ISSUED BY _____ NAME _____ DATE

ACTION VERIFIED BY _____ NAME _____ DATE

2. CORRECTIVE ACTION TAKEN TO PREVENT RECURRENCE

(USE AND REFERENCE ADDITIONAL SHEETS AS REQUIRED)

PREPARED BY _____ NAME _____ DATE

ACTION TAKEN BY _____ NAME _____ DATE

ISSUED BY _____ NAME _____ DATE

ACTION VERIFIED BY _____ NAME _____ DATE

PQAE ACCEPTANCE OF CORRECTIVE ACTION

- ☐ RESOLVES AUDIT FINDING
- ☐ UNACCEPTABLE
- ☐ USE "AS IS"
- ☐ TEMPORARY USE UNTIL RESOLUTION

_____ NAME _____ TITLE _____ DATE

TERA CORPORATION

ENGINEERING CONTROL PROCEDURE	
ECP-5.15	SUBJECT: CORRECTIVE ACTION
REV.: 0 DATE: 7/1/81	
PAGE 1 OF 11	PREPARED BY: APPROVED BY:

1. PURPOSE

This Engineering Control Procedure establishes the requirements for corrective action measures and preparation of associated documentation. These corrective action measures are provided to assure that conditions adverse to quality are promptly identified, reported and corrected. The procedures for preparing Corrective Action Reports are presented in Section 4.0.

2. REFERENCES

2.1 Title 10, Code of Federal Regulations, Part 50.

2.2 Title 10, Code of Federal Regulations, Part 21

3. PROGRAM REQUIREMENTS

3.1 GENERAL REQUIREMENTS

3.1.1 Conditions adverse to quality such as failure, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances shall be promptly identified and corrected.

3.1.2 In the case of significant conditions adverse to quality, the cause of the condition shall be determined, corrective action shall be taken to preclude repetition, and the condition with its determined cause and corrective action shall be documented and reported to appropriate levels of management.

3.1.3 Follow-up reviews shall be conducted to verify proper implementation of corrective actions and to close out the corrective action documentation.

3.2 REPORTABLE DEFICIENCIES

3.2.1 Written procedures shall be established for documenting and reporting possible Reportable Deficiencies as defined in References 2.1 and 2.2.

3.2.2 All personnel within TERA who believe that a Reportable Deficiency may exist, shall promptly report the condition to appropriate management.

3.2.3 The possible Reportable Deficiency shall be evaluated to determine whether or not it is indeed reportable to the Nuclear Regulatory Commission. Technical assistance shall be obtained from the engineering staff and QA staff as necessary to support the evaluation.

3.2.4 When a condition has been evaluated as being a Reportable Deficiency, the Regional Office of Inspection and Enforcement, Nuclear Regulatory Commission shall be notified within the time frame prescribed in references 2.1 and 2.2.

3.2.5 This prompt notification to NRC shall be followed by a written, definitive report, that includes a description of the deficiency, an analysis of the safety implications and the corrective action taken. Also included shall be sufficient information to permit analysis and evaluation of the deficiency and of the corrective action taken to

preclude repetition. If sufficient information is not available for such a definitive report within the time frame prescribed in References 2.1 and 2.2, TERA shall submit an interim report to NRC. This report shall contain all available information, together with a statement as to when a complete report is to be issued.

3.3 SPECIFIC CORRECTIVE ACTION REQUIREMENTS WITHIN TERA

3.3.1 TERA shall establish and implement corrective action procedures consistent with the requirements discussed in this section. The need for corrective action may result from an evaluation of system and procedural deficiencies, and includes those conditions reportable to the NRC. Needs for corrective action may also arise from the results of audit findings, results of TERA design reviews, reviews of surveillance activities, and reviews of material nonconformance reports. When the need for corrective action is identified, the adverse condition shall be documented on a Corrective Action Report.

Appropriate measures shall be taken to bring the condition to the attention of supervisory or management personnel who can take effective action.

3.3.2 Identified conditions requiring corrective action shall be documented on a Corrective Action Report with a control number.

3.3.3 A control log shall be maintained for Corrective Action Reports. Control numbers shall be assigned, and Corrective Action Reports shall be logged, reviewed, and distributed to designated personnel in

accordance with the Project Quality Assurance Plan. The management of the organization responsible for specifying and implementing corrective action shall be included in this distribution.

3.3.4 The organization responsible for implementation of corrective action shall be responsible for identifying the cause(s) and for specifying the action(s) necessary to correct identified conditions requiring corrective action.

3.3.5 When the specified corrective action affects design considerations, a technical review of the Corrective Action Report shall be made by the organization, or its equivalent, that established the original design basis. This technical review shall evaluate the existing condition and concur with the identification of the cause(s) for the adverse condition and the corrective action(s) proposed or taken to preclude its repetition.

3.3.6 Once a response is received on the Corrective Action Report, the proposed corrective action shall be evaluated and the implementation shall be verified. The following activities are required:

1. A review of the report and concurrence with the specified corrective action measures.
2. Verification that adequate corrective action has been implemented, then updating the control log.
3. If the corrective action is not acceptable or if it has not been properly implemented, the responsible Project Manager shall be notified. This notification is documented and distributed to the same organizations that received the original corrective action.

4. Distribution of completed Corrective Action Report.

4. PROCEDURES

4.1 REPORTING A DEFICIENCY DURING AN AUDIT USING THE CAR

1. The individual detecting a deficiency during an audit will initiate corrective action by filling out the appropriate spaces on a Corrective Action Report (CAR) Form, Attachment A. He will state on the CAR as a minimum: (1) a description of the requirement which describes what is required in the deficient area, (2) his observation of the deficient area which show the area to be in nonconformance, and (3) his recommendation for correcting the deficiency. The date on the CAR Form represents the day the CAR was written. The individual detecting the deficiency will then sign the CAR and deliver it to the appropriate Project Quality Assurance Engineer.

2. The Project Quality Assurance Engineer shall review the CAR to ensure its applicability and if satisfied that the deficiency requires corrective action, he will complete the top portion of the form by assigning a CAR number from the CAR Log (Attachment B), and complete the top of the form as applicable.

3. At the post-audit conference, the Project Quality Assurance Engineer will have the Project Manager, or his designated representative, sign the CAR in the "Acknowledged By" space or provide a documented reason for not signing the CAR.

4. The CAR will then be included in an Audit Report which will be generated and distributed in accordance with ECP 5.5.

5. Response to the CAR from the audited organization shall be due as requ ted by the Audit Report. Normally this shall not exceed thirty (30) days.

4.2 REPORTING A NON-AUDIT DEFICIENCY USING THE CAR

1. The individual detecting a deficiency will initiate corrective action by filling out the appropriate spaces on a CAR Form, Attachment A. The individual detecting the deficiency will state on the CAR as a minimum: (1) a description of the requirement which describes what is required in the deficient area, (2) his observation of the deficient area which shows the area to be in nonconformance, and (3) his recommendation for correcting the deficiency. The date on the CAR Form represents the day the CAR was written.

2. The individual detecting the deficiency shall sign the CAR and attach it to a cover letter addressed to the Project Manager responsible for the project on which the deficiency was detected. The cover letter shall state that the "Acknowledged By" space shall be signed by the person receiving the CAR.

3. Signing the "Acknowledged By" space only indicates that the responsible Project Manager, or his designated representative, has received the CAR. If the responsible Project Manager, or his designated representative, will not sign the CAR, a documented reason for not signing shall be required by corporate management.

4. The CAR and cover letter shall be delivered to the Project Quality Assurance Engineer (PQAE) for his review.

5. The PQAE shall review the CAR to ensure its applicability and if satisfied that the deficiency requires corrective action, he or his designate will complete the top portion of the form as applicable, including assigning a CAR number from the CAR Log (Attachment B).

6. The cover letter and CAR will be filed in the project file and distributed in accordance with the PQAP.

7. Response to the CAR from the responsible Project Manager shall be due as requested by the cover letter, normally this shall not exceed thirty (30) days.

4.3 USE OF CAR LOG (ATTACHMENT B)

4.3.1 CAR NUMBER

Each CAR will have a unique number assigned from the CAR Log. This number will be a multidigit identification number consisting of the following:

1. The first four digits will indicate the audit number (i.e., 76-01 would be the first audit in 1976 and 77-12 would be the twelfth audit in 1977). CARs that are issued and that are not the result of an audit will use the designator of double zero following the year (i.e., 76-00 or 78-00).

2. The last two digits will indicate the CAR number (i.e., 76-01-07 would indicate the seventh CAR of audit 76-01, and 76-00-15 would indicate the fifteenth CAR written in 1976 which was not written as the result of an audit).

3. Each Project Quality Assurance Engineer will be responsible for entering in the CAR Log, the CAR numbers used during that audit, immediately after the Audit Report is issued.

4. The CAR Log should be maintained in chronological order and CAR numbers should not be entered in the log until after the previous numbered audits' CARs have been entered. Those CARs which have a double zero (00) prefix will be maintained on a separate sheet in the CAR Log and the PQAE will be responsible for having them entered in chronological order as they are issued.

4.3.2 DATE ISSUED

This date will correspond to the date of the Audit Report inasmuch as that is the date upon which the company bases formal notification to the responsible Project Manager or his designated representative.

4.3.3 ISSUED TO

This space on the CAR Log will be used to denote the Project Manager and Division to which the CAR is issued. Abbreviations are acceptable so long as they are recognized standard abbreviations.

4.3.4 RESPONSE DUE BY

This space will include an estimate of the date by which a response from the audited project is due.

4.3.5 RESPONSE RECEIVED

This will be the date upon which the response from the audited project was received.

4.3.6 PROPOSED ACTION DUE BY

Based upon the response received, a scheduled completion date for proposed corrective action will be established and this date will be entered in the space provided.

4.4 CLOSING OUT A CAR

1. EVALUATING CAR RESPONSE

Once a response is received, the proposed corrective action will be carefully considered by the person designated in 4.1.1 or 4.2.1 above or their supervisor. The response will be evaluated for insuring that the proposed corrective action will be initiated in a timely manner, verifying adequacy of the proposed corrective action, and insuring that the proposed corrective action precludes recurrence of conditions adverse to quality.

2. RESPONSE ACCEPTABLE

If the person evaluating the CAR response is satisfied, he will signify by signing and dating the CAR in the "TERA QA Concurrence with Proposed Action" space provided. If the corrective action is scheduled for a later date, that date will be entered in the CAR Log per 4.3.6 above.

3. RESPONSE NOT ACCEPTABLE

If the response is not acceptable, a responsible person, designated in 4.1.1 or 4.2.1 above or their supervisor will draft a letter to the responsible Project Manager, or his designated representative, stating why their response was inadequate and what would be acceptable as corrective action. This letter will be issued by the PQAE and referenced in the remarks section of the CAR Log. Communications will continue in this manner, with the responsible Project Manager, to the level of management deemed appropriate by the PQAE until resolution is reached.

4. CORRECTIVE ACTION COMPLETED

If the CAR indicates that the corrective action has been accepted per paragraph 4.4.2, the person designated in paragraph 4.1.1 or 4.2.1 or their supervisor will determine what follow-up action is necessary to verify that the corrective action has been completed. When he is satisfied that the corrective action is accomplished he will sign and date the "Closed By" space provided for close out approval on the CAR Form and forward the CAR to the PQAE for review.

5. FILING

Once the PQAE has reviewed a CAR, he or his designee shall be responsible for completing the entry in the CAR Log and ensuring that a copy of the completed CAR is filed in the project files.

4.5 REVIEW OF CAR LOG

It is the responsibility of each PQAE and the Quality Assurance Manager (QAM) as appropriate to ensure through periodic reviews of the CAR Log that timely follow-up action is being taken on the CAR for which they are responsible. The QAM will review the CAR Log at least quarterly and he will make notes of any CAR which is past due, due, or will be due within a short period of time and he will bring these to the attention of the responsible parties for action.

4.6 OVERDUE RESPONSES AND ACTIONS

When it becomes apparent that a Response or Corrective Action has exceeded its due date as listed on the CAR Log the Project Manager, or his designated representative, responsible for the delay will be cited as being in violation of the Corrective Action System as described by this procedure and a CAR or other appropriate correspondence should be issued as a result of that violation. The Project Quality Assurance Engineer or the Quality Assurance Manager, as appropriate, initiates this action as a means of prompting action from the delinquent Project Manager, or his designated representative.

Attachment A

DIN: _____

PROJECT NUMBER: _____

PROJECT TITLE: _____

CLIENT: _____

DATE: _____

CORRECTIVE ACTION REPORT

TO:	FROM:	CAR NO.
ORGANIZATION:	TITLE:	

DESCRIPTION OF REQUIREMENTS:

OBSERVATION:

REPORTED BY: ACKNOWLEDGED BY:

RECOMMENDED ACTION:

PROPOSED CORRECTIVE ACTION:

SCHEDULED COMPLETION DATE: PROPOSED BY: DATE:

TERA CONCURRENCE WITH PROPOSED ACTION _____ NAME _____ TITLE _____ DATE

FOLLOWUP:

CLOSED BY: _____ DATE

REVIEWED: _____ DATE

Attachment A

DIN: _____

PROJECT NUMBER: _____

PROJECT TITLE: _____

CLIENT: _____

DATE: _____

CORRECTIVE ACTION REPORT

TO:	FROM:	CAR NO.
ORGANIZATION:	TITLE:	

DESCRIPTION OF REQUIREMENTS:

OBSERVATION:

REPORTED BY: ACKNOWLEDGED BY:

RECOMMENDED ACTION:

PROPOSED CORRECTIVE ACTION:

SCHEDULED COMPLETION DATE: PROPOSED BY: DATE:

TERA CONCURRENCE WITH PROPOSED ACTION _____ NAME _____ TITLE _____ DATE

FOLLOWUP:

CLOSED BY: _____ DATE

REVIEWED: _____ DATE

CAR LOG

DATE ISSUED	CAR NUMBER	PROJECT NUMBER	ISSUED TO	RESPONSE DUE BY	RESPONSE RECEIVED	PROPOSED ACTION DUE BY	DATE CLOSED	COMMENTS

APPENDIX B

PROJECT INSTRUCTIONS

PROJECT INSTRUCTION

PI- 3201 - 001	SUBJECT: Engineering Evaluation Preparation and Control
REV.: 0 DATE: 11/11/82	
PAGE 1 of 4	PREPARED BY: [signature] APPROVED BY: [signature]

1.0 GENERAL

1.1 Purpose

The purpose of this instruction is to establish the requirements for preparation and control of engineering evaluations required for the Midland Independent Design and Construction Verification (IDCV) Program.

1.2 Scope

Engineering evaluations for the Midland IDCV shall be required for tasks such as design criteria evaluation, commitment compliance evaluation, design evaluation, construction records evaluation, findings determination, safety significance evaluations, and field verification. These evaluations shall pertain to all engineering disciplines of review.

2.0 PREPARATION

2.1 Each evaluation shall be prepared by performing and documenting a point-by-point comparison of the topic being evaluated using design and construction evaluation checklists prepared by the Lead Technical Reviewer. These checklists shall be developed in consideration of the design criteria contained in the FSAR, the regulations, or to the guidance contained in the Standard Review Plan Regulatory Guides, industry codes and standards.

2.2 Engineering evaluations shall include references to sources of information or data used in the evaluation. References shall be listed and identified sufficiently to allow easy recovery. Title, author, copyright date, edition, etc. shall be included as necessary identification information.

2.3. Evaluations shall be complete and orderly and shall include sufficient sketches, notes, and explanatory information to allow any person not familiar with the work, but technically qualified, to understand it without extensive additional inquiry and research.

2.4 All final evaluations shall have an engineering evaluation cover sheet (Attachment A) prepared as completely as possible and attached as Sheet 1 of each final engineering evaluation prior to verification and approval.

3.0 VERIFICATION AND APPROVAL

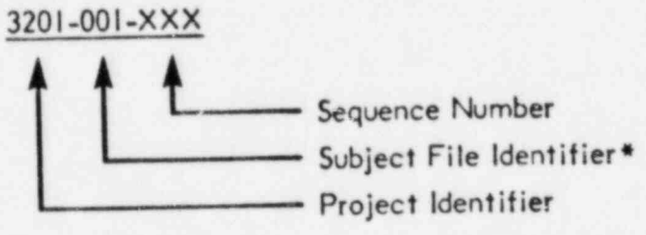
3.1 Engineering evaluations shall be designated as preliminary until verified by reviewing and signed by the Lead Technical Reviewers, Project Manager or his designated representative, or until it is determined that such review and approval is not required. Preliminary evaluations not upgraded to final status shall be maintained in a separate file for reference purposes by the Lead Technical Reviewers, the Project Manager or his designated representative. Each final engineering evaluation shall be reviewed by an individual who has

qualifications at least sufficient to originate the evaluation. The reviewer shall not be the originator but may be the Project Manager. After reviewing, the reviewer shall sign and date the engineering evaluation cover sheet. Any comments shall be resolved with the originator prior to signoff. The Project Manager or his designated representative shall then sign only the cover sheet when the evaluation and its review have been completed.

