(1) EFW
(2) File

PRINCIPAL STAFF			
RA		ENF	
D/RA		[illegible]	
A/RA		PAO	
DPRP		SLO	
DRMA		RC	
DRMSP			
DE			
ML			
OL		FILE	

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

March 11, 1983

Docket Nos: 50-329 OM, OL
and 50-330 OM, OL

MEMORANDUM FOR: R. J. Mattson, Director, Division of Systems Integration
R. Vollmer, Director, Division of Engineering
[redacted]rector, Enforcement & Investigation Staff, Region III
J. M. Taylor, Director, Quality Assurance Safeguards and Inspection Programs, IE
T. Speis, Director, Division of Safety Technology

FROM: Thomas M. Novak, Assistant Director for Licensing
Division of Licensing
Office of Nuclear Reactor Regulation

SUBJECT: REQUEST FOR REVIEW OF TERA's ENGINEERING PROGRAM PLAN AND PROJECT QUALITY ASSURANCE PLAN FOR MIDLAND INDEPENDENT DESIGN AND CONSTRUCTION VERIFICATION PROGRAM

Enclosures 1 and 2 are forwarded for your review and evaluation. Enclosure 1 is the Engineering Program Plan, Revision 1, being followed by the TERA Corporation for the Midland Independent Design and Construction Verification (ID/CV) Program. The TERA Plan is one part of a "Construction Completion Plan" (CCP) described in the Applicant's letter of January 10, 1983, which was the subject of a public meeting on February 8, 1983. The TERA Plan outlines the scope, philosophy of review, methodology, independence requirements, organization, control, documentation, reporting and quality assurance requirements for conducting the Midland ID/CV Program. The QA requirements (Section 6.1 of Enclosure 1) are being implemented, in part, by the QA/QC methods, procedures and instructions identified in the TERA Corporation QA Plan, Revision 3 (Enclosure 2).

Enclosure 3 lists lead NRC review assignments for the major elements of the TERA program. Designation of lead responsibility is primarily with respect to execution of the program. All parties are encouraged to comment on any portion of the enclosures with respect to establishment of a suitable program. Those designated for lead review should solicit support from other parties as they deem appropriate.

Enclosure 4 outlines a tentative review schedule for the TERA Program. The schedule provides for staff comments on the program and a meeting to discuss these comments. At the completion of staff review, the staff will issue an SSER describing the proposed Program. The schedule also provides support for the OM-OL April 1983 soils hearing session since the TERA study and its results will be a part of the on-going hearing issue to determine adequacy of Midland QA implementation.

MAR 16 1983

8406020200 840517
PDR FOIA
RICE84-96 PDR

Please contact the Project Manager (Darl Hood, 492-8474) should you have questions regarding these assignments or the proposed review schedule.

Thomas M. Novak, Assistant Director
for Licensing
Division of Licensing
Office of Nuclear Reactor Regulation

Enclosures:
As stated

cc w/encl:
E. Goodwin
E. Adensam
J. Keppler
J. Gilray
J. Harrison
T. L. Harpster
J. H. Sniezek
W. Shafer
D. Eisenhut
L. Rubenstein
A. Thadani

Enclosure 3

REVIEW ASSIGNMENTS FOR MIDLAND IDCV PROGRAM

Enclosure/Section	Title	Lead NRC Reviewer
1.2	Technical (design) scope	DSI
	Interfacing of construction with design scope	RIII
1.3	Selection of 2nd System	DL
1.4	Independence	DL
2.0	Organization and Control	
	Design	IEHQ
	Construction interface	RIII
3.1	Design Methodology	
3.1.1	Review categories	DSI/DE*
3.1.2	Sampling plan	DST
3.1.3	Design Scope for AFW	DSI/DE*
3.1.4	Design Scope for Second System	DSI/DE*
3.1.5.1	IDV Design Criteria checklists	DSI/DE*
3.1.5.2	Implementing Document Checklists	DSI/DE*
3.1.5.3	Calculation Checklist	DSI/DE*
3.1.5.4	Drawing and Spec. Checklist	DSI/DE*
3.1.6	Additional Sampling or Verif.	DSI/DE*
3.2.1	ICV Review Categories	RIII
3.2.2	ICV Sample Selection	RIII
3.2.3	AFW Construction Review Scope	RIII
3.2.4	Second System Construction Review Scope	RIII
3.2.5	Checklists	RIII
3.2.6	Additional Sampling, Verification and Tests	RIII
4.0	Documentation	IEHQ
5.0	Reporting	DL
6.0	QA (Including referenced TERA QA Plan)	IEHQ

*Lead designation depends upon system/component/structure involved and corresponds to primary review responsibility designated by SRP.

Enclosure 4

MIDLAND ID/CV PROGRAM REVIEW SCHEDULE

Letter to Applicant on Selection of 2nd System	March 11
Staff Comments to PM	March 18
Meeting with TERA and Applicant on Staff Comments	March 22
File QA Testimony with ASLB (Includes staff evaluation of CCP, including ID/CVP)	March 25
QA session of OM-OL Soils Hearing	April 26 - May 3
Provide SSER #3 input to PM	May 13
Issue SSER #3	June 10
TERA completes evaluation and reports results to NRC	TBD
Update SSER with results	TBD (Results dependent)

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

March 2, 1983

Docket Nos: 50-329 OM, OL
and 50-330 OM, OL

APPLICANT: Consumers Power Company

FACILITY: Midland Plant, Units 1 and 2

SUBJECT: TERA CORPORATION's PROJECT QUALITY ASSURANCE AND ENGINEERING PROGRAM PLANS FOR THE MIDLAND INDEPENDENT DESIGN AND CONSTRUCTION VERIFICATION PROGRAM

Enclosed is a copy of two pages that were inadvertantly left out of the QA documents, which were forwarded to you on February 22, 1983.