4. DOCUMENT CONTROL

4.1 Identification

After all approvals have been obtained, the final engineering evaluation shall be assigned a control identification number by the Project Manager or his designated representative in the following format:



1

* Subject file identifiers are established in the PQAP.

4.2 Retention

The final engineering evaluation shall be indexed using the engineering evaluation register (Attachment B) and filed in the appropriate project engineering evaluation binder for each plant. Distribution shall not be made unless specific written instructions are issued to the contrary. All final engineering evaluations shall be maintained by the Project Manager, or his designated representative.

5. REVISIONS

5.1 Revisions to final engineering evaluations shall be made, verified, and approved in the same manner as the original engineering evaluation.

5.2 Superseded final engineering evaluations shall be so identified and transferred to a superseded document binder. The engineering evaluation register shall note this action by referencing the new revision of the evaluation. Revisions shall be entered into the engineering evaluation register.

6. QA AUDIT CHECKLIST

6.1 Audits of the implementation of this procedure shall be conducted by the PQAE using the appropriate Audit Checklist PI-3201-001QA (Attachment C).

ENGINEERING EVALUATION COVER SHEET

TITLE _____ CONT. I.D. NO. 3201-001

PROJECT Consumers Power Company Midland IDCV NO. OF SHTS. _____

SUPERSEDES ENG. EVAL. NO.

REV. NO.	REVISION	ORIGINATOR	DATE	REVIEWED BY	DATE	APPROVED BY	DATE

SUBJECT

PURPOSE

SOURCES of INFORMATION and REFERENCES

(May Be Continued On A Separate Sheet)

ENGINEERING EVALUATION REGISTER

PROJ. NO. 3201
PAGE 1 of 1

PROJECT - Consumers Power Company Midland IDCV

SUBJECT FILE NO. - 3201-001

Engineering Evaluation	I.D. No. & Sequence Subnumber	Date of Issue	Rev. No.

PROJECT INSTRUCTION

PI- 3201 - 001	SUBJECT: Audit Checklist for Engineering Evaluation Preparation and Control
REV.: 0 DATE: 11/11/82	
PAGE 1 of 3	PREPARED BY: [signature] APPROVED BY: John W. Rock

1. PURPOSE

This checklist shall be used by the PQAE to verify the implementation of PI-3201-001, Engineering Evaluation Preparation and Control, for those engineering evaluations directly related to Quality Assured Activities as identified in the PQAP. It shall not be used for any other categories of engineering evaluations or types of activities unless instructions to the contrary are established by the PQAP.

2. CHECKLIST

2.1 References? _____

2.2 Engineering evaluation cover sheet and each page properly prepared and identified? _____

2.3 Review and approval signatures or initials? _____

2.4 Control identification number per PQAP? _____

2.5 Engineering evaluation indexed and filed in loose leaf binder or controlled file? _____

2.6 Revisions processed in same manner as original? _____

2.7 Superseded engineering evaluations identified on index sheet and filed in separate binder? _____

PROJECT INSTRUCTION		
PI- 3201 - 001	SUBJECT: Audit Checklist for Engineering Evaluation Preparation and Control	
REV.: 0 DATE: 11/11/82		
PAGE 2 of 3	PREPARED BY:	APPROVED BY:

3. COMMENTS

3.1 Identify engineering evaluation(s) used in preparing this checklist, state specific cause of any unsatisfactory ratings, and recommend corrective action, if any.

3.2 Prepared by: _____ Date: _____

PROJECT INSTRUCTION		
PI- 3201 - 001	SUBJECT: Audit Checklist for Engineering Evaluation Preparation and Control	
REV.: 0 DATE: 11/11/82		
PAGE 3 of 3	PREPARED BY:	APPROVED BY:

4. FOLLOWUP

4.1 Recommended corrective action of Item 3.1 satisfactorily implemented? _____

4.2 If not, state other action taken to resolve the deficiency, or state rationale justifying no corrective action taken, and whether this item is closed or open.

4.3 Prepared by: _____ Date: _____

PROJECT INSTRUCTION		
PI- 3201 .. 002	SUBJECT: Document Control Cover Sheet	
REV.: 0 DATE: 11/11/82		
PAGE 1 of 4	PREPARED BY:	APPROVED BY:

1.0 GENERAL

1.1 Purpose

The purpose of this project instruction is to establish the requirements for control of final reports and other documents that are developed by TERA in performance of the Midland Independent Design and Construction Verification (IDCV) Program.

1.2 Scope

Documents such as drawings, quality assurance audit reports, Open, Confirmed, and Resolved (OCR) Item reports, finding reports, finding resolution reports, draft, and final reports, shall be controlled by this Project Instruction.

2.0 PREPARATION

2.1 All drawings, quality assurance audit reports, OCR reports, finding reports, finding resolution reports, draft and final reports shall include a document control cover sheet (Attachment A) prepared as completely as possible and attached as Sheet 1 of each such document prior to review and approval.

3.0 REVIEW AND APPROVAL

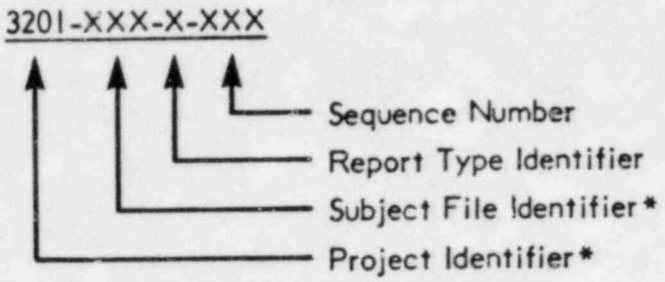
3.1 All documents under the scope of this Project Instruction shall be designated as preliminary until reviewed and approved within TERA. Such preliminary documents shall be maintained in separate files for reference purposes only. Each document under the scope of this Project Instruction shall be reviewed by an individual who has the qualifications to originate the document. The reviewer shall not be the originator, but may be the Project Manager. After reviewing, the reviewer shall sign and date the document control cover sheet. Any comments shall be resolved with the originator prior to signoff. The Project Manager or his designated representative shall then sign only the cover sheet when the document and its review have been completed.

4.0 DOCUMENT CONTROL

4.1 Identification

After all required approvals have been obtained, the OCR reports, finding reports, finding resolution reports, draft and final reports shall be assigned a control identification number by the Project Manager or his designated representative in the following format:

PROJECT INSTRUCTION		
PI- 3201 - 002	SUBJECT: Document Control Cover Sheet	
REV.: 1 DATE: 1/17/83		
PAGE 3 of 4	PREPARED BY:	APPROVED BY:



1

4.1.1 The following report type identifiers shall be utilized:

O - Open Item Report
C - Confirmed Item Report
R - Resolved Item Report
E - Finding Report
Z - Finding Resolution Report
D - Draft Final Report
F - Final Report

4.1.2 Related OCR and finding reports or draft final and final reports shall be assigned the same sequence number, starting from 000 to 999. Note that all sequence numbers may not be used for all report types.

* Project and subject file identifiers are established in the PQAP.

4.2 Retention

The draft and final reports shall be indexed using the appropriate Document Control Register (Attachment B-1 (OCR Reports), B-2 (Reports), B-3 (Drawings), B-4 (Quality Assurance) and B-5 (Finding Reports), and B-6 (Finding Resolution Reports), and filed in the appropriate project controlled documents file. Distribution shall not be made unless specific written instructions are issued to the contrary. All such final documents shall be maintained by the Project Manager or his designated representative. These documents shall be transmitted to the client as final reports in accordance with project schedules.

5.0 REVISIONS

5.1 Revisions to final documents shall be made, verified, and approved in the same manner as the original document.

5.2 Superseded final documents shall be so identified and transferred to a superseded document binder. The document control register shall note this action by referencing the new revision of the evaluations. Revisions shall be entered into the Document Control Register.

6.0 QA AUDIT CHECKLIST

6.1 Audits of the implementation of this procedure shall be conducted by the PQAE using the appropriate Audit Checklist PI-3201-002QA (Attachment C).

DOCUMENT CONTROL COVER SHEET

TITLE _____ CONT. I.D. NO. 3201- - -

PROJECT Consumers Power Company Midland IDCV NO. OF SHTS. _____

SUPERSEDES DOCUMENT NO.

REV. NO.	REVISION	ORIGINATOR	DATE	REVIEWED BY	DATE	APPROVED BY	DATE

SUBJECT

PURPOSE

SOURCES of INFORMATION and REFERENCES

(May Be Continued On A Separate Sheet)

DOCUMENT/REPORT CONTROL REGISTER

PROJ. NO. 3201
PAGE 1 of 1

PROJECT - Consumers Power Company Midland IDCV

SUBJECT FILE NO. - 3201-008 (OCR Reports)

Document Title	I.D. No. & Sequence Subnumber	Date of Issue	Rev. No.

DOCUMENT/REPORT CONTROL REGISTER

PROJ. NO. 3201
PAGE 1 of 1

PROJECT - Consumers Power Company Midland IDCV

SUBJECT FILE NO. - 3201-002 (Reports)

Document Title	I.D. No. & Sequence Subnumber	Date of Issue	Rev. No.

DOCUMENT/REPORT CONTROL REGISTER

PROJ. NO. 3201
PAGE 1 of 1

PROJECT - Consumers Power Company Midland IDCV

SUBJECT FILE NO. - 3201-002 (Drawings)

Document Title	I.D. No. & Sequence Subnumber	Date of Issue	Rev. No.

QUALITY ASSURANCE DOCUMENT REGISTER

PROJ. NO. 3201
PAGE 1 of 1

PROJECT - Consumers Power Company Midland IDCV

SUBJECT FILE NO. - 3201-005

Document Title	I.D. No. & Sequence Subnumber	Date of Issue	Rev. No.

DOCUMENT/REPORT CONTROL REGISTER

PROJ. NO. 3201
PAGE 1 of 1

PROJECT - Consumers Power Company Midland IDCV

SUBJECT FILE NO. - 3201-008 (Finding Reports)

Document Title	I.D. No. & Sequence Subnumber	Date of Issue	Rev. No.

TERA CORPORATION

DOCUMENT/REPORT CONTROL REGISTER

PROJ. NO. 3201
PAGE 1 of 1

PROJECT - Consumers Power Company Midland IDCV

SUBJECT FILE NO. - 3201-008 (Finding Resolution Reports)

Document Title	I.D. No. & Sequence Subnumber	Date of Issue	Rev. No.

PROJECT INSTRUCTION

PI- 3201 - 002 QA	SUBJECT: Audit Checklist for Document Control Cover Sheet
REV.: 0 DATE: 11/11/82	
PAGE 1 of 3	PREPARED BY: APPROVED BY:

1. PURPOSE

This checklist shall be used by the PQAE to verify the impiementation of PI-3201-001, Engineering Evaluation Preparation and Control, for those engineering evaluations directly related to Quality Assured Activities as identified in the PQAP. It shall not be used for any other categories of engineering evaluations or types of activities unless instructions to the contrary are established by the PQAP.

2. CHECKLIST

2.1 References? _____

2.2 Engineering evaluation cover sheet and each page properly prepared and identified? _____

2.3 Review and approval signatures or initials? _____

2.4 Control identification number per PQAP? _____

2.5 Engineering evaluation indexed and filed in loose leaf binder or controlled file? _____

2.6 Revisions processed in same manner as original? _____

2.7 Superseded engineering evaluations identified on index sheet and filed in separate binder? _____

PROJECT INSTRUCTION		
PI- 3201 . 002 QA	SUBJECT: Audit Checklist for Document Control Cover Sheet	
REV.: 0 DATE: 11/11/82		
PAGE 2 of 3	PREPARED BY:	APPROVED BY:

3. COMMENTS

3.1 Identify engineering evaluation(s) used in preparing this checklist, state specific cause of any unsatisfactory ratings, and recommend corrective action, if any.

3.2 Prepared by: _____ Date: _____

PROJECT INSTRUCTION		
PI- 3201 - 002 QA	SUBJECT: Audit Checklist for Document Control Cover Sheet	
REV.: 0 DATE: 11/11/82		
PAGE 3 of 3	PREPARED BY:	APPROVED BY:

4. FOLLOWUP

4.1 Recommended corrective action of Item 3.1 satisfactorily implemented? _____

4.2 If not, state other action taken to resolve the deficiency, or state rationale justifying no corrective action taken, and whether this item is closed or open.

4.3 Prepared by: _____ Date: _____

PROJECT INSTRUCTION

PI- 3201 - 008	SUBJECT: Preparation and Control of Open, Confirmed and Resolved Item Reports, Finding Reports and Finding Resolution Reports
REV.: 0 DATE: 11/11/82	
PAGE 1 of 8	PREPARED BY: APPROVED BY:

1.0 GENERAL

1.1 Purpose

The purpose of this instruction is to establish the requirements for preparation and control of Open, Confirmed and Resolved (OCR) Item Reports, Finding Reports and Finding Resolution Reports required for the Midland Independent Design and Construction Verification (IDCV) Program.

1.2 Scope

The evaluation process leading to findings, including the resolution of findings, shall be documented throughout the IDCV program, categorized as to the status of disposition and an auditable record maintained showing the bases for the determination and categorization. OCR Item Reports, Finding Reports, and Finding Resolution Reports shall be prepared and controlled in accordance with the provisions of this instruction.

1.3 Definitions

1.3.1 Potential Open Item

A determination by an IDCV reviewer that the item is a potential deviation in implementation of design criteria, design or construction commitments and design or construc-

tion procedures, thus requiring additional investigation or confirmatory analysis in areas such as: quality assurance or design control implementation, licensing criteria or commitments compliance, analytical or mathematical technical approach, design analysis evaluation, specifications review, field configuation and constructed product verification, etc. Potential Open Items that are verified by the project team (Project Manager and all Lead Technical Reviewers) become open items.

1.3.2 Open Item

The item has the potential for becoming a Confirmed Item, but additional investigation or confirmatory analysis is necessary to make a final judgement.

1.3.3 Confirmed Item

The item is judged to be an apparent finding by the review team and will require action, such as additional documentation not utilized by the team that documents the resolution of the item or additional analysis, design or construction changes or procedural changes that may be necessary to resolve the item. Confirmed Items that are later verified become findings.

1.3.4 Resolved Item

Sufficient additional information was available in the ongoing review to resolve the Open or Confirmed Item and to completely close out any concern.

1.3.5 Finding

A verified deviation in implementation of design criteria, design or construction commitments and design or construction procedures in areas such as: quality assurance, design or construction control, analysis, design, engineering evaluation, specification, design or construction implementation, field installation, etc. Findings may fall into two categories; those affecting the ability of systems, components or structures to meet their intended safety function and those without an impact to safety functions.

1.3.6 Resolved finding

Sufficient additional information was made available by CPC, the original design or construction organization to resolve the finding and completely close out any concern about the finding. Finding resolution may require additional analysis, design or construction changes or procedural changes. Full resolution requires the identification of root-cause and extent and a plan for corrective action if required.

2.0 RESPONSIBILITIES

2.1 The technical reviewers are responsible for preparing OCR Item Reports, recommending the classification of OCR Items and forwarding these to their Lead Technical Reviewer (LTR).

2.2 The Lead Technical Reviewers are responsible for the classification of OCRs and the preparation of Finding Reports and Finding Resolution Reports. The LTRs shall consider input provided to them by the technical reviewers. An LTR may perform the duties of the technical reviewer.

2.3 The Project Manager is responsible for periodically organizing meetings or telecons of the project team (Project Manager and all LTRs) for the purpose of conducting an integrated review of the classification and significance of OCRs and findings, and the resolution of findings.

2.4 The Project Manager is responsible for forwarding OCR Item Reports, Finding Reports, and Finding Resolution Reports to the Principal-in-Charge and Senior Review Team (SRT); forwarding Confirmed Item Reports and Finding Reports to CPC with the carbon copies to the appropriate design organizations; and forwarding Finding Reports and Finding Resolution Reports to the NRC and recognized intervenors. The Project Manager may perform the duties of the LTR.

2.5 The project team (Project Manager and all LTRs) shall review the classification of and attempt to resolve Open or Confirmed Items, conduct further technical review or call for further technical review to clarify, expand or reassess open or Confirmed Items. The project team is responsible for verification of a Confirmed Item leading to the declaration of a finding, resolution of a finding or the re-classification of a finding as "resolved".

2.6 The Principal-in-Charge is responsible for concurring with the classification of OCRs, findings, findings resolution, making a determination if a review is required by the Senior Review Team, and directing the Project Manager to forward Confirmed Item Reports, Finding Reports, and Finding Resolution Reports to appropriate parties.

2.7 The Senior Review Team is responsible for reviewing forwarded OCR Item Reports, Finding Reports, and Finding Resolution Reports, identifying the need for clarification, expansion of review or re-assessment by the LTRs and technical reviewers. The SRT shall review the safety significance of forwarded OCR Reports and Finding Reports and may recommend a course of action for resolution. The SRT shall review the Finding Resolution Reports to assess the acceptability of any remedial actions taken by CPC and the original design or construction organization.

3.0 PREPARATION

3.1 The preparation of reports under the scope of this Project Instruction shall follow the report generation process shown on the diagram, "Report Flow Chart" (Figure 1).

3.2 Open, Confirmed and Resolved Item Reports, Finding Reports and Finding Resolution Reports shall be prepared utilizing the attached forms (Attachments A, B, C) assuring that all pertinent information is documented completely and orderly.

3.3 The OCR Reports, Finding Reports and Finding Resolution Reports including any supplementary sketches, notes, and explanatory information shall be prepared in such a manner as to allow any person not familiar with the work, but technically qualified, to understand it without extensive additional inquiry and research.

3.4 All OCR Reports, Finding Reports and Finding Resolution Reports shall have a document control cover sheet which has been prepared in accordance with instructions documented in PI-3201-002, Document Control Cover Sheet.

3.5 All OCR Reports, Finding Reports and Finding Resolution Reports shall be identified and retained in accordance with instructions documented in PI-3201-002, Document Control Cover Sheet.

4.0 VERIFICATION AND APPROVAL

4.1 OCR Reports, Finding Reports and Finding Resolution Reports shall be designated as preliminary until verified by reviewing and signing by the Project Manager.

4.2 The technical reviewers shall sign OCR Reports thereby verifying the accuracy of the information presented and signifying that the report has been prepared under his review.

4.3 The LTRs shall sign OCR Item Reports signifying his concurrence. The LTRs shall sign Finding Reports and Finding Resolution Reports thereby verifying the accuracy of information presented and signifying that the report has been prepared under his review.

4.4 The Project Manager shall verify and approve OCR Reports and Finding Reports and Finding Resolution Reports signifying completion of review and concurrence by the project team.

4.5 The Principal-in-Charge shall sign OCR Reports, Finding Reports and Finding Resolution Reports signifying his review and decision whether these reports require SRT review.

4.6 The SRT (any member) shall sign all OCR Reports, Finding Reports and Finding Resolution Reports which the SRT is requested to review, thereby signifying completion of their review and concurrence by the SRT.

5.0 DISTRIBUTION AND INTERCHANGE OF INFORMATION

5.1 Confirmed Item Reports shall be distributed by the Project Manager to CPC (with a carbon copy to the original design or construction organization) upon receiving direction from the Principal-in-Charge.

5.2 Finding Reports and Finding Resolution Reports shall be distributed by the Project Manager to CPC (with a carbon copy to the original design or construction organization), NRC and recognized intervenors upon receiving direction from the Principal-in-Charge.

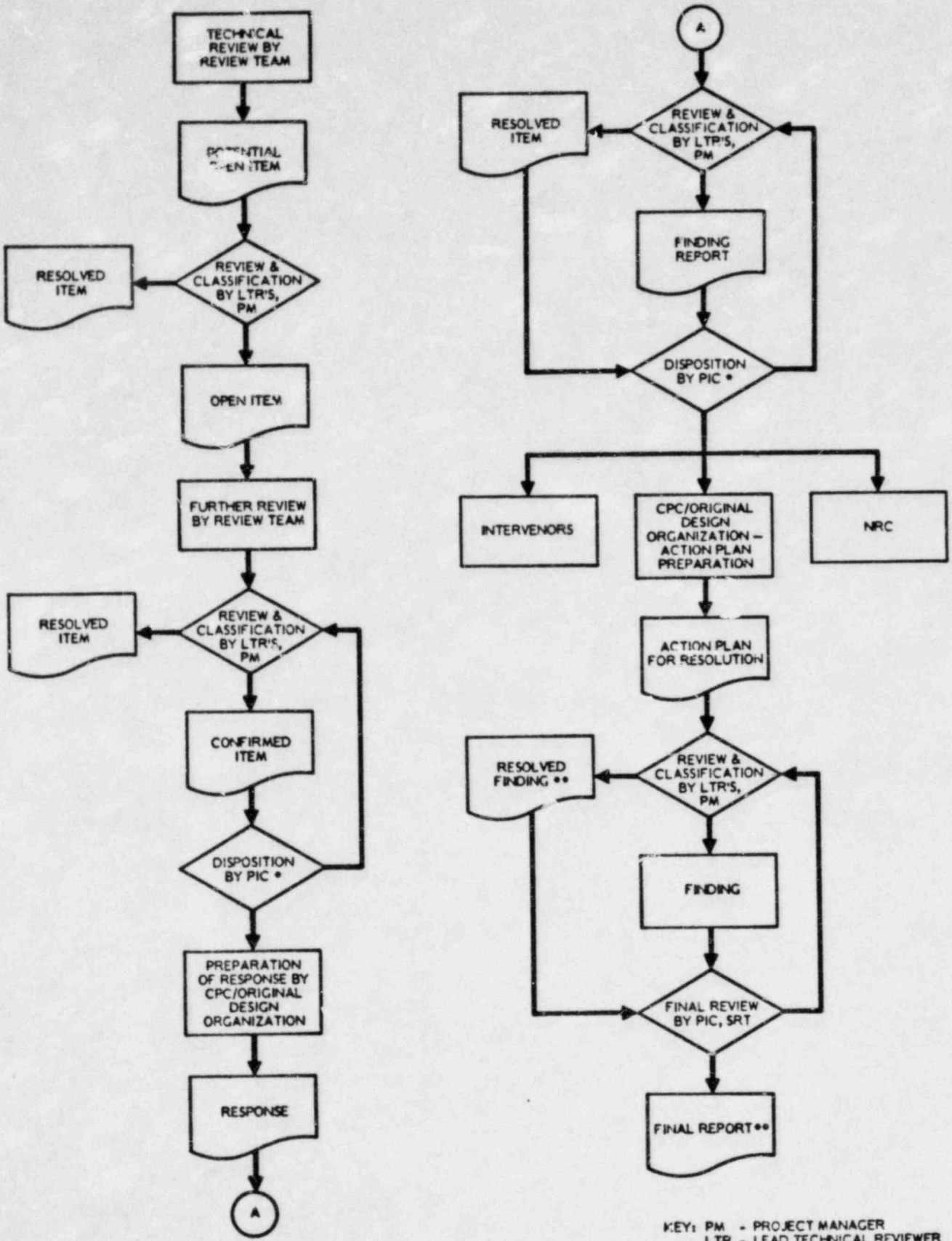
5.3 It shall be the responsibility of the Project Manager to determine when there is a need to have a meeting with the project team, CPC and the original design or construction organization to discuss findings or resolution of findings. He shall then notify CPC at least one week prior to the meeting so that the NRC can be notified that such a meeting will be taking place.

6.0 REVISIONS

6.1 Revisions to final documents shall be made, verified, and approved in the same manner as the original document.

6.2 Superseded final documents shall be so identified and transferred to a superseded document binder. The document control register shall note this action by referencing the new revision of the document. Revisions shall be entered into the Document Control Register.

REPORT FLOW CHART
MIDLAND INDEPENDENT DESIGN AND CONSTRUCTION VERIFICATION PROGRAM



NOTE: * PIC TO DETERMINE SRT REVIEW AND CONCURRENCE REQUIRED
** DISTRIBUTED TO CPC, NRC AND INTERVENORS

KEY: PM - PROJECT MANAGER
LTR - LEAD TECHNICAL REVIEWER
PIC - PRINCIPAL-IN-CHARGE
SRT - SENIOR REVIEW TEAM
CPC - CONSUMERS POWER COMPANY

MIDLAND INDEPENDENT DESIGN AND CONSTRUCTION VERIFICATION
OPEN, CONFIRMED AND RESOLVED (OCR) ITEM REPORT

TYPE OF REPORT: OPEN _____ CONFIRMED _____
RESOLVED _____ ITEM

FILE NO. 3201-008
DOC NO. 3201-008- -____
REV. NO. _____

DATES REPORTED TO: LTR _____ SRT _____ PROJECT TEAM/PROJECT MGR. _____
PRINCIPAL-IN-CHARGE _____ CPC/DESIGN ORG. _____

STRUCTURE(S), SYSTEM(S), OR COMPONENT(S) INVOLVED:

IDCV PROGRAM AREA OR TASK (IF APPLICABLE):

DESCRIPTION OF CONCERN:

SIGNIFICANCE OF CONCERN:

RECOMMENDATION _____ OR RESOLUTION _____:

COMMENTS BY SRT (IF REQUIRED):

REFERENCES (INCL. RELATED OCR ITEM REPORT NO.):

SIGNATURE(S):

OCR ITEM REPORT ORIGINATOR	LTR	PROJECT MANAGER FOR PROJECT TEAM	PRINCIPAL-IN-CHARGE	SRT (IF REQUIRED)
DATE	DATE	DATE	DATE	DATE

MIDLAND INDEPENDENT DESIGN AND CONSTRUCTION VERIFICATION FINDING REPORT

CLASS: SAFETY _____ NON-SAFETY _____

FILE NO. 3201-008
DOC NO. 3201-008- -____
REV. NO. _____

DATES REPORTED TO: PROJECT TEAM/PROJECT MGR. _____ PRINCIPAL-IN-CHARGE _____
SRT _____ CPC/DESIGN ORG. _____

STRUCTURE(S), SYSTEMS(S), OR COMPONENT(S) INVOLVED:

DESCRIPTION OF FINDING:

SIGNIFICANCE OF FINDING:

RECOMMENDATION:

COMMENTS BY SRT (IF REQUIRED):

REFERENCES (INCL. RELATED OCR ITEM REPORT NO.):

SIGNATURE(S):

FINDING REPORT ORIGINATOR (LTR)	PROJECT MANAGER FOR PROJECT TEAM	PRINCIPAL-IN-CHARGE	SRT (IF REQUIRED)
DATE	DATE	DATE	DATE

MIDLAND INDEPENDENT DESIGN AND CONSTRUCTION VERIFICATION
FINDING RESOLUTION REPORT

CLASS: SAFETY _____ NON-SAFETY _____

FILE NO. 3201-008
DOC NO. 3201-008- -
REV. NO. _____

DATES REPORTED TO: PROJECT TEAM/PROJECT MGR. _____ PRINCIPAL-IN-CHARGE _____
SRT _____ CPC/DESIGN ORG. _____

STRUCTURE(S), SYSTEMS(S), OR COMPONENT(S) INVOLVED:

DESCRIPTION OF FINDING (OR REFERENCE DOC. NO. OF FINDING REPORT):

DESCRIPTION OF RESOLUTION:

RESOLUTION BASED UPON FOLLOWING DOCUMENTATION:

COMMENTS BY SRT (IF REQUIRED):

SIGNATURE(S):

FINDING RESOLUTION REPORT ORGIN. (LTR)	PROJECT MANAGER FOR PROJECT TEAM	PRINCIPAL-IN-CHARGE	SRT (IF REQUIRED)
DATE	DATE	DATE	DATE

PROJECT INSTRUCTION

PI- 3201 - 010	SUBJECT: External Communications: Preparation of Contact Log Sheets
REV.: 0 DATE: 11/11/82	
PAGE 1 of 3	PREPARED BY: APPROVED BY:

1.0 GENERAL

1.1 Purpose

The purpose of this project instruction is to establish the requirements for the documentation and control of records summarizing oral communications and meetings between TERA Independent Design and Construction Verification (IDCV) Program personnel and all other external parties.

1.2 Scope

All oral communications and meetings that include discussion with parties external to the IDCV review organization of any subjects material to the scope of the Midland IDCV or findings and findings resolution shall be controlled by this Project Instruction.

2.0 PREPARATION

2.1 A "Midland Independent Design and Construction Verification Contact Log Sheet" (Attachment A) shall be prepared completely; identifying participants in the conversation or meeting, their organizations, the date of the conversation or meeting, an accurate summary of all substantive issues discussed and an identification of any actions agreed upon as a result of the conversation or meeting.

3.0 REVIEW AND APPROVAL

3.1 All contact log sheets prepared under the scope of this Project Instruction shall be designated as final upon logging in the appropriate project subject file in accordance with the provisions of Section 4.0 of this procedure. No further review or approval is required.

4.0 DOCUMENT CONTROL

4.1 Identification

Contact log sheets shall be assigned a control identification number in accordance with the requirements of section 4.0, Administrative Control, of the Project Quality Assurance Plan.

4.2 Retention

The contact log sheets shall be indexed using the Control Register (Attachment B) and filed in the appropriate project controlled subject file. Distribution shall not be made unless specific written instructions are issued to the contrary by the project manager. All such contact log sheets shall be maintained by the project manager or his designated representative.

PROJECT INSTRUCTION		
PI- 3201 - 010	SUBJECT: External Communications: Preparation of Contact Log Sheets	
REV.: 0 DATE: 11/11/82		
PAGE 3 of 3	PREPARED BY:	APPROVED BY:

5.0 REVISIONS

5.1 Revisions of contact log sheets shall not be made by any individuals other than the originator or his designated representative.

5.2 Under no circumstances should facts, figures or any other details of the conversation or meeting be modified except to correct an error of omission or transposition.

MIDLAND INDEPENDENT DESIGN AND CONSTRUCTION VERIFICATION CONTACT LOG SHEET	FILE NO. 3201-010 DOC. NO. 3201-010- REV. NO.

SUMMARY OF TELECON ___ OR MEETING ___ DATE: _____

SUBJECT: _____

ORGANIZATION(S): _____

PARTICIPANTS: TERA: _____

OUTSIDE: _____

SUMMARY: _____

ACTION: _____

DOCUMENT/REPORT CONTROL REGISTER

PROJ. NO. 3201

PAGE ____ of ____

PROJECT - External Communications: Preparation of Contact Log Sheets

SUBJECT FILE NO. - 3201-010

Document Title	I.D. No. & Sequence Subnumber	Date of Issue	Rev. No.

APPENDIX C

RESUMES

JOHN W. BECK
Vice President - Southern/Southwestern Operations

Education

M.S.	Mechanical Engineering, Northeastern University
B.S.	Engineering Physics, University of Tulsa

Summary of Experience

Mr. Beck has extensive experience in technical and corporate management. He has managed projects and engineering support activities in the areas of fuel management and procurement, power plant licensing, environmental systems, electrical and mechanical engineering, reactor physics and nuclear safety analysis. His corporate management experience was as the Chief Operating Officer of the Vermont Yankee Nuclear Power Corporation which owns and operates a 525 MWe nuclear generating station. He also served as Chairman of the EPRI Nuclear Engineering and Operations Task Force and as a member of the Nuclear Divisional Committee of EPRI.

1980 - Present	Vice President, TERA Corporation. Responsible for the Southern and Southwestern Operations of the company.
1976 - 1980	Executive Vice President, Vermont Yankee Nuclear Power Corporation. Served as the Chief Operating Officer of the company. The output of the nuclear plant is sold wholesale to its owners, ten New England electric utilities. As Chief Operating Officer, was responsible for the technical and business management of the corporation.
1974 - 1976	Director of Engineering, Yankee Atomic Electric Company. Responsible for the general supervision and management of the Plant, Reactor, and Environmental Engineering Departments as well as Research and Engineering Development and computer applications for the company.
1973 - 1974	Reactor Engineering Manager, Yankee Atomic Electric Company. Direct responsibility for fuel management, transient and safety analyses for the Yankee Rowe, Vermont Yankee, Maine Yankee, Seabrook and New England Electric System nuclear installations.
1967 - 1973	Engineer/Licensing Engineer, Yankee Atomic. Reload core physics design and analysis for operating plants and nuclear design follow for new plants. Licensing engineer for Maine Yankee.
1964 - 1967	Scientist, Bettis Atomic Power Laboratory. Experimental reactor physics and analysis for the Shippingport and Light Water Breeder core physics design.

Professional Associations

American Nuclear Society

HOWARD A. LEVIN
Project Manager

Education

M.S.	Structural Engineering, Massachusetts Institute of Technology
B.E.	Civil Engineering, Stevens Institute of Technology

Summary of Experience

Mr. Levin has over eight years of experience in the commercial nuclear field with emphasis in nuclear plant design and construction, operating reactor safety, licensing, project management, and federal regulation.

1981 - Present — Project Manager - TERA Corporation. Responsible for the management and implementation of large projects servicing clients in the nuclear services area.

1976 - 1981 — Technical Assistant to the Director, Division of Engineering, NRC. Responsible for the development of policies and programs related to the technical review of license applications and operating reactor safety. Administered technical activities in the areas of mechanical, equipment qualification, structural, materials, chemical, hydrological, geotechnical, earthquake and environmental engineering. Represented the Director and provided testimony before the NRC, ACRS, ASLB, public hearings and industry meetings, presenting and justifying technical analyses and evaluations.