Darl Hood
Darl S. Hood, Project Manager
Licensing Branch No. 4
Division of Licensing

Enclosure:
As stated

cc w/encl:
See next page

8303140063

MIDLAND (For TERA Revisions)

cc: Ms. Mary Sinclair
5711 Summerset Drive
Midland, Michigan 48640

Stewart H. Freeman
Assistant Attorney General
State of Michigan Environmental
Protection Division
720 Law Building
Lansing, Michigan 48913

Mr. Wendell Marshall
Route 10
Midland, Michigan 48640

Cherry & Flynn
Suite 3700
Three First National Plaza
Chicago, Illinois 60602

Mr. Steve Gadler
2120 Carter Avenue
St. Paul, Minnesota 55108

Ms. Barbara Stamiris
5795 N. River
Freeland, Michigan 48623

Lee L. Bishop
Harmon & Weiss
1725 I Street, N.W., Suite 506
Washington, D. C. 20006

Billie Pirner Garde
Director, Citizens Clinic
for Accountable Government
Government Accountability Project
Institute for Policy Studies
1901 Que Street, N.W.
Washington, D. C. 20009

Charles Bechhoefer, Esq.
Atomic Safety & Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dr. Frederick P. Cowan
Apt. B-125
6125 N. Verde Trail
Boca Raton, Florida 33433

Jerry Harbour, Esq.
Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

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:__________

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:
	APPROVED BY: John W. Ruel

I. 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? ________

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

February 23, 1983

Docket Nos: 50-329 OM, OL
and 50-330 OM, OL

APPLICANT: Consumers Power Company

FACILITY: Midland Plant, Units 1 and 2

SUBJECT: TERA CORPORATION'S PROJECT QUALITY ASSURANCE AND ENGINEERING PROGRAM PLANS FOR THE MIDLAND INDEPENDENT DESIGN AND CONSTRUCTION VERIFICATION PROGRAM

Enclosed is a copy of a letter from TERA Corporation dated February 17, 1983, forwarding Revision 2 to the Project Quality Assurance Plan.

Darl S. Hood, Project Manager
Licensing Branch No. 4
Division of Licensing

Enclosure:
As stated

cc w/encl:
See next page

8303030780

cc: Ms. Mary Sinclair
5711 Summerset Drive
Midland, Michigan 48640

Stewart H. Freeman
Assistant Attorney General
State of Michigan Environmental
Protection Division
720 Law Building
Lansing, Michigan 48913

Mr. Wendell Marshall
Route 10
Midland, Michigan 48640

Cherry & Flynn
Suite 3700
Three First National Plaza
Chicago, Illinois 60602

Mr. Steve Gadler
2120 Carter Avenue
St. Paul, Minnesota 55108

Ms. Barbara Stamiris
5795 N. River
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Billie Pirner Garde
Director, Citizens Clinic
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Government Accountability Project
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Washington, D. C. 20009

Charles Bechhoefer, Esq.
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Washington, D. C. 20555

Dr. Frederick P. Cowan
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Boca Raton, Florida 33433

Jerry Harbour, Esq.
Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

TERA

BERKELEY · DALLAS · BETHESDA · BATON ROUGE · DEL MAR · NEW YORK · SAN ANTONIO · DENVER · LOS ANGELES

February 17, 1983

Mr. J. G. Keppler, Administrator
Region III, Office of Inspection
and Enforcement
U.S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, IL 60137

Mr. D. G. Eisenhut, Director
Division of Licensing
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Midland Independent Design Verification Program

Enclosed please find Revision 2 pages to be inserted in the Project Quality Assurance Plan (PQAP) for the subject program. Changes have been made to designate additional personnel who may potentially participate in the project and their functional areas of expertise. Corresponding resumes are provided. Engineering Control Procedures ECP-5.2, "Calculation Preparation and Control," and ECP-5.2QA, "Audit Checklist for Calculation Preparation and Control," have been updated as a general revision (Rev. 3) by our Corporate Quality Assurance Department to include further detail and clarification.

Sincerely,

Howard A. Levin

Howard A. Levin
Project Manager

HAL/lah

cc: w/o Enclosure
G. Keeley, CPC

8303030789

TERA CORPORATION
7101 WISCONSIN AVENUE BETHESDA, MARYLAND 20814 301·654·8960

TO BE INSERTED WITHIN THE BODY OF THE PQAP

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

Prepared by:
Howard A. Levin
Project Manager
TERA Corporation

Verified by:
Charles E. Lemon
Project Quality Assurance Engineer
TERA Corporation

Approved by:
John W. Beck
Principal-in-Charge
Vice President
TERA Corporation

Approved by:
Robert W. Felton
Executive Vice President
TERA Corporation

Copy No. 018

February 15, 1983

Revision: 2

8303030792

TERA CORPORATION

TERA CORPORATION
QUALITY ASSURANCE PROGRAM

Midland IDCV Program

PQAP

DOCUMENT REVISION RECORD

REV	DATE	DESCRIPTION OF CHANGES
1	1/17/83	Changes made reflect omission of required graphics - no substantative changes in content. Affected pages: PQAP - pg. 19; PIDocument Control Cover Sheet - pg. 3; PI-Engineering Eval. Prep & Control - pg. 3.
2	2/15/83	Pages 12a, 13, 14a: designation of personnel who may potentially participate in the project and their functional areas of expertise.
		Appendix A, ECP-5.2 and 5.2QA, "Calculation Preparation and Control" and "Audit Checklist...", updated to include corporate revision. Includes reformatting, further detail and additional attachments.
		Appendix C, Resumes: addition of resumes for personnel who may potentially participate in the project.