Program Manager, Systematic Evaluation Program-NRC. Responsible for the development of program goals, scope, technical criteria and scheduling for the SEP structural, mechanical, and seismic safety review of older operating reactors. Responsibilities included the administration and management of large dollar resources and multi-disciplined engineering professionals. Developed new and innovative procedures for seismic safety assessment.

Senior Engineer, NRC. Responsible for the review of Safety Analysis Report information pertaining to complex structural, mechanical and materials issues related to all operating power and research reactor facilities. Coordination of technical assistance programs; preparation of licensing criteria documents, codes and standards; documentation and presentation of safety analyses and evaluations supporting licensing actions.

1974 - 1976 — Structural Engineer, Stone and Webster Engineering Corp. Responsible for the analysis and design of nuclear power plant structures, systems and components for normal and extreme loading conditions. Emphasis on dynamic analysis and computer code development to solve problems related to qualification for seismic and pipe rupture loadings. Developed new design concepts for prestressed concrete containment buildings.

1972 - 1974 Held engineering positions with Slattery Associates and Hercules, Inc. Responsible for design of structural systems used in construction of bridges, subways, sewage plants, and process chemical plants. In charge of field surveying team.

Professional Affiliation

American Society of Civil Engineers

Honors and Publications

M.I.T. Engineering Resident Fellowship
U.S. Naval Academy Appointment
Moles Heavy Construction Award

Selected Technical papers and Publications:

Prestressed Concrete Containments for Nuclear Power Plants, Operating Experience with Snubbers, Fracture Toughness and Lamellear Tearing of Component Supports, Equipment Response at the El Centro Steam Plant. During the October 15, 1979, Imperial Valley Earthquake, Seismic Review of Operating Plants, Systematic Evaluation Program Seismic Review, Evaluation of Existing Nuclear Power Plant Facilities for Postulated Heavy Load Drop Consequences, Seismic Design Guidelines for Existing Nuclear Power Facilities in Light of an Expanding Data Base of Knowledge.

CHARLES E. LEMON
Manager - Quality Assurance

Education

B.S. Mechanical Engineering, University of Idaho

Summary of Experience

Mr. Lemon has over eight years of supervisory and technical experience in nuclear and fossil fueled power plant engineering, quality assurance, licensing, environmental studies and computer systems application. At present, he performs quality assurance functions for TERA nuclear safety functions, including review of project QA plans and performance of audits. In addition, he is responsible for the system design of the NRC Document Control System Project. He has assisted in the design and implementation of Automated Records Management Systems for three nuclear power plant projects, including computer software for document indexing and micrographics systems.

1976 - Present Manager - Quality Assurance. Implementation of TERA quality assurance program, development of QA procedures, review of project QA plans, and auditing of QA activities. In addition, responsible for the design and implementation of user oriented records and information management systems for nuclear projects. Special emphasis in computer indexing systems for nuclear power plant QA/QC records and documentation.

1974 - 1976 Project Manager - Power Engineering, TERA Corporation. Responsible for the preparation of capital cost and capability models for fossil and nuclear fueled power plants. Performed technical and economic evaluations of the impact of thermal effluent limitations on steam electric power plants for the National Commission on Water Quality.

1973 - 1974 Mechanical Group Quality Engineering Coordinator, Bechtel. Responsible for review and approval of vendor QA/QC manuals, and preparation and implementation of group QA/QC effort with project and corporate QA/QC program.

1970 - 1973 Engineer, Bechtel. Responsible for the design and procurement of mechanical draft cooling tower system for conversion of existing open cycle circulating water system to closed cycle circulating water system for an 800 MWe PWR. System design and equipment procurement for Balance of Plant thermal cycle systems for two unit 1100 MWe BWR. System design and equipment procurement for gaseous radwaste system, fuel pool cooling and cleanup systems and containment atmospheric control systems.

Registrations

Registered Professional Engineer - Nuclear Engineering, California
Registered Professional Engineer - Mechanical Engineering, California

Professional Associations

American Society of Mechanical Engineers
National Society of Professional Engineers
California Society of Professional Engineers
National Micrographics Association

DONALD K. DAVIS
Manager - Nuclear Safety and Licensing

Education

B.S.	Nuclear Engineering, North Carolina State University
Graduate Studies	Numerical Sciences, The Johns Hopkins University

Summary of Experience

Mr. Davis has 15 years of nuclear engineering experience. He has managed licensing programs for the NRC and has performed safety analyses for commercial power plants. He has directed multiple discipline engineering groups evaluating the design aspects of commercial power plants including potential site hazards such as earthquakes and floods, structural and mechanical design, electrical engineering, system performance and reactor core accident analysis. He is an expert in nuclear licensing issues from a policy and engineering viewpoint. At TERA Mr. Davis has been the Project Manager for two key projects related to the Diablo Canyon nuclear plant; the performance of Seismic Design Studies to verify the safety design basis of the plant and the development of an Earthquake Emergency Plan to address the potential effects of an earthquake on emergency planning activities.

1979 - Present	Manager - Nuclear Safety and Licensing, TERA Corporation.
1972 - 1979	Chief, Systematic Evaluation Program Branch, NRC. Responsible for the safety evaluation of 11 older power plants in over 130 technical issues from seismic design to accident analyses. Chief, Operating Reactor Project Branch, NRC. Responsible for the licensing activities associated with 15 power reactors. Technical Assistant, Division of Operating Reactors, NRC. Provided technical direction to the licensing staff evaluating operating reactors. Technical Support Section Leader, Office of Nuclear Reactor Regulation. Provided technical assistance and advice on policy issues to the Director and Deputy Director of Nuclear Reactor Regulation. Project Manager, Light Water Reactors, AEC. Responsible for the licensing of nuclear power reactors for construction and operation.
1967 - 1972	Reactor Engineer, Hittman Associates. Responsible for the design and safety analyses of several nuclear power plants and spent fuel shipping containers. Conducted analyses of primary and secondary system transients and loss-of-coolant accident analyses for several power reactor designs.
1964 - 1967	Research Assistant, North Carolina State University. Responsible for dosimetry research associated with 10 kilowatt research reactor and 30,000 Curie Cobalt-60 irradiator.

Professional Affiliations and Honors

American Society of Mechanical Engineers
Tau Beta Pi, Engineering Honorary
Sigma Pi Sigma, Physics Honorary
Phi Kappa Phi, Academic Honorary

WILLIAM J. HALL
Principal Scientist

Education

Ph.D.	Civil Engineering, University of Illinois
M.S.	Civil Engineering, University of Illinois
B.S.	Civil Engineering, University of Kansas
	University of California, Berkeley

Summary of Experience

Dr. Hall has had over 39 years of experience in the fields of structural engineering, structural mechanics and dynamics, soil mechanics, earthquake engineering, plasticity, fatigue, fracture mechanics, nuclear power, and civil defense including 33 years on the faculty of the Civil Engineering Department at the University of Illinois. He is author or co-author of over 115 formal publications (books and professional articles) and over 150 major consulting reports, many of public record and wide distribution. He is editor for a series of texts in civil engineering and engineering mechanics for Prentice-Hall, Inc. On his own and as an associate of the late Nathan M. Newmark, he has carried major consulting engineering responsibility for projects in such areas as development of design criteria for hardened protective structures, physical vulnerability studies, vibration studies of missile test stands, reactor containment structural design and analysis, nuclear field test studies, review of structural criteria and designs for nuclear power plants and equipment for seismic loadings, M-X system development, and the trans-Alaska pipeline design.

Professional Affiliations

American Society of Civil Engineers, Fellow, officer of local section and numerous committees
American Association for the Advancement of Science, Fellow
Earthquake Engineering Research Institute - past Director
American Concrete Institute
American Society of Engineering Educators
International Institute of Welding
Seismological Society of America
American Society for Testing and Materials
Society for Experimental Stress Analysis
International Association for Bridge and Structural Engineering
Illinois Society of Professional Engineers
National Society of Professional Engineers
Structural Engineers Association of Illinois
Applied Technology Council
National Science Foundation Advisory Committee on Earthquake Engineering

Honors

Who's Who in America
Who's Who in Engineering
Who's Who in the Midwest
Who's Who in Metals

Personalities of the West and Midwest
American Men of Science
Engineers of Distinction
A. Epstein Memorial Award
Walter L. Huber ASCE Research Award
Adams Memorial Award of the AWS
Halliburton Engineering Education Leadership Award of the University of Illinois College of Engineering
National Academy of Engineering
U.S. Delegation on Earthquake Engineering and Hazards Reduction to People's Republic of China, National Academy of Sciences
Tau Beta Pi
Sigma Tau
Phi Kappa Phi
Sigma Xi
Chi Epsilon

ROBERT L. WILSON
Senior Vice President

Education

M.S.	Nuclear Engineering, Purdue University
B.S.	Aeronautical Engineering, Purdue University

Summary of Experience

Mr. Wilson has extensive experience in management of engineering, environmental and licensing activities for power plants, mining projects and chemical industry projects. He has managed numerous projects involving the design of various power plant systems and studies of environmental impacts as a result of plant or mine operations. He has directed numerous management consulting projects for TERA ranging from development of Project Control Systems to Corporate Organizational Planning and Development projects.

1979 - Present	Senior Vice President, TERA Corporation. Responsible for three divisions of the firm providing environmental engineering, seismic analysis and management consulting services.
1974 - 1979	Vice President and Division Manager, TERA Corporation. Responsible for managing multi-disciplined projects including lignite mining studies, environmental assessments, project management services, waste handling evaluation, nuclear radiological assessments, emergency/contingency planning, facilities licensing services, and computer applications projects.
1969 - 1974	Sacramento Municipal Utility District (SMUD), Supervisor of Nuclear Engineering. Full responsibility for nuclear engineering, environmental assessment, and federal, state, and local licensing activities for the Rancho Seco Nuclear Project. Responsibility for administration of the NSSS contract for Rancho Seco Unit.
1966 - 1969	Plant Engineer, Knolls Atomic Power Laboratory (KAPL). Responsible for management of operation and testing activities for a nuclear power plant facility.

Professional Affiliations

Professional Engineer, Nuclear Engineering, State of California
Member, American Nuclear Society; member of Executive Committee of Reactor Operations Division
Member, Northern California Section, American Nuclear Society; past Chairman and member of the Executive Committee
Co-founder and Chairman of the Utilities Nuclear Coatings Work Committee, a national organization with membership from all segments of the nuclear industry, currently representing over 80 countries.

CURT M. STALEY
Principal Engineer - Project Engineering

Education

M.S.	Structural Engineering, University of California, Berkeley
B.S.	Structural Engineering, University of California, Berkeley

Summary of Experience

Mr. Staley specializes in the development and application of management methods and systems to large engineering and construction projects. His responsibilities have included supervision and management of engineering design, field construction and project management activities. His extensive experience has been applied to major petrochemical and power plant projects in the United States and abroad.

1977 - Present	Principal Engineer - Project Engineering, TERA Corporation. Responsible for directing management services, including the design and implementation of management systems for large industrial projects.
1976 - 1977	Engineering Supervisor and Deputy Project Engineer, Bechtel Power Corporation. Responsible for all phases of the civil design for the water treatment and particulate control addition to a coal-fired power plant. As Deputy Project Engineer, he managed the project team and was responsible for coordinating client, vendor, and construction management activities.
1974 - 1976	Project Civil Engineer, Chemico (Africa), Inc. Responsible for all field engineering activities, including document control, engineer/constructor coordination, quality control, contract administration, and client interface for one of the world's largest LNG plants.
1968 - 1974	Senior Engineer and Group Leader, Bechtel Power Corporation. Leader in the analysis and design evolution for the Mark II containment, reactor building and associated facilities for a 2200-MW nuclear power plant project. Other assignments included design and analysis of refining and petrochemical plant components and systems
1967 - 1968	Dynamics Engineer, General Dynamics Corporation. Developed mathematical models, conducted analyses, and directed laboratory testing related to the structural dynamics of airframes.

Registrations

Registered Professional Engineer - California, Maryland and Texas

Associations

American Society of Civil Engineers
Tau Beta Pi, National Engineering Honor Society

Awards

Awarded a National Defense Education Act Fellowship in Civil Engineering

FRANK A. DOUGHERTY
Project Manager

Education

M.B.A.	University of Chicago
M.S.	Nuclear Engineering, Georgia Institute of Technology
B.S.	Chemistry, Illinois Institute of Technology

Summary of Experience

Mr. Dougherty has more than 14 years of experience in the nuclear power industry. He has managed numerous projects for utility and architect-engineer clients including licensing, quality assurance, design review, and design engineering tasks. The plants for which these services were provided include both BWRs and PWRs ranging from the pre-PSAR stage through backfit modification for operating plants. Among his more recent projects have been the evaluation of the QA program and implementing procedures for a utility, the performance of a design evaluation for an architect-engineer, and the management of a project involving backfit modifications during an outage.

1982 - Present Project Manager, TERA Corporation.

1973 - 1982 Manager, Project Management Division, EDS Nuclear. Responsible for all major projects in the western region including engineering design and analysis, QA, licensing, and design reviews. Directed a staff of project managers who were responsible for specific projects.

Manager, Utility Services, EDS Nuclear. Directed non-nuclear work in the areas of project management, environmental services, and management consulting. Projects included pipelines and fossil-fired power plants.

Manager, Nuclear Systems Division, EDS Nuclear. Directed plant safety evaluations, prepared system design criteria, managed design review projects, and developed QA programs.

Supervising Engineer, Nuclear Systems Division, EDS Nuclear. Wrote and reviewed PSARs, FSARs, and ERs, performed safety analyses, wrote QA procedures, developed licensing strategies, evaluated NSSS bids.

1968 - 1973 Mechanical Engineer, Sargent & Lundy. Responsible for A-E interface with NSSS vendor, developed system designs, wrote PSARs, wrote specifications, evaluated bids.

Nuclear Analyst, Sargent & Lundy. Performed safety evaluations and dose calculations, performed numerous economics studies, analyzed fuel supply options, developed computer programs for economic analysis.

Professional Affiliations and Honors

American Management Association
American Nuclear Society
ANS 3 Committee (Operations)
ANS 59 Subcommittee (Diesel-generators)
American Chemical Society, Midwestern Section,
Undergraduate Research Award

Professional Licenses

Professional Engineer, California, NU-0021

RICHARD P. SNAIDER
Senior Systems Engineer

Education

B.S.	Systems Engineering, U.S. Naval Academy
M.B.A.	Wharton School, University of Pennsylvania

Summary Of Experience

Mr. Snaider has fifteen years of experience in nuclear power, nine years of which have been in the commercial nuclear field with emphasis on operation, maintenance, and design, particularly as applied to operating reactor safety and licensing.

1982 - Present — Senior Systems Engineer - TERA Corporation. Has participated in several projects related to key technical issues, such as fire protection, the control of heavy loads, and commitment tracking. Particular emphasis has been in the area of nuclear plant system design and operation.

1975 - 1981 — Senior Project Manager, Operating Reactors, Division of Licensing, NRC. Responsible for managing and performing review of licensing issues for operating nuclear power plants. Assisted in developing Commission policy regarding relaxation of licensing requirements on older and smaller power reactors.

Task Manager, Unresolved Safety Issues Program, NRC. Assigned responsibility for developing and managing programs for resolution of two safety issues, related to BWR Nozzle Cracking and Fracture Toughness of Component Supports in PWRs.

Senior Mechanical Systems Engineer, Systematic Evaluation Program, NRC. Responsible for safe shutdown reviews on the three Mk. I BWRs included in the program. Also assisted in reviews regarding the qualification of equipment to withstand post-accident harsh environments, as well as materials and mechanical topics.

1973 - 1975 — Project Engineer, Generation Engineering Department - Jersey Central Power & Light Company. Served as JCP&L coordinator, with General Public Utilities Service Corporation and Burns and Roe, Inc., on large facility modification involving design and construction of new liquid, solid, and gaseous radwaste treatment facilities for the Oyster Creek Nuclear Generating Plant. Responsible for selection, purchase, and installation of a system to treat chromated wastewater from the Oyster Creek torus. Served as an assistant to the Oyster Creek Maintenance Engineer during refueling outages, supervising seven crews of personnel in the accomplishment of assigned tasks on plant safety systems, auxiliary systems, and turbine systems.

1966 - 1973 — Officer, U.S. Navy Served aboard three submarines in positions of increasing responsibility, including two department head tours. Awarded Navy Commendation Medal and Navy Achievement Medal, among others.

Professional Affiliation

American Nuclear Society

10/20/82

LIONEL D. BATES, P.E.
Principal Associate Engineer

EDUCATION

Graduate	Westinghouse Nuclear Plant Engineering School
M.S.	Mechanical Engineering, Bringham Young University
B.S.	Mechanical Engineering, Bringham Young University

SUMMARY OF EXPERIENCE

Mr. Bates has extensive experience in the design, manufacture and test of instrumentation and control systems for nuclear power plants.

1981 - Present — Principal Engineer. Provides expertise in reviews involving nuclear plant electrical, instrumentation and control systems.

1977-1981 — System Design Group Manager - NUTECH. Directed the activities of electrical, instrumentation and control engineers in the design of safety-related systems for nuclear power plants. These systems included safety relief valve monitoring, containment temperature monitoring, post-accident sampling, emergency power systems, hydrogen recombiner control and other similar plant electrical, instrumentation and control (I&C) systems. Mr. Bates also directed activities in the area of equippment qualification including the development of "Q" lists, evaluation of qualification status and the development of qualification programs for Class IE equipment.

As a Senior Engineer at Nutech, Mr. Bates has lead technical responsibility for modifications to I&C systems for Susquehanna I, Laguna Verde, Fermi 2 and LaSalle I. These modifications were made to the NSSS systems and included testability, safety relief valve control and over thirty (30) others of varying scope and complexity.

1973-1977 — Westinghouse Electric Corporation, Idaho National Engineering Lab

While employed by Westinghouse Electric at the Naval Reactor Facility (NRF), Mr. Bates qualified as Engineering Officer of the Watch (EOOW) at the AIW Prototype. He also qualified and functioned as Nuclear Plant Engineer (NPE), and Emergency Director. His responsibilities at NRF were at the management level for the operation and maintenance of the reactor plant, and for the training of nuclear navy personnel. While at NRF, Mr. Bates participated in numerous plant start-ups, shutdowns, abnormal events/transients, and site emergencies (actual and training drills).

1972-1973 — Associate Engineer - San Diego Gas & Electric Company. Responsible for the forecasting of gas supply and demand, and for the economic justification of projects involving gas transmission and storage.

ROBERT L. CUDLIN
Principal Nuclear Systems Engineer

Education

J.D.	Georgetown University Law Center
M.S.	Nuclear Engineering, The Catholic University
B.S.	Mechanical Engineering, Cornell University

Summary of Experience

Mr. Cudlin has over nine years of experience in the nuclear energy field. He had direct involvement at the Congressional level with the policy oversight and budget authorization for the NRC and development of nuclear energy legislation. At the NRC he managed the containment research program and was Chairman of the Containment Research Review Group. He also directed multi-disciplinary engineering groups in assessing methods for combining dynamic responses, the analysis of hydrodynamic forces in pressure-suppresion containments, the development of a reactor safeguards program, and the environmental qualification of safety related equipment. Most recently he was part of the NRC's TMI recovery team and a member of the Lessons Learned Task Force.

1980 - Present Principal Nuclear Systems Engineer, Systems Engineering Operations, TERA Corporation.

1979 - 1980 Principal Technical Staff Member, Subcommittee on Nuclear Regulation, U.S. Senate. Provided technical analysis and advice on nuclear energy policy issues and legislation to the members of the Subcommittee.

1972 - 1979 Program Manager, Office of Nuclear Regulatory Research, NRC. Responsible for managing NRC's containment safety research program. This included major experimental studies and analytical model development for pressure-suppression containment dynamic loads. Also responsible for interfacing with international containment research programs such as Marviken I and 2, Battelle C and D, GKSS and JAERI.

Technical Assistant, Division of Operating Reactors, NRC. Assisted in the direction of the technical staff for the evaluation of operating reactors.

Technical Assistant, Office of Nuclear Reactor Regulation, NRC. Provided technical assistance and advice on policy issues to the Director of Nuclear Reactor Regulation.

Systems Analyst, Containment Systems Branch, NRC. Responsible for technical licensing reviews of nuclear power plant containments. Was lead reviewer on BWR Mark I, II and III type containments including assessment of suppression pool dynamic loads. Also lead staff person for development and promulgation of 10 CFR 50.44, Standards for Combustible Gas Control Systems in Light Water Cooled Power Reactors.

Honors

Tau Beta Pi Engineering Honorary

Publications

"Recent Considerations of Pool Dynamic Loads in Pressure-Suppression Containments," presented at IAEA Conference in Cologne, West Germany, December 1976.

HENRY J. GEORGE
Senior Mechanical Engineer

Education

Graduate Study	Nuclear Engineering, Catholic University
M.A.S.	Administrative Science, University of Alabama
B.S.	Mechanical Engineering, The Johns Hopkins University

Summary of Experience

Mr. George has eight years experience in the licensing and evaluation of nuclear power plants and three years experience in general mechanical engineering on defense projects. At TERA he has managed and performed technical work on various engineering analyses and design verifications. At the NRC, he directed a multidisciplinary engineering group which established adequate measures for the control of heavy loads throughout the plant; served as group leader for a review team that evaluated the adequacy of protection from fires at a large number of operating facilities, and evaluated the adequacy of available systems and equipment to achieve safe shutdown under various conditions. His defense-related work involved experience in reliability engineering, system test plans, sampling plans, failure analysis, and component qualification testing. He has extensive training in nuclear plant systems and reliability engineering.

1981 - Present	Senior Mechanical Engineer - TERA Corporation
1979 - 1981	Senior Engineering Systems Analyst, NRC. Served as Task Manager on a major unresolved generic issue managing the efforts of a multi-disciplined engineering group to analyze the radiological and system operational consequences of various postulated events.
1974 - 1979	Engineering Systems Analyst, NRC. Served as group leader of a multidisciplinary review team in evaluating the effects of fires at nuclear power facilities. These reviews included detailed site visits, reviews of facility drawings, and analysis of plant system responses to the effects of fires. Performed quality assurance tasks, including review of utility and vendor quality assurance programs, equipment and system test programs, procedures to implement the test program, and technical specification surveillance requirements.
1971 - 1974	Mechanical Engineer, U.S. Army Missile Command. Responsible for providing engineering support during the development and production phases of various missile systems. In this capacity, he developed reliability models, established programs for system acceptance and qualification testing and reliability assessment, and evaluated test and operational failures.

JOSEPH A. MARTORE
Senior Engineering Mechanics Engineer

EDUCATION

M.S.	Civil Engineering, Massachusetts Institute of Technology
B.S.	Civil Engineering, Massachusetts Institute of Technology
M.B.A. Candidate	George Washington University

SUMMARY OF EXPERIENCE

Mr. Martore has over eight years of engineering experience, with an emphasis on nuclear power plant design, construction, and licensing. At the NRC he managed the safety and environmental reviews for operating license applications, and performed technical reviews and evaluations of operating reactor safety issues. He has also had lead responsibility for the structural, mechanical, seismic, and accident analysis and design of nuclear plant facilities.

1981 - Present	Senior Engineering Mechanics Engineer - TERA Corporation
1979 - 1981	Technical Assistant to the Director, Division of Licensing, NRC. Coordinated and reviewed the technical and project management efforts related to the licensing and safe operation of nuclear plants. Provided presentations of a variety of technical and safety matters for Congressional, Commission, ASLB, ACRS, and industry meetings. Licensing Project Manager, NRC. Managed and participated in the safety and environmental review and evaluation of applications for operating licenses. Structural Engineer, NRC. Responsible for the review, analysis, and evaluation of structural, mechanical, and seismic safety issues for operating nuclear facilities. Evaluated and recommended design criteria, acted as the principal NRC witness on these issues at public hearings and before ACRS, participated in the NRC sponsored research activities, and managed technical assistance programs.
1976 - 1979	Structural Engineer, Stone and Webster Corporation. Responsible for the analysis and design of nuclear power plant structures, systems and components. Emphasis on soil-structure interaction and seismic engineering.
1973 - 1976	Field Engineer, North East Post-tensioning Consultants, Inc. Responsible for structural design and construction management of bridges and office buildings.

AWARDS AND PROFESSIONAL AFFILIATIONS

NRC Special Achievement Award for superior efforts associated with his review of the seismic and structural issues related to the General Electric Test Reactor

Registered Professional Engineer, Rhode Island
American Society of Civil Engineers
Earthquake Engineering Research Institute

ROBERT C. SNYDER
Project Engineer

SUMMARY OF EXPERIENCE

Mr. Snyder is highly qualified in the field of facilities design and construction. He has worked extensively in the design and analysis of waste treatment systems for nuclear power plants and industrial manufacturing plants. In addition, he has had overall project management experience from formulation of concept through construction, start-up and operation. Control of A&E efforts, construction operations; budgets; subcontracts; purchasing; and equipment design are elements of his expertise. His experience has included mechanical and electrical design of facilities, equipment and processes for radwaste and heavy industrial manufacture.

Present	Project Engineer, Waste Management Services Division TERA Corporation. Responsibilities include evaluation and design of radwaste facilities, processes, and equipment with emphasis on operations and maintainability.
1977-1980	Principle Engineer, Hittman Nuclear & Development Corporation, Columbia, Maryland. Provided design concepts and engineering analysis for all HNDC activities. Fields of endeavors covered; solidification systems, storage facilities solidification machinery, and casks. Particular tasks covered: powdered resin dewatering equipment, pumping systems, structures, machine design mechanical and pneumatic conveyors, electrical control, filtration equipment, ion exchange equipment, process, system and equipment specifications, shipping cask safety analysis, hydraulic and pneumatic power units and controls, instrumentation and others.
1966-1977	Project Manager, Assistant Division Engineer, Plant and Facilities Engineer, Kaiser Aluminum & Chemical Corporation, Oakland, California. Projects included construction of casting, extrusion, fabricating facilities, water and air pollution control and complete processing plants. Consulted with foreign affiliates, and Saudi Industrial Development Fund. Performed new plant planning function. Controlled multi-million dollar projects from concept to start-up. Supervised A&E and Construction operations directly and through subordinates.
1962-1966	Vice President, Division Manager Container Division, The Baltimore Steel Company, Baltimore, Maryland. Designed, tested and fabricated military and engine containers for companies such as General Dynamics, Kholmorgen, Nortronics, Martin, General Electric, Westinghouse, North America Aviation, Pratt & Whitney Aircraft, Thiokol, U.S. Navy, U.S. Army, and others.
1959-1962	Chief Engineer, Charles T. Brandt, Baltimore, Maryland. Duties involved overall supervision of Engineering Department engaged in design of fabricated metal products, machinery, military and commercial vehicle components, process equipment and architectural products.

MICHAEL B. AYCOCK
Project Manager

EDUCATION

Graduate Studies	Nuclear Engineering, Catholic University
B.S.	Aerospace Engineering, U.S. Naval Academy

SUMMARY OF EXPERIENCE

Mr. Aycock has eight years of experience in the federal regulation of commercial nuclear power plants. Since joining TERA Corporation, he has managed and participated in a number of projects with nuclear utility clients. This includes acting as the Project Manager and/or principal engineer on projects involving the evaluation of heavy load handling operations at nuclear power plants. At the NRC he has developed programs for resolving important generic safety issues encompassing numerous technical disciplines and has participated in directing the efforts necessary to carry out the programs. He has also managed the safety reviews of nuclear power plant construction permit and operating license applications.

1980 - Present Project Manager - TERA Corporation

1972 - 1980 Deputy Director, Unresolved Safety Issues Program, NRC. Responsible for planning and carrying out the highest priority NRR tasks addressing generic safety issues.

Technical Assistant, NRC. Coordinated and reviewed the technical efforts necessary to develop proposals and recommendations to assist in the formulation of policy by Director, Office of Nuclear Reactor Regulations, with principal participation in the formulation of policy on generic safety issues. Acted as the principal NRC witness on generic safety issues at public hearings associated with licensing nuclear power plants.

Licensing Project Manager, NRC. Managed the activities associated with the safety review and evaluation of applications for construction permit and operating licenses.

AWARDS

Received NRC Meritorious Service Award in 1979 for outstanding performance in the development, organization, implementation and management of the NRC Generic Issues Program.

Received NRC Special Achievement Award in 1976 for superior efforts associated with his performance as Project Manager for the safety review of the Indiana Point Unit 3 operating license application.

PROFESSIONAL AFFILIATION

American Nuclear Society

CHRISTIAN P. MORTGAT
Senior Engineering Mechanics Engineer

Education

Ph.D.	Civil Engineering, Stanford University
Engineer's Degree	Geotechnical Engineering, Stanford University
M.S.	Structural Engineering, Stanford University
B.S.	Civil Engineering, Tennessee Technological University

Summary of Experience

Dr. Mortgat has a broad background in probabilistic earthquake engineering that ranges from structural analysis for buildings and earth dams to the development of seismic hazard maps. Dr. Mortgat has developed a unique Bayesian risk analysis methodology and has studied earthquake response spectrum shapes and their attenuation. He has directed or participated in major seismic risk analysis projects for Costa Rica, Nicaragua, Alaska, and Algeria. He has published numerous articles and reports in these areas and has served as an independent seismic risk consultant to several companies. Developed a methodology based on expert opinion solicitation for computation of seismic hazard in the Eastern United States. The procedure was applied in the NRC Systematic Evaluation Program aimed at evaluating the seismic design margin of nine older nuclear power plants in the Central and Eastern U.S. Developed a Monte Carlo approach to define the seismic hazard at a site on an event specific basis. The approach was used to determine the seismic input in the NRC Seismic Safety Margin Research Program.

1977 - Present	Project Manager, Earthquake Engineering, TERA Corporation. Responsible for several major seismic risk analyses, including one directed at all the Department of Energy (DOE) facilities.
1976 - 1977	Earthquake Engineer, Woodward-Clyde Consultants. Participated in a seismic risk analysis of the Gulf of Alaska for offshore drilling platforms.
1973 - 1977	Research Affiliate, Stanford University, J. A. Blume Earthquake Engineering Center. Developed new techniques to characterize the frequency content of postulated earthquake motions and developed unique approaches to calculating seismic exposure.

Professional Associations

American Society of Civil Engineers
Earthquake Engineering Research Institute

Publications

Journal Papers

Mortgat, C. P., "Seismic Risk Analysis, a General Approach," Pan American Institute of Geography and History, Reviste Geofisica, December, 1976.

Mortgat, C. P., and Shah, H. C., "A Bayesian Model for Seismic Hazard Mapping." Bulletin of Seismological Society of America. (in publication).

Papers Presented at Conferences

Kiremidjian, A., and Mortgat, C., "A Probabilistic Approach for Seismic Load Determination," ASCE-EM Specialty Conference on Probabilistic Methods in Civil Engineering, Stanford, California, July, 1974.

Mortgat, C. P., and Shah, H. C., "An Intensity Scale for Earthquakes," The Fifth European Conference on Earthquake Engineering, Istanbul, Turkey, September, 1975.

Shah, H. C., Mortgat, C. P., Kiremidjian, A., and Zsutty, T., "A Study of Seismic Risk for Nicaragua," The Sixth World Conference on Earthquake Engineering, New Delhi, India, January, 1977.

Mortgat, C. P., and Shah, H. C., "A Study of Stable Earthquake Parameters," The Sixth World Conference on Earthquake Engineering, New Delhi, India, January, 1977.

Mortgat, C. P., and Shah, H. C., "Stable Seismic Design Parameters," ASCE/EMD Specialty Conference at North Carolina State University, May, 1977.

Mortgat, C. P., Patwardhan, A. S., and Idriss, I. M., "Influence of Seismicity Modeling on Seismic Exposure Evaluation." Seventy-Third Annual Meeting of the Seismological Society of America, April 6-8, 1978.

Mortgat, C. P., and Shah, H. C., "A Bayesian Model for Seismic Hazard Mapping--A Case for Algeria." Sixth European Conference on Earthquake Engineering, Dubrovnik, Yugoslavia, September, 1978.

Other Publications

Shah, H. C., Mortgat, C. P., Kiremidjian, A., and Zsutty, T. C., "A Study of Seismic Risk for Nicaragua, Part I," Technical Report No. 11, The John A. Blume Earthquake Engineering Center, Department of Civil Engineering, Stanford University, January, 1975.

Shah, H. C., Zsutty, T. C., Krawinkler, H., Mortgat, C. P., Kiremidjian, A., and Dixon, J. O., "A Study of Seismic Risk for Nicaragua, Part II," In two volumes, Technical Report No. 12A and No. 12B, the John A. Blume Earthquake Engineering Center, Department of Civil Enginering, Stanford University, March, 1976.

Mortgat, C. P., "Finite Element Analysis of Embankments on Weak Clay Foundations," Engineer's Thesis, Stanford University, California, June, 1976.

Mortgat, C. P., "A Bayesian Approach to Seismic Hazard Mapping, Development of Stable Parameters," Ph.D. Dissertation, Stanford University, California, December, 1976.

Mortgat, C. P., Zsutty, T. C., Shah, H. C., and Lubetkin, L., "A Study of Seismic Risk for Costa Rica." Technical Report No. 25, The John A. Blume Earthquake Engineering Center, Department of Civil Engineering, Stanford University, April, 1977.