PAGE REVISION RECORD

CONT. I.D. NO. 3201-004 PREPARED BY S. Alfaro DATE 2/15/83

REV. 2 DATE ______ CHECKED BY S. Lynd DATE 2/15/83

SUBJECT PQAP: Midland IDCV

PAGE	REV	PAGE	REV	PAGE	REV	PAGE	REV	PAGE	REV	PAGE	REV
cover		23		p3	3	p3	3	p3		Att C	
i		Fig 1		ECP-5.3		p4	3	P1-3201-002		P1-3201-010	
ii		Att A		p1	1	Att A	3	p1		p1	
iii		Att B-1		p2	1	Att B	3	p2		p2	
iv		Att B-2		p3	1	ECP-5.15		p3	1	p3	
1		Att B-3		p4	1	p1		p4		Att A	
2		Att B-4		p5	1	p2		Att A		Att B	
3		Att B-5		Att A	1	p3		Att B-1		App C	2
4		Att B-6		Att B	1	p4		Att B-2			
5		Att B-7		Att C 5.3QA		p5		Att B-3			
6		Att B-8		p1	1	p6		Att B-4			
7		Att B-9		p2	1	p7		Att B-5			
8		Att C		p3	1	p8		Att B-6			
9		App A		ECP-5.5		p9		Att C			
10		ECP-5.2		p1	3	p10		p1			
11		p1	3	p2	3	p11		p2			
12		p2	3	p3	3	Att A		p3			
12a	2	p3	3	p4	3	Att B		P1-3201-008			
13	2	p4	3	p5	3	App B		p1			
14		p5	3	p6	3	P1-3201-001		p2			
14a	2	p6	3	p7	3	p1		p3			
15		Att A	3	Att A	3	p2		p4			
16		Att B	3	Att B	3	p3	1	p5			
17		Att C	3	Att B contd	3	p4		p6			
18		Att D	3	Att C	3	Att A		p7			
19	1	Att E	3	Att D	3	Att B		p8			
20		Att F 5.2QA		ECP-5.6		Att C		Rept Flow Chart			
21		p1	3	p1	3	p1		Att A			
22		p2	3	p2	3	p2		Att B			

Technical Reviewer	Functional Areas of Expertise
Christian Mortgat	Engineering mechanics, earthquake engineering
Jorma 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 analysis and design, licensing, plant reliability analysis
Gary Smith	Civil engineering, design and analysis, hydraulics, project management
Douglas Witt	Nuclear power plant systems and mechanical design, safety analysis, equipment design, licensing, HELBA, thermal-hydraulics
Randy Cleland	Power plant mechanical design, piping/hanger design and construction, review and inspection of mechanical systems, construction supervision and management, results engineering
Patrick Longstreth	Project and construction management, administration, control and planning, contracting
George Trigilio	Design and analysis of waste treatment systems, health physics, radiological engineering
Stephen Schreurs	Engineering analysis computational methods, ECCS evaluation, waste management, licensing

Technical Reviewer	Functional Areas of Expertise
Farzin Ramezanbeigi	Structural and mechanical engineering, usage and interpretation of structural/mechanical computer codes
Christian Nelson	Nuclear power plant operations, design, safety analysis, seismic design evaluation, inspection program development

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.

Associate	Functional Areas
Louis Fusco	Nuclear systems engineering and licensing, equipment qualification, engineering and project management, nuclear power plant operations and management
James Owens	Nuclear and fossil power plant design and construction, nuclear steam supply systems design and construction, project management, control systems, safeguards, licensing
Stanley Kaut	Design review, construction, testing, operation and licensing of electrical power, instrumentation and control systems and equipment; project management, plant procedures development, quality assurance
Edward Beck	Nondestructive testing, Level III in radiography, ultrasonics, magnetic particle, liquid penetrant, materials testing
Robert Reneau	Nondestructive testing, Level II in radiography, ultrasonics, magnetic particle, liquid penetrant, materials testing

TO BE INSERTED WITHIN APPENDIX A OF THE PQAP

ENGINEERING CONTROL PROCEDURE

ECP- 5.2

REV.: 3 DATE: 1/7/83

PAGE 1 OF 6

SUBJECT: CALCULATION PREPARATION AND CONTROL

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 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 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.

2.2 Calculations shall be complete and orderly and shall include problem statement and input requirements such as assumptions, basic criteria, methodology, data and references, and applicable codes and standards. Major equation sources shall be given and the source or derivation of any uncommon equations introduced in the calculation.

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

2.4 All final calculations shall be made on standard Control Sheets (Attachment A) or on sheets stamped in the lower right corner with the Control Stamp (Attachment B) with all required information completed by the originator. A Calculation Cover Sheet (Attachment C) shall also be prepared and attached as sheet 0 of each final calculation prior to verification and approval.

2.5 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. Computer calculations shall be be controlled by ECP-5.4, when implemented by the PQAP.

3. VERIFICATION AND APPROVAL

3.1 Status

Calculations shall be designated as preliminary until verified by checking and approved by the Project Manager or his designated representative, or until he determines that such review and approval are not required. Preliminary calculations not upgraded to final calculation status shall be maintained in a separate file.

3.2 Verification

3.2.1 Each final calculation shall be checked by an individual who has qualifications at least sufficient to originate the calculation. The checker shall not (1) be the originator or the originator's immediate superior, (2) have specified a singular calculational approach, (3) have ruled out certain considerations, or (4) have established the input for a certain aspect being verified.

3.2.2 The extent of verification required is a function of the importance of the calculation, its complexity, degree of standardization and relation to the state-of-the-art. Based on these considerations, the input, assumptions, and method of calculation may be reviewed as well as the reasonableness of the results. The depth of verification can range from a detailed check of the whole calculation to a limited check of the calculation approach and an alternative or simplified calculation technique.

3.3 Documentation of Verification

3.3.1 To provide a basis for project manager approval and future traceability, the extent and method of verification shall be clearly indicated by such methods as check marks on the original calculation and a description of the verification on the Calculation Cover Sheet or a separate sheet. The checker shall flag all errors. However, only the originator may alter the original calculation. In all cases when the propagation of the error is not corrected in the calculation or later in the design process, the originator shall clearly discuss its significance either on the cover sheet or on the original calculation.

3.3.2 In cases where only certain aspects of a calculation were verified either due to the perceived need (Section 3.2) or any limitations in the qualifications of the checker, this shall be stated explicitly on the Calculation Cover Sheet or attachments as necessary.

3.3.3 After checking, 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.

3.4 Approval

The calculation shall then be passed to the Project Manager or his designated representative for approval. The extent and method of verification must be reviewed and determined to be satisfactory prior to signoff. The 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:

XXXX-XX-XXX

Sequence number

Subject file identifier*

Project identifier*

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

The Project Manager or his designee shall insert the control identification number on the cover sheet and each page of the final calculation.

4.2 Retention

The final calculation shall be indexed, Attachment D, and filed in the appropriate subject file. Calculations shall not be stored loosely but shall be filed in binders or contained in folders. Distribution shall not be made unless specific written instructions are issued to the contrary. Filing and distribution of final calculations shall be controlled by the Project Manager or his designated representative. Further controls resulting from contractual agreement or project specific needs may be stated in the PQAP.

5. REVISIONS

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

5.2 Superceded final calculations shall be so identified and transferred to a superceded calculation file. This action shall be noted by completing the "Superceded By" blanks on the Calculation Index for the superceded calculation. Superceded final calculations shall either be identified as such on each page or shall be securely bound with at least the cover page so identified.

5.3 Calculation packages may be revised by inserting replacement pages or additional pages with the revision number added to the Control I.D. number on these pages. Appropriate page numbers shall be supplied with subpage numbers used if necessary (e.g., 41A, 41B or 41.01, 41.02, etc.). The Page Revision Record, Attachment E, must be used to record all removed, replaced or revised pages and shall be attached to the Calculation Cover Sheet. Superceded pages shall be identified as such and transferred to a separate file.

6. QA AUDIT CHECKLIST

6.1 Audits of the implementation of this procedure shall be conducted by the PQAE using Audit Checklist ECP-5.2QA, Rev. 2, Attachment F.

ECP-5.2, Rev.3, Attachment A

TERA

SUBJECT ____________________

SHEET______OF______SHEETS

PROJECT NO. ____________________

PREPARED BY____________DATE________

CONTROL I.D. NO.____________________

CHECKED BY____________DATE________

CONTROL STAMP

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

ECP-5.2, Rev. 3 ATTACHMENT C

CALCULATION COVER SHEET

SUBJECT ______________________________

______________________________ CONT. ID. NO. ______________

PROJECT ______________________________ NO. OF SHTS. ______________

SUPERCEDES CALC. NO.

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

VERIFICATION

PURPOSE/INPUT REQUIREMENTS

SOURCES OF DATA, FORMULAE AND REFERENCES

(References may be listed on a separate sheet)

TERA CORPORATION

ATTACHMENT D

CALCULATION INDEX

CONT. ID. NO.	REV.	TITLE	DATE	SUPERCEDED BY	REV.	DATE

ECP-5.2, Rev. 3 Attachment E

PAGE REVISION RECORD

CONT. I.D. NO. ______________ PREPARED BY __________________________ DATE ________

REV. ________ DATE ________ CHECKED BY ___________________________ DATE ________

SUBJECT ____

PAGE	REV	PAGE	REV	PAGE	REV	PAGE	REV	PAGE	REV	PAGE	REV

TERA CORPORATION

ENGINEERING CONTROL PROCEDURE

ECP- 5.2 QA	SUBJECT: AUDIT CHECKLIST FOR CALCULATION PREPARATION AND CONTROL
REV.: 2 DATE: 1/7/83	
PAGE 1 OF 3	PREPARED BY: APPROVED BY:

I. 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 identified ______

2.3 Verification and approval signatures or initials? ______

2.4 Control and identification number per PQAP? ______

2.5 Extent of verification indicated? ______

2.6 Calculation indexed and filed in loose leaf binder or contained in folders? ______

2.7 Revisions processed in same manner as original? ______

2.8 Superseded calculations identified on index sheet properly identified and filed separately? ______

ENGINEERING CONTROL PROCEDURE

ECP- 5.2 QA		SUBJECT: AUDIT CHECKLIST FOR CALCULATION PREPARATION AND CONTROL
REV.: 2	DATE: 1/7/83	
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- 5.2 QA	SUBJECT: AUDIT CHECKLIST FOR CALCULATION PREPARATION AND CONTROL
REV.: 2 DATE: 1/7/83	
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:________

TO BE INSERTED WITHIN APPENDIX C OF THE PQAP

DOUGLAS M. WITT
Senior Mechanical Engineer

Education

M.S.	Mechanical Engineering, Illinois Institute of Technology
B.S.	Mechanical Engineering, Illinois Institute of Technology

Summary of Experience

Mr. Witt has more than 15 years of experience in the nuclear engineering and consulting field. His project work in this area has included safety sequence analysis, licensing, system design, equipment design, pipe rupture analysis, and procurement. He has managed and participated in numerous projects for several corporate organizations with responsibility for technical services and financial management. In addition, he has provided special technical services for an advanced analysis group performing thermal hydraulic analysis for nuclear and fossil power plants, and has served as technical manager for a design organization of more than 100 engineers.