Mortgat, C. P., and Shah, H. C., "A Study of Seismic Risk for Algeria." Technical Report No. 28, The John A. Blume Earthquake Engineering Center, Department of Civil Engineering, Stanford University, March, 1978.

JORMA ARROS
Structural Engineer

Education

Ph.D. (candidate)	Civil Engineering, Stanford University
M.S.	Engineering, Helsinki University of Technology, Helsinki, Finland
B.S.	Engineering, Helsinki, University of Technology, Helsinki, Finland

Summary of Experience

Mr. Arros has experience in research and analysis in the nuclear engineering field. He has conducted analyses of both the dynamics of structures under earthquake conditions and a finite element model of groundwater seepage. He has also analyzed pressure vessels using structural analysis computer programs.

1980 - present	Structural Engineer, TERA Corporation. Responsible for seismic hazard analysis codes.
1978 - 1979	Consulting Engineer, Wartsila, Inc. Consulted on a study of mathematical modeling of paper web through a paper splitter.
1977 - 1978	Research Engineer, Technical Research center of Finland. Performed research in the Nuclear Engineering Laboratory and analyzed structures under earthquake conditions, groundwater seepage and pressure vessels.
1974 - 1977	Teaching Assistant, Helsinki University of Technology

Presentations/Publications

"Coupled Vibrations of a Structure and Fluid Excited by Pressure Shocks," presented to the Topical Meeting on Nuclear Power Safety in Brussels, 1978. Also published in Nuclear Technology, December 1979.

KENNETH W. CAMPBELL
Senior Earthquake Engineer

Education

Ph. D.	Soil Mechanics Engineering, University of California
M. S.	Soil Mechanics Engineering, University of California
B. S.	Engineering, University of California

Summary of Experience

Mr. Campbell has ten years experience in soil mechanics engineering. In addition to responsibilities that have included shallow seismic geophysical surveys, and seismic risk and seismicity studies, he has been involved in research in the fields of Bayesian seismic risk analysis and investigated earthquake site effects. Mr. Campbell has published extensively in these and related areas and has served as an independent seismic risk consultant to several companies.

1978 - Present	Senior Earthquake Engineer, TERA Corporation. Responsible for seismic risk analyses and other geotechnical studies.
1978	Research Engineer, J. H. Wiggins Company. Responsibilities included the development of a Bayesian seismic risk map of California based on geologic data on major faults in California and adjacent areas.
	Consulting Earthquake Engineer. Responsible for shallow seismic geophysical surveys, seismic risk and seismicity studies, design earthquake motions, site response analyses, and characteristic site period determinations.
1977 - 1978	Postdoctoral Scholar, University of California. Conducted research in the fields of Bayesian seismic risk analysis, earthquake site effects, seismic reliability of lifeline systems, and the correlation of the seismic velocity of near surface deposits with geology, depth and soil type.
1973 - 1978	Earthquake/Geotechnical Engineer, LeRoy Crandall and Associates. Participated in the analysis and design of building foundations, and the performance of seismicity and seismic risk studies, seismic geophysical surveys and their analysis, liquefaction analyses, characteristic site period studies, and seismic site response analyses.
1972 - 1973	Research Geophysicist, National Oceanic and Atmospheric Administration. Responsible for research in engineering seismology and earthquake seismicity and risk. Developed site-dependent earthquake intensity distributions of large earthquakes.

Professional Affiliations

American Society of Civil Engineers
Earthquake Engineering Research Institute
Seismological Society of America
Tau Beta Pi, National Engineering Honor Society
International Society of Soils and Foundation Engineering

Publications

Duke, C. M., J. A. Johnson, Y. Kharraz, K. W. Campbell, and N. A. Malpiede, Subsurface Site Conditions and Geology in the San Fernando Earthquake Area, School of Engineering and Applied Science, University of California, Los Angeles, (UCLA-ENG-7206), 1971.

Campbell, K. W., An Empirical Earthquake Intensity Function in Bedrock, M.S. Thesis in Engineering, University of California, Los Angeles, 1972.

Perkins D. M., S. T., Harding, K. W. Campbell, and A. F. Espinosa, Studies of Site Amplification in San Fernando, Proceedings of the Microzonation Conference, University of Washington, Seattle, Vol. II, pp. 910-927, 1972.

Campbell, K. W., Site Properties and Bedrock Intensities in the San Fernando, California Earthquake of February 9, 1971, in Earthquake Research in NOAA, 1971-1972, edited by J. C. Stepp, Environmental Research Laboratories, National Oceanic and Atmospheric Administration, Boulder, Colorado, (NOAA TR ERL 256-ESL 28), p. 54, 1973.

Algermissen, S. T., D. M. Perkins, W. Rinehart, K. W. Campbell, and M. Hopper, A Study of Earthquake Losses in the Los Angeles, California Area, Environmental Research Laboratories, National Oceanic and Atmospheric Administration, Boulder, Colorado (prepared for HUD), 1973.

Campbell, K. W. and C. M. Duke, Bedrock Intensity Attenuation and Site Factors from San Fernando Earthquake Records, in Optimization of Water Resource Systems Incorporating Earthquake Risk: 1973 Contributions, edited by C. M. Duke and S. E. Jacobsen, University of California Water Resources Center, Contribution No. 141, pp. 81-114, 1973.

Duke, C. M., J. A. Johnson, Y. Kharraz, K. W. Campbell, and N. A. Malpiede, Subsurface Site Conditions in the San Fernando Earthquake Area, in The San Fernando, California, Earthquake of February 9, 1971, (EERI/NOAA), Vol. IIB, 785-799, 1973.

Campbell, K. W. and C. M. Duke, Bedrock Intensity Attenuation and Site Factors from San Francisco Earthquake Records, Bull. Seism. Soc. Am., 64:173-185, 1974.

Campbell, K. W. and C. M. Duke, A Reply to a Discussion of Bedrock Intensity Attenuation and Site Factors from San Fernando Earthquake Records by P. C. Jennings, Bull. Seism. Soc. Am., 64:2009-2010, 1974.

Campbell, K. W., A Note on the Distribution of Earthquake Damage in Long Beach, 1933, Bull. Seism. Soc. Am., 66:1001-1005, 1976.

Eguchi, R. T., K. W. Campbell, C. M. Duke, A. W. Chow, and J. Paternina, Shear Velocities and Near Surface Geologies at Accelerograph Sites That Recorded the San Fernando Earthquake, School of Engineering and Applied Science. University of California, Los Angeles, (UCLA-ENG-7653), 1976.

Publications, Cont.

Campbell, K. W. and C. M. Duke, Correlations Among Seismic Velocity, Depth and Geology in the Los Angeles Area, School of Engineering and Applied Science, University of California, Los Angeles, (UCLA-ENG-7662), 1976.

Duke, C. M., R. T. Eguchi, K. W. Campbell, and A. W. Chow, Effects of Site on Ground Motion in the San Fernando Earthquake, School of Engineering and Applied Science, University of California, Los Angeles, (UCLA-ENG-7688), 1976.

Campbell, K. W., Design Earthquakes Based on the Statistics of Source, Path and Site Effects, Proceedings of the 6th World Conference on Earthquake Engineering, New Delhi, India, Vol. 2, 2-51 - 2-55, 1977.

Duke, C. M., R. T. Eguchi, K. W. Campbell, and A. W. Chow, Effects of Site on Ground Motion in the San Fernando Earthquake, Proceedings of the 6th World Conference on Earthquake Engineering, New Delhi, India, Vol. 2, 2-93 - 2-99, 1977.

Eguchi, R. T. and K. W. Campbell, Seismicity and Site Effects on Earthquake Risk, Proceedings of the 6th World Conference on Earthquake Engineering, New Delhi, India, Vol. 2, 2-399 - 2-404, 1977.

Campbell, K. W., The Use of Seismotectonics in the Bayesian Estimation of Seismic Risk, School of Engineering and Applied Science, University of California, Los Angeles, (UCLA-ENG-7744), 1977.

Campbell, K. W., Geotechnical Correlations of In Situ Seismic Velocity in Southern California, Proc. of Two Day Symposium on Living With the Seismic Code, Structural Engineers Assoc. of So. Calif., Los Angeles, March 7 & 14, Sess. I - Characteristic Site Period, Sect. B, pp. 1-13, 1978.

Campbell, K. W., An Estimate of Recurrence Times from Seismotectonic Data on a Fault, in Geologic Guide and Engr. Geology Case Histories, Los Angeles Metropolitan Area, Ist Annual Calif. Sect. Meeting, Assoc. of Engr. Geol., May 12-14, 1978, Los Angeles, pp. 95-101, 1978.

Campbell, K. W., Lifeline Reliability and Seismic Risk, (Summary), Proc. of Lifeline Earthquake Engineering Workshop, Earthquake Engineering and Soil Dynamics Conference and Exhibit, Pasadena, Calif., June 19-21, 1978, Geotechnical Engineering Div., ASCE, Vol. III, 1978.

Campbell, K. W., Empirical Synthesis of Seismic Velocity Profiles from Geotechnical Data, Proc. Second International Conference on Microzonation, Nov. 26-Dec. 1, 1978, San Francisco, Vol. II, pp. 1063-1075 1978.

Campbell, K. W., R. T. Eguchi, and C. M. Duke, Reliability in Lifeline Earthquake Engineering, American Society of Civil Engineers, Annual Convention and Exhibit, October 16-20, 1978, Chicago, Preprint 3427, 1978.

Publications, Cont.

Campbell, K. W., A Bayesian Procedure for Incorporating Seismotectonics in the Estimation of Seismic Risk on a Fault, Proc. ASCE Specialty Conference on Probabilistic Mechanics and Structural Reliability, January 10-12, 1979, Tucson, Arizona, pp. 290-294, 1979.

Campbell, K. W., R. T. Eguchi and C. M. Duke, The Use of Reliability in Lifeline Earthquake Engineering, Proc. ASCE Specialty Conference on Probabilistic Mechanics and Structural Reliability, January 10-12, 1979, Tucson, Arizona, pp. 305-310, 1979.

Presentations

"Subsurface Site Conditions and Geology in the San Fernando Earthquake Area," Presented at the San Fernando Earthquake Conference, Los Angeles, February, 1972 (With J. A. Johnson).

"Bedrock Intensity Attenuation and Site Factors from San Fernando Earthquake Records," Presented at the 68th Annual Meeting of the Seismological Society of America, Golden, Colorado, May, 1973.

"Distribution of Earthquake Damage in Long Beach in 1933 as Related to Propagation and Site Effects," Presented at the 70th Annual Meeting of the Seismological Society of America, Los Angeles, March 1975.

"A Comparison of Linear and Psuedo Nonlinear Methods of Site Response Analysis," Presented at the 70th Annual Meeting of the Seismological Society of America, Los Angeles, March, 1975 (M. Lew, Speaker).

"Site Effects in Earthquakes," Presented at the meeting of the Los Angeles Section of the American Society of Civil Engineers, Los Angeles, April, 1976 (with C. M. Duke and R. T. Eguchi).

"Design Earthquakes Based on a Damage Threshold Level," Presented at the 71st Annual Meeting of the Seismological Society of America, Edmonton, Alberta, Canada, May, 1976.

"Bayesian Estimation of Seismic Risk," Presented at the 72nd Annual Meeting of the Seismological Society of America, Sacramento, California, April, 1977.

"Correlations Among Seismic Velocity, Depth and Geology in the Los Angeles Area," Presented at the 72nd Annual Meeting of the Seismological Society of America, Sacramento, California, April, 1977.

"The Use of Seismotectonics in the Bayesian Estimation of Seismic Risk," Presented at the J. H. Wiggins Company, Redondo Beach, California, October, 1977.

Presentations, Cont.

"Bayesian Estimation of Seismic Risk on a Fault with Emphasis on Lifeline Systems, Presented at the Two Day Course on Seismic Risk Analysis, EERI, Univ. of So. Calif., Los Angeles, February 8 and 9, 1978.

"Geotechnical Correlations of In Situ Seismic Velocity in Southern California," Presented at the two Evening Symposium on Living with the Seismic Code, SEAOC, So. Calif. Section, Los Angeles, Calif., March 7 & 14, 1978, Session I, Characteristic Site Period.

"Geotechnical Correlations of In Situ Seismic Velocity in Southern California," Presented at the 73rd Annual Meeting of the Seismological Society of America, Sparks, Nevada, April 6-8, 1978.

"The Use of Seismotectonics in the Bayesian Estimation of Seismic Risk," Presented at the 73rd Annual Meeting of the Seismological Society of America, Sparks, Nevada, April 6-8, 1978.

"Lifeline Reliability in Seismically Active Regions," Presented at 73rd Annual Meeting of the Seismological Society of America, Sparks, Nevada, April 6-8, 1978, (R. T. Eguchi, speaker).

"Geotechnical Considerations of the Seismic Design Code," Presented at Portland State University, Portland, Oregon, May 22, 1978.

"Lifeline Reliability and Seismic Risk," Presented at the Lifeline Earthquake Engineering Workshop Session, (Panelist), Earthquake Engineering and Soil Dynamics Conference and Exhibit, Geotechnical Engineering Div., ASCE, Pasadena, Calif., June 19-21, 1978.

"Empirical Synthesis of Seismic Velocity Profiles from Geotechnical Data," Presented at the Second International Conference on Microzonation, San Francisco, California, November 26-December 1, 1978.

"A Bayesian Procedure for Incorporating Seismotectonics in the Estimation of Seismic Risk on a Fault," Presented at the ASCE Specialty Conference on Probabilistic Mechanics and Structural Reliability, Tucson, Arizona, January 10-12, 1979.

NORMAND A. BERUBE
Senior Engineering Systems Analyst

Education

M.S.	Mechanical Engineering, University of New Hampshire
B.S.	Astronautical Engineering, U.S. Air Force Academy

Summary of Experience

Mr. Berube has extensive technical experience in the design and application of energy related systems analysis programs. In addition, he has over five years experience in computer programming and data management projects related to the development of analytical models to support energy technology development.

1981 - Present Senior Engineering Systems Analyst, Waste Management, Services Division, TERA Corporation. Primary responsibilities include analytical evaluation and modification of radwaste systems, computer programming and system analysis to support development of similation modeling techniques, and participation in information retrieval software development projects associated with the nuclear utility industry.

1979 - 1981 Senior Systems Analyst - JBF Scientific Corporation. Developed and applied analytical models to simulate the operational performance of solar-electric energy systems along with methods and models to evaluate their economic potential in a wide variety of applications. Assessed the major technical, economic, resource, environmental, and institutional constraints to the successful commercialization of energy technologies. Prepared technology transfer strategies and market development plans. Principal investigator and author of technical reports containing recommendations to the U.S. Congress, the U.S. Department of Energy, and the Solar Energy Research Institute.

1978 - 1979 Mechanical Engineer, Research and Development - Data General Corporation. Performed analytical and experimental research in heat transfer, fluid dynamics, and contamination control. Inventor of patented equipment related to the operation of a computer disk drive.

1977 - 1978 University of New Hampshire. Designed and established a solar radiation data acquisition system. Conducted bi-weekly recitations in Heat Transfer and Fluid Mechanics.

1978 - 1980 Consulting Systems Analyst - Marine Systems Engineering Laboratory (part-time). Completed all heat transfer analysis and computer modeling of an unmanned thermal ice drill. Three-dimensional finite difference simulation verified by the U.S. Army Cold Regions Laboratory.

1971 - 1976 Captain, United States Air Force, Standard Evaluation Flight Examiner. Responsible for squadron navigational training and evaluation. Received the U.S.A.F. Commendation Medal for outstanding service.

FREDERICK M. BERTHRONG
Senior Mechanical Engineer

Education

M.S.	Nuclear Engineering, University of Washington
B.S.	U.S. Naval Academy

Summary of Experience

Mr. Berthrong has extensive experience in the management and administration of design, licensing, procurement and construction of large power plant projects. He is currently involved in the design and implementation of information and management systems including computerized systems for on-line performance of a variety of administrative tasks. He has recently completed the design and implementation of a Maintenance and Operating Data System for a large electric generating station. His responsibilities have included day-to-day supervision and management of large-scale projects both in the design office and at construction sites.

1977 - Present	Senior Mechanical Engineer - Information Systems Division, TERA Corporation. Performed and managed numerous projects related to information management including the design and implementation of large-scale records management, maintenance management and material control systems and the development of other computer applications.
1975 - 1977	Lead Project Field Engineer, Bechtel. Directly responsible for all field engineering activities in the Reactor Building and Containment complex (2-1100 MWe Units) and interfacing with all other on-site organizations. Coordinated directly with superintendents for planning, scheduling and problem solving. Acted as lead superintendent during various project phases.
1972 - 1976	Engineering Supervisor, Bechtel. Mechanical Group Supervisor responsible for supervising all nuclear, mechanical and HVAC systems design and procurement and for project licensing.
1965 - 1970	U.S. Navy. Completed nuclear power training and served aboard a nuclear submarine with primary responsibilities in the engineering department.