1983	Senior Mechanical Engineer, TERA Corporation.
1973-1982	Manager, Structural Design Division, EDS Nuclear. Responsible for structural design services for operating nuclear plant backfit and for design modification and analytical qualification associated with licensing upgrades. Manager, Advanced Analysis Section, EDS Nuclear. Managed analysis efforts to define thermal hydraulic forcing functions for plant structures and systems subjected to transients associated with both abnormal occurrences and anticipated operational conditions. Project Manager, EDS Nuclear. Provided technical direction on multi-discipline projects for construction-stage and operating nuclear plants. Projects included both PWRs and BWRs with integrated design and analysis activities including safety sequence analysis, licensing, system design, pipe rupture mitigation, piping system qualification and design.
1972 - 1973	Industrial Consultant, Argonne National Laboratory. Designed mechanical test facilities, and test programs for equipment and components utilized in the sodium fast breeder program.
1971 - 1972	Mechanical Engineer, Projects Group, Sargent and Lundy. Directed interfacing mechanical design efforts for safety-related systems within the NSSS vendor scope of supply.
1967 - 1971	United States Navy, Nuclear Power Program. Completed tour of duty as Director, Heat Transfer and Fluid Flow Division at the nuclear training command with responsibility for establishing qualifications and implementing a training and testing program to qualify personnel.

(1/83)1

Registrations

Registered Professional Engineer - Mechanical Engineering, California and Illinois

Professional Affiliations

American Society of Mechanical Engineers

(1/83)1

RANDY S. CLELAND
Project Engineer

Education

M.A.	Business Administration, Sangamon State University
B.S.	Mechanical Engineering, Purdue University

Summary of Experience

Mr. Cleland has over ten years of experience in the design, construction, operation, and maintenance of power generation facilities with emphasis on mechanical engineering, construction management and results engineering.

1983 - Present	Project Engineer - TERA Corporation. Responsible for providing construction management and plant operations support services.
1975 - 1983	Results Engineering Supervisor, Coffeen Power Station, Central Illinois Public Service Company. Responsible for coal fired power plant operating efficiency, instrument and control maintenance, and laboratory activities. Developed performance test procedures, periodic testing programs, equipment inspection procedures, and preventive maintenance programs. Recommended improvements in operating procedures and managed plant betterment projects. Mechanical Engineer, Power Plant Construction. Responsible for review and monitoring of mechanical design portion of a major fossil fueled power plant and other operating station additions. Area Construction Engineer, Power Plant Construction. Responsible for contractor management and monitoring of various construction activities for a major fossil fueled power plant.
1971 - 1975	Cooperative Engineer, Sargent and Lundy Engineers. Completed work-study program which included positions as draftsman, designer, assistant engineer, and mechanical engineer on nuclear and fossil power plant design projects.

Registration

Registered Professional Engineer - Illinois

Professional Affiliations

American Society of Mechanical Engineers
Tau Beta Pi, Engineering Honorary Society
Pi Tau Sigma, Mechanical Engineering Honorary Society

PATRICK LONGSTRETH
Senior Engineer - Project and Construction Management

Education

M.B.A.	Management, Golden Gate University, San Francisco
B.S.	Industrial Construction Management, Colorado State University

Summary of Experience

Mr. Longstreth has more than fourteen years experience in project and construction management. He has worked on a variety of projects including power plants, a fuel maintenance and examination facility, and a hazardous waste management facility. His experience has involved project management, administration, control and planning as well as contracting and claims. Mr. Longstreth also developed and implemented an Integrated Computerized Cost Reporting System for the Fast Flux Test Facility; the system included all Field Cost and Control Reports.

1981 - Present	Senior Engineer, TERA Corporation.
1967 - 1981	Assistant Estimator to Project Services Manager, Bechtel Group of Companies.
1980 - 1981	Project Engineer and Project Services Manager. Project Engineer for a Department of Energy Breeder Reactor Program at a fuel maintenance and examination facility. The project was a mechanical/electrical contract worth $40 million. As Project Services Manager was responsible for project services--accounting, administration, cost and schedule engineering, legal, and insurance--for IT Corporation's Louisiana Hazardous Waste Management Facility.
1977 - 1980	Manager of Planning and Scheduling, Hydro and Community Facilities Division. Was responsible for all aspects of planning and control on numerous hydroelectric, transportation, community, commercial, and infrastructure projects.
1974 - 1977	Manager of Planning and Scheduling, San Francisco Power Division. Responsible for planning functions on numerous power plant projects. Developed System Basis Scheduling Engineering/Procurement methods for the San Francisco Power Division.
1967 - 1974	Cost Engineer, Estimator. Worked on numerous power industry projects involving contracting, change orders, and claims.

Professional Associations

American Association of Cost Engineers
International Association of Professional Planners and Schedulers
Project Managers Institute

GEORGE JOSEPH TRIGILIO, JR.
Engineering Manager

Education

B.S. Chemical Engineering, Northeastern University, Boston, Massachusetts

Chemical Engineering Technology, Franklin Institute of Technology, Boston, Massachusetts

Summary of Experience

Mr. Trigilio has held numerous management and technical positions of increasing responsibilities. He is presently directs a multi-disciplined team of senior level professionals. Mr. Trigilio's technical expertise is in the design of waste treatment systems. He has worked extensively in the design and analysis of radioactive waste treatment systems for nuclear power plants and has been involved in the design, specification and purchase of waste treatment system components for numerous utility plants. In addition, he has supervised a research and development department and managed the technical and licensing requirements for a fleet of radioactive waste shipping casks used in the transportation of power plant wastes.