Registrations

Registered Professional Engineer - Mechanical Engineering, California and Washington

Awards

Awarded an Atomic Energy Commission Special Fellowship In Nuclear Engineering by the University of Washington.

LEONARD M. STOUT
Senior Project Manager

Education

B.S. Engineering Management, University of Missouri School of Mines. Majored in Mechanical Engineering and Business Management.

Summary of Experience

Mr. Stout has a broad background in the energy industry including cost engineering, construction field engineering, design development and field implementation of computerized project control systems and managing "grass-roots" implementations of minicomputer facilities and systems. His extensive knowledge of the work process and control aspects of the design, construction, startup and operations phases of fossil and nuclear projects has been incorporated into computerized scope, schedule and cost control systems developed by TERA for our clients.

1977 - Present Senior Project Manager - Information Systems, TERA Corporation. Mr. Stout has provided project leadership to several major projects. These projects include the conceptual phase studies for a utility-wide information management system, technical services implementation plan for a developing Engineering and Construction Department within a utility service company, development of material control systems that integrate activities of manufacturers, architect/engineers, and constructors, the design and management of projects in Michigan, Texas, New Jersey, Georgia, Pennsylvania, California, Arizona, Colorado and New York.

1976 - 1977 Project Control Systems Group Supervisor, Bechtel. Provided consulting services and technical direction to project scheduling and cost groups to ensure technical quality of methods and procedures as related to computerized project control systems.

In this capacity, Mr. Stout has traveled extensively throughout the U.S. to consult on both nuclear and fossil projects, including BWR, lignite, and low sulfur coal plants.

1975 - 1976 Project Control Engineer, Bechtel. Implemented material, cost and scheduling control systems on two Bechtel nuclear projects in the Engineering Design phase.

1974 Staff Assistant to Field Construction Manager on a three-unit (each 500-MWe) mine mouth coal station in Wyoming. Responsibilities included coordinating the activities of cost engineering, scheduling, subcontracts, field engineering, supervision, and startup.

1971 - 1973 Senior Field Engineer on a two-unit, 600-MWe oil-fired station in New York. Successively served as a Field Cost Engineer, Assistant Field Electrical Engineering Group Leader, and Staff Assistant to the Project Superintendent, responsible for all computer and material control activities.

1968 - 1969 Design and Field Engineer for Trunkline Gas Company in Texas and Illinois.

SUSAN SLY
Project Engineer

Education

B.S. Civil Engineering, University of Toledo

Summary of Experience

Ms. Sly coordinates the design, development, and implementation of large scale automated information retrieval and records management systems related to nuclear licensing and engineering in the utility industry. In this capacity, her experience in on-site client interface and program management has included participation in the development and application of systems hardware, software, and procedures tailored to meet specific user needs and satisfy a broad scope of regulatory and quality assurance requirements. As a civil engineer, she has been involved in the structural design and analysis of nuclear power plants and has actively participated in the technical review and update of engineering records for those plants, including the development of specialized keyword indexes used to analyze and update FSARs.

1981 - Present	Project Engineer, TERA Corporation. Responsible for implementing automated information management systems within nuclear utilities. Developed keyword indexes used in FSAR update systems along with procedures for system implementation through program completion and acceptance. Provides interface between software development and user requirements as well as user training. Participated in the technical review and update of FSARs and other technical documents related to the nuclear utility industry, including participation in implementing specialized subject indexing capabilities for the Nuclear Regulatory Commission Document Control System.
1978-1981	Civil Engineer, Bechtel Power Corporation. Involved in the design of nuclear power plants; including structural design, dynamic analysis, computer applications, and seismic survey. Worked on-site during construction of a nuclear power plant where duties included design, design verification, and inspection. Participated in a project involving oil to coal conversion of a steam plant. Responsibilities included structural design and interface with mechanical, electrical, and architectural design groups. Wrote specifications for purchase and placement of materials.
1977-1978	Engineering Aide, City of Toledo. Collected and compiled data on street measurements and conditions, inspected bridges, surveyed, and scheduled street maintenance.

RICHARD R. MacDONALD
Senior Mechanical Engineer

Education

M.B.A. Management, Golden Gate University
B.S. Physics, U.S. Naval Academy (with merit)

Summary of Experience

Mr. MacDonald has diversified experience in all facets of the design, procurement, construction, and licensing of large power plants, including the development of various computerized systems for efficient plant operations. He has managed a wide range of engineering efforts at various stages of project development, such as conceptual and detailed design, construction, startup and continuing support to operating plants. He has directed and participated in the design and implementation of computerized systems which control data related to power plant equipment, maintenance management, engineering and construction task management, spare parts and material control, plant reliability assessment and tracking of radiological exposure data. His efforts have been focused on the development of systems to support utilities in the construction, operation and maintenance of power plants.

1980 - Present Senior Mechanical Engineer - Information Systems, TERA Corporation. Responsible for the development of computerized document control and operating data systems, as well as large-scale systems for project management and project control. Manages the development and implementation of multi-application records and data management systems for power plant environments. These systems and services are designed to yield immediate benefits to the client in terms of improved productivity and plant availability.

1971 - 1979 Project Engineer - Bechtel Power Corporation. Directed the analysis requirements, alternatives and costs for decommissioning nuclear power plants. Provided consulting support to an international team which developed a new reactor/containment design, including evaluation of plant arrangement, systems and structural design concepts.

Assistant to the Manager of Engineering, developed and maintained engineering standards and procedures and monitored research and development programs.

Engineering Group Supervisor, responsible for mechanical, nuclear, instrument and control, and HVAC systems design, procurement activities and project licensing efforts for two twin 1100 MWe nuclear power plants. Special assignment to BWR Owners' Group Task Force for the resolution of common containment design problems.

1967 - 1971 Officer, U.S. Navy. Assigned to the Engineering and Operations Departments and attended numerous training programs (e.g., nuclear power and engineering officer schools). Responsibilities included supervision of the operation and maintenance of all engineering systems of a destroyer and coordination of all material maintenance management activities for a guided missile cruiser.

SIDNEY J. BROWN
Construction Services

Education

Engineering Management, University of California, Berkeley, California
Electrical Engineering, San Francisco City College, San Francisco, California

Summary of Experience

Throughout his 30 years in the engineering/construction profession, Mr. Brown has gained extensive experience in the areas of construction management and scheduling, labor relations, craft supervision and personnel administration. As manager of a construction computer systems group, Mr. Brown developed systems to facilitate the processing of project data and quality control reports related to both nuclear and nonnuclear power projects. Developed a TERA site access monitoring and security system for the construction industry. Most recently, completed the construction, startup, initial operation and maintenance of the nation's first residential electric cogeneration power plant at a large apartment complex for Southern California Edison.

1980 - Present	Manager, Construction Services, TERA Corporation. Primarily responsible for coordinating tasks associated with the design, construc-tion, startup and operation of major power-generating facilities. Con-trols all phases of project implementation relating to construction, engineering review, cost engineering, planning and scheduling, field construction and quality control engineering. Serves as interface between construc-tion contrac-tors and subcontractors, suppliers, architect/engineers, and owners of property involved with projects.
1965 - 1980	Construction Specialist, Bechtel Power Corporation. Held various positions, ranging from field engineer, craft supervisor, assistant site manager and assistant project engineer to construction coordinator, responsible for project control systems design, implementation, training and auditing. Supervised the mechanical/piping area on three-unit nuclear power project.
1964 - 1965	Area Administrator and Construction Planning Consultant, H. L. Yoh and McDonnell Douglas Corporation. Directed support services for an aerospace facilities project during design and construction operations.
1961 - 1964	Assistant Project Superintendent, Field Project Engineer, and Contracts Administrator, Noble Company. Responsible for the engineering/procurement administration of support services contracts.
1960 - 1961	Manager of Engineering, Bloxham Engineering. Supervised the design and fabrication of prototype equipment.
1955 - 1960	Lead Research and Development Engineer, Senior Layout Specialist, and Assistant Production Manager, Noble Company. Responsible for the manu-facture of construction-related equipment.
1951 - 1954	U.S. Army, Army Security Agency, Electronics installations and maintenance.

DONALD B. TULODIESKI
Project Manager

Education

B.S. U. S. Naval Academy

Summary of Experience

Mr. Tulodieski manages projects ranging in scope from project control and management systems to integrated information systems including material control, maintenance management, cost and schedule control, records management, and systems interface evaluation. He has extensive management experience in nuclear and fossil-fueled power plant licensing, warehousing procurement, testing and operations. Mr. Tulodieski has designed and implemented data base systems which provide quantitative means of evaluating power plant reliability and availability in addition to automated systems designed to provide professionals access to vital technical and contractual information and data.

1978 - Present Project Manager, TERA Corporation. Manages and participates in the evaluation, design, development, and implementation of projects relating to document, information and management control systems. Additionally, he has conducted evaluations and seminars and consulted in major utility corporate material control programs.

1973 - 1978 Project Manager, Babcock & Wilcox Company; Supervisor, Site Support and Testing, Babcock & Wilcox Company. Directly responsible for all aspects of interfacing and focusing technical and licensing related resources to satisfy client's needs as stipulated in contractual agreements while maintaining cost and schedule goals as promulgated by company guidelines and as required by the client. The above project management activities were performed for two separate NSSS contracts consisting of a total of four nuclear generating facilities.

As supervisor, site support and testing, established data base and real-time systems for site-generated test data and implemented a reliability and availability tracking system for B&W systems and equipment. Resolved operating and start-up site problems associated with the performance of equipment and system testing and core physics test programs.

1970 - 1973 Engineer, Public Service Electric & Gas Company of New Jersey. Qualified stationary engineer in the operation of 1,100 MW oil-fired generating station and the start-up and operation of gas turbine peaking units. Responsible for the generation and implementation of start-up testing procedures associated with the pre-critical and critical testing of two 1,100 MW nuclear generating units.

1965 - 1970 Lieutenant, U. S. Navy Nuclear Submarine Force. Responsible for the maintenance and operation of nuclear and diesel powered propulsion and auxiliary equipment.

Professional Affiliation

American Nuclear Society
National Micrographics Association

MONTE J. WISE
Principal Associate Engineer

EDUCATION

B.S. Chemical and Nuclear Engineering, Texas Tech University, Lubbock, Texas

SUMMARY OF EXPERIENCE

Mr. Wise has had extensive and diverse experience in nuclear and systems engineering. Throughout his career, he has worked at several levels, including superintendent, for nuclear power plants and been responsible for varied duties such as recruiting and training staff, directing engineering functions, supervising construction surveillance, and designing, constructing, modifying, and operating in-reactor and out-of-reactor research and development testing facilities. In systems engineering he has been responsible for welding and fabrication engineering, nondestructive examination technique and equipment development, maintenance engineering, quality and reliability assurance programs, and computer systems development.

1982 - Present	Principal Associate Engineer.
1980 - 1982	Senior Project Manager, TERA Corporation. Responsible for providing senior level technical services to utilities. Since joining TERA, Mr. Wise has participated in and managed projects involving updating Final Safety Analysis Reports, developing and implementing information management systems, nuclear plant quality assurance program assessment and improvement, generating plant productivity improvement programs, inservice inspection program assessment and definition, and organizing and developing nuclear plant technical support programs.
1982 - 1980	Director and Assistant Director of Quality Systems Engineering Department, and Management, Operations Engineering Section, Southwest Research Institute. Functions included welding and fabrication engineering services, nondestructive examination (NDE) technique and equipment development, NDE services including inservice inspection, maintenance engineering services, quality and reliability assurance program development and implementation, vendor evaluation and surveillance services, and data processing and information management systems development and services. Project Manager and primary participant in the development, implementation, and operation of the Nuclear Plant Reliability Data System (NPRDS).
1964 - 1972	Superintendent and Assistant Superintendent of the LaCrosse Nuclear Power Plant, Dairyland Power Cooperative. Responsible for the overall management of the plant and several support functions including plant engineering, fuel management, quality assurance, and contract administration. Licensed Senior Reactor Operator.

1962 - 1964	Engineer, Coolant Systems Development Operations, General Electric Company. Responsibilities included the design, construction, modification, operation and results evaluation of in-reactor and out-of-reactor research and development testing facilities.
1957 - 1962	Supervisor, Reactor Operations, and Reactor Operations Specialist, General Electric Company.

PROFESSIONAL AFFILIATIONS

Wisconsin Professional Engineer Society
American Society for Quality Control
American Society for Nondestructive Testing
American Nuclear Society

MEHMET CELEBI
PRINCIPAL SCIENTIST

EDUCATION

Ph.D.	Civil Engineering, McGill University
M.S.	Civil Engineering, Stanford University
B.S.	Civil Engineering, Middle East Technical University

SUMMARY OF EXPERIENCE

Dr. Celebi has had over 16 years of experience in the fields of structural engineering, structural mechanics and dynamics, earthquake engineering, plasticity, and nuclear power, including 8 years on the faculties of the Civil Engineering Departments at the Middle East Technical University and San Francisco State University. He is author or co-author of over 40 formal publications (books and professional articles), regarding structural and seismic engineering and engineering mechanics. On his own and as an associate with engineering and consulting firms, he has carried major engineering responsibility for projects in such areas as development of design criteria for nuclear structures, vibration and seismic studies for structures, reactor containment structural design and analysis (including inelastic studies) and review of structural criteria and designs for nuclear power plants and equipment for seismic loadings. In addition to his engineering and design experience, Dr. Celebi held the position of Manager of Quality Assurance at a leading engineering consulting firm. He has also had extensive involvement with professional and code committees related to development of earthquake engineering design criteria.

PROFESSIONAL AFFILIATIONS AND HONORS

Registered Professional Engineer (California)
American Society of Civil Engineers, Full Member
Earthquake Engineering Research Institute, Full Member
Fulbright Scholarship, Stanford University
Dominion Bridge Co. Fellowship, McGill University
Japanese Government Scholarship at ISSEE, regarding dynamic testing studies

STANISLAV FABIC
Principal Scientist

EDUCATION

Ph.D.	Nuclear Engineering, University of California, Berkeley
M.S.	Nuclear Engineering, University of California, Berkeley
M.E.	Mechanical Engineering, University of Melbourne, Australia
B.E.	Mechanical Engineering, University of Melbourne, Australia
	Naval Architecture, University of Zagreb, Yugoslavia

SUMMARY OF EXPERIENCE

1982 - Present — Principal Scientist, TERA Corporation.

1973 - 1981 — Chief, Analysis Development Branch, Nuclear Regulatory Commission. Supervised professionals (all GS-15 grade) engaged in managing various research programs, conducted at five National Laboratories and various universities in the area of analysis development and verification, for application to nuclear safety. Yearly budget over $10 M. As a Branch Chief, responsible for identification of goals, plans, work programs, selection of contractors, review of work progress, and reporting of accomplishments to NRC higher level management, Commissioners, Advisory Committee for Reactor Safeguards, and Congressional Committees. From July 1979 was a member of the Senior Executive Service.

Chairman of the NRC/RES Containment Review Group. Member of the following: (a) NRC/RES Advanced Code Review Group, (b) NRC/RES Code Assessment Review Group, (c) CSNI/NEA Working Group on ECCS (Paris, France), (d) CSNI/NEA Working Group on Containments, (e) NORHAV (Nordic Countries) Review Group, and (f) Marviken IV Project Board (Sweden).

1967 - 1973 — Advisory Engineer, Westinghouse Nuclear Energy Systems. At Westinghouse, Pittsburgh, involved in the methods development for analyses of the following: (a) blowdown-induced forces on piping, reactor, and steam generator internals; (b) blowdown-induced thermal and hydraulic transients in the primary coolant system before and after injection of the emergency coolant; (c) pipe rupture (break opening time); (d) choked two-phase flow during blowdown; and (e) steam generator feed-line break (hydro-elastic analysis).

Participated in drafting Westinghouse position statements on matters pertaining to ECCS hearings.

1963 - 1967	Project Engineer, Kaiser Engineers. At Kaiser Engineers, Oakland, worked on the following projects: (a) Hallogen and noble gas removal; (b) blowdown analyses for the preliminary design of LOFT test facility; and (c) thermal radiation from the nuclear rocket exhaust plume at NERVA test facility.
1958 - 1963	Research Engineer, Institute of Engineering. At the Institute of Engineering Research, Berkeley, participated in a research project on transient boiling and boiling incipience.

PROFESSIONAL AFFILIATION

American Nuclear Society
Sigma-Xi

PUBLICATIONS AND LECTURES

Books

S. Fabic, "Review of Existing Codes for Loss-of-Coolant Accident Analysis", pp. 365-404 in ADVANCES IN NUCLEAR SCIENCE AND TECHNOLOGY, Vol. 10 Edited by E. Y. Henley, Y. Lewins, M. Becker, (Plenum Publishing Corp., 1977).

S. Fabic, "Accident Analysis", Chapter 6.6 in HANDBOOK OF MULTIPHASE SYSTEM, Editor G. Hetsroni, (Hemisphere Publishing Corp., 1981).

Technical Paper (Sole Author)

"BLODWN-2: Westinghouse APD Computer Program for Calculation of Fluid Pressure, Flow, and Density Transients During a Loss-of-Coolant Accident", ANS Transactions Vol. 12, No. 1, p. 358 (1969).

"Investigation of Methods for Coupled Structural Hydrodynamic Analysis of Reactor Internals" Proceedings, Conference on Flow Induced Vibrations in Reactor System Components, ANL-7685 (1970).

"BLODWN-2 Code Prediction of Pressure Undershoot During Transition from Subcooled to Saturated Blowdown" ANS Transactions Vol. 13, No. 1, p. 386 (1970).

"Two- and Three-Dimensional Fluid Transients" ANS Transactions Vol. 14, No. 1, p. 360 (1971).

"Comparisons Between Results of the Westinghouse Loss-of-Coolant Analyses and Semiscale (ECC) Test Data Part II: BLODWN-2A Code Results," CONF-730304, p. 702 (1973).

"Data Sources for LOCA Code Verification," Nuclear Safety Journal, Vol. 17, No. 6, (Nov.-Dec., 1976).

"Computer Codes in Water Reactor Safety: Problems in Modeling of Loss-of-Coolant Accident," Conf. Heat-Fluid Flow in Water Reactor Safety, Manchester, U.K., paper C201/77 in Proceedings, Institute of Mechnical Engineers, London, England (Sept. 1977).

"Analytical Modeling of Transient Two-Phase Flow," ANS Transactions 1979 Summer Annual Meeting in Atlanta, Georgia, (June 1979).

"Code Assessment for Nuclear Reactor Accident Analysis Programs," 1980 International Conf. on World Nuclear Energy, Washington, D.C., pp. 254-255, ANS Transactions Vol. 35, (1980).

Reports

I. Company Reports (All Sole Author)

a. Kaiser Engineers Division of Kaiser Industries Corp.

1. "Early Blowdown (WATER-HAMMER) Analysis for Loss-of-Fluid Test Facility," 65-28-RA (1965).

2. "Digital Computer Blowdown Analysis for Loss-of-Fluid Test Facility, Part I: Engineering," 65-29-R (1965).

3. "MERCURY: Digital Computer Program for Heat Transfer Analysis," 66-26-R (1966).

4. "GASRAD: Digital Computer Program for Calculation of Thermal Radiation from Plumes," 67-11-R (1967).

5. "Computer program WHAM for Calculation of Pressure, Velocity, and Force Transients in Liquid Filled Piping Networks," 67-49-R (1967).

b. Westinghouse, Nuclear Energy Systems, PWR Systems Division

1. "BLODWN-2: Digital Computer Program for Calculation of Hydraulic Transients During a Loss-of-Coolant Accident," WCAP-7235 (1968).

2. "Tornado Induced Water Removal from Spent Fuel Storage Pool," WCAP 7313-L (1969).

3. "Topical Report, Loss-of-Coolant Analysis: Comparison Between BLODWN-2 Code Results and Test Data," WCAP-7401 (1969).

4. "Calculation of Loss-of-Coolant Through a Propagating Longitudinal Crack, Using the Modified BLODWN-2 Code," WCAP-7405 (1969).

5. "Preliminary Report on Synthesis of Equivalent Piping Networks for Blowdown Analysis of the Reactor Primary Coolant System, with BLODWN-2 Code," WCAP-7421-L (1969).

6. "Description of the BLODWN-2 Computer Code," WCAP-7593 (1970).

7. "Application of BLODWN-2 Code to PWR Loss-of-Coolant Analysis," WCAP-7489 (1970).

8. "Feed-Line Break Analysis for Model-D Steam Generator," WCAP-8158 (1973).

II. Government Sponsored Reports: Reactor Technology TID-4500

Issued by Institute of Engineering Research, University of California, Berkeley, under AEC Contract AT(11-1)-34, Project 42: "Reactor Heat Transients Project".

1. "Reactor Heat Transients Research, Annual Summary Report," SAN-1002, TID-4500, 16th Edition (Nov. 1961) (co-author).

2. "Reactor Heat Transients Research, 1962 Annual Report," SAN-1007, TID-4500, 18th Edition (March 1963) (co-author).

3. "Vapor Nucleation on Surfaces Subjected to Transient Heating: Ph.D. Thesis," SAN-1008, TID-4500 (August 1964) (sole author).

4. "A High Pressure Test Facility for Transient Boiling Studies," SAN-1010, TID-4500 (June 1963) (principal author).

III. Reports Issued by Nuclear Regulatory Commission

S. Fabic and P.S. Andersen, "Plans for Assessment of Best Estimate LWR Systems Codes," NUREG-0676 (July 1981).

Lectures (All Invited)

"Design Basis Accidents and Containment Criteria for LWR's"

Presented at IAEA Interregional Training Course on Nuclear Power Plant Construction and Operations Management, at Argonne National Laboratory. (Courses sponsored by the International Atomic Energy Agency).

Lectures presented during:

1. Fall Session (Sept.-Dec., 1976),

2. Spring Session (Jan.-April, 1977),

3. Fall Session (Oct.-Nov., 1977).

4. "Emergency Core Cooling System Performance," Two lectures presented at the IAEA Training Course in Nuclear Power Safety Analyses Review, at Argonne National Laboratory (Sept. 1978).

5. "Nuclear Reactor Safety Applications," Lecture presented at the course, "Two-Phase Flow" at Drexel University (Continuing Professional Education), Philadelphia (Dec. 18, 1978).

6. "Survey of LOCA Computer Codes," (Lecture #LWRS/80/7) and "LOCA Computer Code Assessment," (Lecture #LWRS/80/11), Two lectures presented at the ISPRA Course (1980) titled "Thermal-hydraulic Problems Related to LWR Safety", sponsored by Commission of the European Communities Joint Research Center, Ispra, Italy (May 19-23, 1980).

7. "Application of Computer Codes to Resolution of LWR Safety Issues," Lecture presented at a Seminar on Two-Phase Flow, Massachusetts Institute of Technology (April 30, 1981).

Panels

1. As a member of the panel on "Loss of Coolant Accidents in Nuclear Reactors," Eighth National Heat Transfer Conference (ASME-AICHE), in Los Angeles, presented a discussion of methods of blowdown analysis (August 8, 1965).

2. "Summary Review of Meeting Highlights - Understanding NSSS Response to Design Basis Events," presented at ANS Thermal Reactor Safety Meeting at Sun Valley, Idaho (August 1977).

3. "Problems in Simulation of Nuclear Reactor Plant Thermal Hydraulics for Postulated Small and Intermediate Break Accidents," presented at the Simulation and Analysis Panel, Working Conference on Advanced Electro Technology Applications to Nuclear Power Plants, sponsored by NRC and IEEE, Washington, D.C. (Jan. 15-17, 1980).

4. "How Good the Codes Have To Be," Third CSNI Specialist Meeting on Transient Two-Phase Flow, California Institute of Technology (March 1981).

ALBERT V. MARTORE
Principal Engineer - Construction Services

EDUCATION

B.S., Civil Engineering, Massachusetts Institute of Technology
Graduate Studies, Business Management, Harvard University

SUMMARY OF EXPERIENCE

Mr. Martore has over 30 years of experience in engineering and construction, with an expertise in the area of structural engineering. His extensive experience includes all areas of light and heavy construction, commercial, and industrial projects, both domestically and internationally. As Vice President of Prescon Corporation and President of North East Post-tensioning Consultants, Inc., he has been responsible for the entire range of engineering and construction activities, including conceptual and final design; specification, fabrication, and supply of construction materials; preparation of design drawings and specifications; construction management, scheduling, supervision, and inspection. In addition, he was directly involved in the design and construction of nuclear plant containment structures for Arkansas I and 2; Crystal River 3; Calvert Cliffs I and 2; Oconee I, 2 and 3; and Turkey Point 3.

PROFESSIONAL AFFILIATIONS

Registered Professional Engineer, Massachusetts

Member, American Society of Civil Engineers

Member, American Concrete Institute

JOHN ANGELO
Senior Systems Engineer

EDUCATION

Graduate Studies	Mathematics, Physics, Chemistry, Rensselaer Polytechnic Institute, Troy, New York
	Solid and Fluid Mechanics, George Washington University, Washington, D.C.
M.S.	Engineering, Union College, Schenectady, New York
B.S.	Electrical Engineering, University of Idaho, Moscow, Idaho

SPECIALIZED TRAINING COURSES

Steam Turbine Supervisors Course, General Electric Company
Fluid Mechanics, General Electric Company
Heat Transfer, General Electric Company
Advanced Engineering Program, General Electric Company

SUMMARY OF EXPERIENCE

Mr. Angelo has thirty years of engineering experience covering a broad range of responsible assignments as a test, performance, installation and maintenance engineer for the General Electric Turbine Division; development and design of fluid systems and components for nuclear plants; supervisory and management experience on nuclear projects for the U.S. Navy; technical expert for the U.S. Army Engineers Reactor Group; and management of safety and licensing reviews of nuclear power plant construction permits and operating licenses for the Atomic Energy Commission and the Nuclear Regulatory Commission.

1981 - Present Senior Systems Engineer, TERA Corporation.

1972 - 1980 Task Manager for Systems Interaction in Nuclear Power Plants, Unresolved Safety Issues Program, NRC. This included managing a program for modeling nuclear plant systems and their interdependencies using fault trees, and developing methodologies for the purpose of identifying potential interactions between redundant systems or subsystems as a result of physical or spatial interconnections.

Senior Licensing Project Manager, NRC. Managed the activities associated with the safety review and evaluation of applications for construction permits and operating licenses.

1964 - 1972 Branch Chief, Nuclear Engineering Branch, Naval Facilities Engineering Command, U.S. Navy. Supervised the work of a number of engineers with responsibilities for engineering evaluations of nuclear projects for the shore-based naval nuclear program.

1963 - 1964 Mechanical Engineer, U.S. Army Engineers Reactor Group. Performed a wide variety of engineering assignments as a mechanical engineering in the design, operation, maintenance, installation, testing and inspection of power plants, systems and components.

1960 - 1963 Mechanical Engineer, Performed design engineering for fluid systems and components for the Nuclear Power Division of ALCO Products, Inc. and ALLIS CHALMERS MANUFACTURING CO, including transient analysis and final safety analysis for nuclear reactors.

1949 - 1958 Development Engineer, Large Steam Turbine-Generator Dept., General Electric Co. Provided specialized analysis of steam turbine and heat cycle performance in central power plants. Responsible for planning, performing, and analyzing the results of tests of power plant heat cycles for design improvements of large steam turbines. Developed specialized instrumentation and data gathering techniques needed to obtain the design information.

Turbine Supervisor, General Electric Co. Responsible for general work in the installation, startup and maintenance of steam turbine generators in central power plants, including turbine vibration balancing.

Performance Engineer, Large Steam-Turbine Dept., General Electric Co. Responsible for planning and performing overall efficiency and heat cycle performance tests in central power plants, including supervision and instruction of test personnel and calculation and analysis of test results for design information and contract obligations.

REGISTRATION

Professional Engineer in the State of Massachusetts

JOSEPH PENZIEN
Senior Scientist

Sc.D.	Civil Engineering, Massachusetts Institute of Technology
B.S.	Civil Engineering, University of Washington

Summary of Experience

Dr. Penzien has had over thirty-five years of experience in structural engineering, including twenty-seven years on the factulty of the University of California at Berkeley. He is the Director of the Earthquake Engineering Research Center at the UC Berkeley. Dr. Penzien is an expert in the seismic response of structures including highway bridges.

Professional Affiliations

American Society of Civil Engineers
Structural Engineers Association of California
Earthquake Engineering Research Institute
Seismological Society of America
American Concrete Institute

Honors

1959 NSF Post Doctoral Fellowship
1965 Research Prize, ASCE
1969 NATO Senior Science Fellowship
1973 NSF Senior Science Fellowship
1977 Electec Member, National Academy of Engineering
1978 Elected Fellow, American Academy of Mechanics
1979 Elected Honorary Member, Peruvian Assoc. of Earthquake Engineering
1980 Silver Medal of Paris

MARTIN B. JONES, JR.
Senior Project Manager

Education

B.S.E.E. The Citadel, Charleston, South Carolina

Summary of Experience

During Mr Jones' twenty-two years of responsible experience in the electric utility industry, he has directed and participated in a number of major plant construction projects built by both union and non-union contractors. He has also had direct responsibility for the development and implementation of quality control, warehousing and records management programs and systems.

1980	Senior Project Manager, TERA Corporation.
1975 - 1980	Manager of Construction, South Carolina Electric & Gas Co. Mr. Jones was responsible for all major company construction activities. Among his primary responsibilities with S.C.E.&G.CO. were the $200 million Fairfield Pumped Storage Facility (8 60MW units; completed in 1978) and the $800 million Summer Station (scheduled for completion in 1981).
1973 - 1975	Quality Control Manager, S.C.E.&G.CO. Mr. Jones established and organized a quality control group within the Construction Department for the construction of V.C. Summer Unit 1 (960MW PWR). He was responsible for hiring and training inspectors, warehousemen and records personnel. He developed and implemented the initial quality control, warehousing and records management systems for the Summer Project.
1969 - 1973	Senior Construction Supervisor, S.C.E.&G.CO. Mr. Jones organized a Construction Department electrical startup group. He directed the check-out and startup of Wateree Units 1 & 2 (350 MW-coal) and Williams 1 (650MW-heavy oil). He was also responsible for check-out of Saluda Hydro Unit 5, a 75MW expansion of an existing plant.
1963 - 1969	I&E Engineer, Project Engineer, Carolinas Virginia Nuclear Power Association, Inc. Mr. Jones was engaged in a federally funded R&D program during operation of the prototype plant (CVTR). He was also in charge of an 18-month program on containment leakage and simulated steam-break accidents following shut-down. Mr. Jones was engaged in a responsible role in decomissioning this plant.
1963	South Carolina Industries. Mr. Jones participated in the startup of a Kraft Paper Mill in Florence, South Carolina.
1959 - 1963	Staff Electrical Engineer, Plant Instrument Supervisor, Carolinas Virginia Nuclear Power Association. Mr. Jones was involved in designing, building and operating a prototype nuclear power plant at Parr, South Carolina.
1958 - 1959	Assistant Electrical Superintendent, South Carolina Electric & Gas Company. Mr. Jones participated in the construction of two 125MW coal fired units.

LENNY R. LAAKSO
Senior Associate
Structural Engineer

EDUCATION

B.S.C.E. Tufts University, 1974
M.S.C.E. Massachusetts Institute of Technology, 1976

SUMMARY OF EXPERIENCE

Mr. Laakso has seven years of experience as a structural engineer in the power industry, primarily in the structural analysis and design of buildings and equipment for nuclear, hydroelectric, and fossil fuel power plants.

1980 - Present Sr. Associate Structural Engineer, TERA Corporation

Lead Structural Engineer, Riley Stoker Corporation, Worcester, Mass. Responsible for analysis and design of steam generator support structures from review of customer specifications through completion of construction. Designs boiler intimate steel for high temperature service. Determines feasibility of modifications to existing structures. Establishes and maintains structural engineering schedules and provides technical guidance to personnel in the group. Writes department technical standards.

1977 - 1980 Lead Civil Engineer, Hydroelectric Power Division, Chas. T. Main, Inc., Boston, Mass. Responsible for final civil and structural design of powerhouse, intake structure, spillway, roads, and bridges for 600 MW Shiroro Hydroelectric Project; scheduling and approval of construction drawings; development of structural design criteria; review of specifications. Administered technical aspects of contract for spillway radial gates, intake gates, and draft tube gates. Conducted technical studies and reviewed contractor submittals for the Construction Manager. Supervised conceptual design phase for Merrill Creek Reservoir Project.

Civil Engineer, C. T. Main. Analysis and design of reinforced concrete structures; review of construction drawings; review of vendors' calculations and drawings.

1974 - 1977 Engineer, Structural Mechanics Section, Stone & Webster Engineering Corporation, Boston Mass. Seismic analysis of nuclear power plants; analysis and design of steel support frame for polar crane; evaluated design of concrete shear walls for seismic and wind loads; finite analysis of stress in concrete ring girder.

1973 - 1974 Engineering Aide, Planning Branch, U.S. Army Corps of Engineers, Waltham, Mass. Collected and organized technical data relating to water resource projects; studied feasibility of structural and nonstructural flood control measures.

PROFESSIONAL AFFILIATIONS

Registered Professional Engineer (Structural), Massachusetts
Member, American Society of Civil Engineers

HONORS & PUBLICATIONS

Graduated summa cum laude from Tufts
Elected to Tau Beta Pi, National Engineering Honor Society
Design of Offshore Gravity Platforms, thesis presented at MIT, 1976