1979 - Present	Engineering Manager - Waste Management Services Division, TERA Corporation. Responsibilities include all engineering aspects of the radwaste generation and disposal cycle with extensive involvement in the design and analysis of radwaste treatment systems, low-level waste storage facilities and the economic and engineering violability of volume reduction systems. During this time period a study was begun for the Nuclear Regulatory Commission which resulted in his authoring NUREG-2206 which represents a comprehensive completion and data base of volume reduction techniques for low-level radioactive waste.
1977 - 1979	Engineering Group Manager, Hittman Nuclear & Development Corporation, Columbia, Maryland. Responsibilities included department budgetary control, technical direction, and personnel supervision of: the Engineering Design; Research, Development and Testing; and the Planning/Scheduling and Document Control sections. Additionally, was Project Manager for a Shipping Cask project, with direct responsibility for all corporate radioactive waste shipping container design, safety analyses, and Nuclear Regulatory licensing certification.
1975 - 1977	Analysis Group Lead Engineer, Brown & Root, Incorporated, Houston, Texas. Responsible for supervising the development of a major program to simulate the operation of a Radioactive Waste Treatment system. Assisted in the preparation of an Environmental Report for licensing of a multiple-unit nuclear site, involving economic evaluation of power production alternatives and calculation of isotopic dispersion.

1972 - 1975	Engineer, Stone & Webster Engineering Corporation, Boston, Massachusetts. Responsible for determining the capital cost and operating economics of three processes for BTX extraction from reformatted and/or pyrolysis feed stocks. Assistant to the Head of Computational Methods Specialist. Prepared the specification for the purchase and assisted in the design of an Off-Gas treatment system. Co-authored a curve fitting program.

Professional Affiliations

American Institute of Chemical Engineers
American Nuclear Society
National Energy Coordinating Committee of the American Institute of Chemical Engineers (past member)
Board of Directors of Harris County Municipal Utility District #5 (past President)

STEPHEN F. SCHREURS
Project Manager, Waste Management Services Division

Education

B.S. University of Massachusetts, Chemical Engineering

Summary of Experience

Mr. Schreurs has nine years of nuclear experience in the area of radwaste processing, design, analysis and disposal. This experience has included both engineering analysis and group managerial responsibilities for private and governmental organizations. He has developed computerized analytical models of ECCS, CSS, and boron recovery systems. Mr. Schreurs has been involved in all facets of the nuclear waste problem, especially the immobilization and disposal of high-level and transuranic wastes and the solidification, packaging and disposal of low-level radioactive wastes.

1980	Project Manager, Waste Management Services Division, TERA Corporation. Primary responsibilities include radwaste system evaluation and analysis.
1977 - 1980	Project Manager, Performance Analysis Section, High-Level Waste Licensing Branch, Division of Waste Management, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission. Responsibilities included developing a capability to analyze the performance of a deep geologic nuclear waste repository. Mr. Schreurs assisted in the development of the proposed 10 CFR 60 regulation, along with the accompanying regulatory documents (i.e. regulatory guides and staff technical positions), and interfaced with other government agencies on matters concerning the performance assessment of repositories. He also monitored the technical aspects of contracts related to deep geologic repositories which were sponsored by other NRC offices.
1976 - 1977	Computational Methods Specialist and Sampling Systems Specialist, Process Engineering Specialty Group, Nuclear Industries Division, Stone and Webster Engineering Corporation. Major activities consisted of reviewing and updating specifications for buying sampling systems; laboratory testing of simulated nuclear plant radioactive wastes; preparation of sections pertaining to the processing systems for a PSAR of an Italian nuclear power plant; and modeling the CSS for redesign using eductors for pH control instead of injection pumps.
1972 - 1976	Computational Methods Specialist, Process Engineering Specialty Group, Nuclear Industries Division, Stone and Webster Engineering Corporation. Supervised the Computer Section of the Process Engineering Group. Responsible for modeling the complete radioactive waste system for BWRs (i.e. reactor core to drums); modeling and refining the existing computer program for the boron recovery systems in PWRs, and modeling other chemical process systems for nuclear power plants (e.g. waste evaporators and demineralizers). Further responsibilities included recruitment, managing the engineer-in-training program for the group, and teaching refresher courses in math for the Professional Engineers Exam.

Licenses

E.I.T. portion of professional engineer

Societies

American Institute of Chemical Engineers - Full Member

Publications

Schreurs, S.; "Overview of the High-Level and Transuranic Waste Branch Modeling Effort;" U.S. Nuclear Regulatory Commission, 1978

Contributing author to "Technical Writing Style Guide," NUREG-0650, U.S. Nuclear Regulatory Commission, November 1979.

FARZIN RAMEZANBEIGI
Civil/Structural Engineer

Education

B.S.	Structural Engineering, San Francisco State University

Summary of Experience

1982 - Present	Civil Engineer, TERA Corporation. Responsibilities include usage and interpretation of structural computer codes such as SAP IV, SAP V, and ADLPIPE.
1982	Teaching Assistant, San Francisco State University. Responsible for assisting advisor in use of computerized systems for engineering applications.
1981 - 1982	Assistant, Billman Construction Corporation. Assisted owner of this small business in determining technical engineering requirements for residential buildings. Also performed a wide range of general construction duties.

CHRISTIAN C. NELSON
SENIOR REACTOR OPERATIONS ENGINEER

EDUCATION

B.S. Naval Engineering, U.S. Naval Academy

SUMMARY OF EXPERIENCE

Mr. Nelson has over twelve years of experience in the nuclear energy field. At the NRC he was responsible for maintaining an effective program for the inspection of operating nuclear power plants. He has managed numerous safety and environmental evaluations associated with operating nuclear power plants. He directed a multidisciplinary engineering team in reviewing implementation of TMI Lessons Learned at operating reactors. He has also been lead engineer in resolving several generic safety issues.

1983 - Present	Senior Reactor Operations Engineer - TERA Corporation.
1975 - 1983	Operating Reactors Project Manager, Office of Nuclear Reactor Regulation, NRC. Responsible for directing and performing evaluations of licensing issues for numerous operating power plants. In particular coordinated safety evaluations for power upgrades, seismic design reviews and increases in spent fuel storage capacity. Responsible for resolution of various technical issues including PWR moderator dilution, station blackout procedures and natural circulation cooldown. Senior Reactor Operations Engineer, Office of Inspection and Enforcement, NRC. Responsible for managing the operating reactor inspection program to assure proper emphasis on the priority among inspections, balance inspection requirements with manpower resources and integrate the inspection program with other NRC activities. Team Leader, Lessons Learned Implementation Review, NRC. Directed review of TMI Category A Lessons Learned implementation at all Combustion Engineering and early Westinghouse designed power reactors.
1970 - 1975	Officer, U.S. Navy. Served as engineering officer during four deterrent patrols and shipyard overhaul aboard a nuclear powered submarine. Qualified in submarines.

AWARDS

NRC Special Achievement Award for managing evaluation of GETR seismic issues and representing NRC evaluation at public hearing.

LOUIS L. FUSCO, JR.
Senior Associate Engineer

Education

B.S. Ocean Engineering, U.S. Naval Academy

Summary of Experience

Mr. Fusco has had over eight years of nuclear engineering experience, with emphasis on equipment qualification, systems engineering, licensing and project management.

Present	Senior Associate Engineer, TERA Corporation.
1981 - Present	Senior Engineer, Western OMTEC Corporation. Responsible for the preparation of field change instructions to operations and instruction sites.
1981	Staff Engineer, NUS Corporation. Assigned as on-site technical consultant to the Sacramento Municipal Utility District, in responding to the environmental qualification of Class IE electrical equipment at Rancho Seco Nuclear Power Plant. Responsible for equipment inspection, record and test reviews, and vendor/client interface. Also responsible for nulcear engineering studies and evaluations in areas such as nuclear process system design and operation, seismic qualification, radioactive waste, shielding and licensing.
1980 - 1981	Senior Engineer, EDS Nuclear, Inc. Nuclear systems engineering and licensing lead responsible for the direction and supervision of up to eight engineers on three major projects. Review and preparation of FSAR chapters on electrical and control systems. Responsible for nuclear system piping rupture postulation with interaction analysis and protection of unacceptable scenarios. Responsible for NUREG-0660 reviews for nuclear utility clients.
1975 - 1980	Lieutenant, U.S. Navy. Qualified as engineer officer, officer of the deck and engineering officer of the watch on a nuclear-powered fast attack submarine. Major division officer assignments included: Main Propulsion Assistant, Damage Control Assistant, Reactor Controls Officer, Chemistry and Radiological Controls Officer, and Sonar Officer.

STANLEY W. KAUT

Associate Electrical Engineer

Education

B.S. Electrical Engineering, Rochester Institute of Technology

Summary of Experience

Mr. Kaut has had 20 years of diversified engineering experience with emphasis in design review, construction, testing, operation, licensing and quality assurance of electrical power, instrumentation and control systems and equipment. He has made continuous contributions to the nuclear power industry since his involvement with the BWR turnkey program. His experience with electrical power includes the installation, testing, and servicing of substations, motor control centers, switchgear, power trnasformers, motors, generators, D.C. battery systems, bus duct, cabling and related metering, and relaying. His experience with instrumentation and control includes the installation, testing, design, calibration, and maintenance of process systems and equipment that measure such variables as level, flow, pressure, temperature, and vibration; and of nuclear systems such as neutron monitoring, area and process radiation monitoring, and rod control. Mr. Kaut has also had significant experience with design review, plant procedures and Quality Assurance (QA). He has directed a technical group responsible for providing design review services to nuclear utilities. The services have been directed toward providing an independent assessment of plant safety, operability, maintainability, inspectability, and availability features. Mr. Kaut has developed procedure programs for several BWR and PWR power plants providing for the administrative control of plant personnel during startup testing, operation, maintenance or on-line surveillance testing. Mr. Kaut's involvement with quality (QA/QC) includes first-hand experience performing QC activities in manufacturing shops, electrical equipment installation sites and at nuclear power plant construction sites. He has been involved in the development and review of quality programs and procedures (including training) for AE's utilities, and manufacturing organizations. He has participated in many audits and is certified as a lead auditor.

Present	Associate Electrical Engineer, TERA Corporation.
1975 - Present	Manager, Systems Engineering, NUTECH.
1970 - 1975	Manager of Projects, Nuclear Services Corporation.
1963 - 1970	Field Engineer, General Electric Company.

Registration

Electrical Engineer, State of California
Nuclear Engineer, State of California
Control System Engineer, State of California

JAMES I. OWENS
Principal Associate Engineer

Education

B.S.E.E Iowa State University
Advanced Engineering Program, General Electric Company

Summary of Experience

Mr. Owens has had over 30 years of experience in the design and construction of power plants - fossil and nuclear. He was General Manager Production Engineering and Construction for a major utility with responsibility for generation planning, as well as design and construction of all production facilities. In this capacity he functioned as a member of the utility executive staff and worked with AEs, suppliers, NRC, other regulatory bodies and interfaced with the public. He has had major responsibility for cost and schedule performance.

1982 - Present	Principal Associate Engineer, TERA Corporation.
1979 - 1982	General Manager, Production Engineering and Construction, Delmarva Power & Light Company. Responsible for the design and construction of a 500MWe coal fired power plant and the conversion of a two unit oil fired plant to coal, as well as additions and improvements to the existing system.
1978 - 1979	Manager, Production Engineering & Construction, Delmarva Power & Light Company. Responsible for planning new facilities and all preliminary engineering and licensing work on a 500MWe coal fired power plant.
1976 - 1978	Manager, Power Plant Design, Delmarva Power & Light Company. Responsible for the specification, bidding, and evaluation of twin unit Nuclear Steam Supply Systems and preliminary design of BOP.
1973 - 1976	Project Manager, Summit Nuclear Power Plant, Delmarva Power & Light Company. Staffed the Project Organization, negotiated contracts for the NSSS, Turbine Generator, and most major auxiliaries. Directed Preliminary Design and Licensing through the Construction Permit for twin HTGRs. Responsible for nuclear engineering for the station.
1950 - 1972	General Electric Company, Gibbs and Hill and General Atomic Company. Engineering and managerial assignments included development of control systems for Peach Bottom & Dresden Nuclear Power Plants and the Sea Wolf nuclear submarine, and preparation of PSARs for sixteen research and test reactors.

Professional Affiliations

Registered Professional Engineer, New York
Member, American Nuclear Society
Member, IEEE
Member, EPRI Nuclear Divisional Committee

TERA CORPORATION

EDWARD M. BECK
Principal Associate Engineer, Nondestructive Testing

Education

B.C.E. Auburn University

Summary of Experience

Mr. Beck has over 15 years experience in the area of nondestructive testing. He has been responsible for the direction and management of several major projects. He has distinguished himself by serving as Section Chairman and Director of the AWS and ASNT.

Present	Principal Associate Engineer, Nondestructive Testing
1978 - Present	Assistant Vice President, Corporate Consultant/Metals, Radiation Safety Officer for Carolinas. Responsible for the development of new techniques and services. Responsible to the Director of Engineering for the approval of all NDE procedures established in the Engineering Procedures Manual. Responsible to the Director of Engineering for approval of all NDE Level III candidates.
1976 - 1978	Manager of NDE Services - Charlotte Branch, Law Engineering Testing Company. Managed nondestructive testing services for the District. Responsible for Virginia and Carolinas.
1972 - 1975	Project Manager, Law Engineering Testing Company. Administered and controlled radiographic, magnetic particle, and dye penetrant investigations for the Brunswick Steam and Electric Plant. Responsible for the supervision of up to 25 engineering technicians.
1968 - 1972	Manager of the Nondestructive Testing Department, Georgia Division, Law Engineering Testing Company. Administered and controlled all work which included radiography, ultrasonic, and magnetic particle investigation, dye penetrant tests and in general, all metal inspection in building and construction.
1964 - 1967	Assistant to Chief of Operations, United States Public Service Commission.

Certifications/Registrations

Professional Engineer, North Carolina and New York
Level III ASNT certification in ultrasonic, radiographic, liquid penetrant and magnetic particle testing.

Professional Associations

American Welding Society - past Section Chairman and Director
American Society for Nondestructive Testing - past Section Director
American Society of Mechanical Engineers
American Institute of Steel Construction
American Society for Metals
Numerous technical committees and task forces

TERA

BERKELEY · DALLAS · BETHESDA · BATON ROUGE · DEL MAR · NEW YORK · SAN ANTONIO · DENVER · LOS ANGELES

February 17, 1983

PRINCIPAL STAFF
✓ Eng +3

Mr. J. G. Keppler, Administrator
Region III, Office of Inspection
and Enforcement
U.S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, IL 60137

Mr. D. G. Eisenhut, Director
Division of Licensing
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Midland Independent Design Verification Program

Enclosed please find Revision 2 pages to be inserted in the Project Quality Assurance Plan (PQAP) for the subject program. Changes have been made to designate additional personnel who may potentially participate in the project and their functional areas of expertise. Corresponding resumes are provided. Engineering Control Procedures ECP-5.2, "Calculation Preparation and Control," and ECP-5.2QA, "Audit Checklist for Calculation Preparation and Control," have been updated as a general revision (Rev. 3) by our Corporate Quality Assurance Department to include further detail and clarification.

Sincerely,

Howard A. Levin

Howard A. Levin
Project Manager

HAL/lah

cc: w/o Enclosure
G. Keeley, CPC

8303030189

FEB 18 1983

TERA CORPORATION
7101 WISCONSIN AVENUE BETHESDA, MARYLAND 20814 301·654·8960

TO BE INSERTED WITHIN THE BODY OF THE PQAP

PROJECT QUALITY ASSURANCE PLAN FOR MIDLAND INDEPENDENT DESIGN CONSTRUCTION AND VERIFICATION PROGRAM

CONSUMERS POWER COMPANY

PROJECT 3201

Prepared by: Howard A Levin
Howard A. Levin
Project Manager
TERA Corporation

Verified by: Charles E Lemon
Charles E. Lemon
Project Quality Assurance Engineer
TERA Corporation

Approved by: John W. Beck
John W. Beck
Principal-in-Charge
Vice President
TERA Corporation

Approved by:
Robert W. Felton
Executive Vice President
TERA Corporation

Copy No. 017

February 15, 1983

Revision: 2

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TERA CORPORATION

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QUALITY ASSURANCE PROGRAM

Midland IDCV Program

PQAP

DOCUMENT REVISION RECORD

REV	DATE	DESCRIPTION OF CHANGES
1	1/17/83	Changes made reflect omission of required graphics - no substantative changes in content. Affected pages: PQAP - pg. 19; PIDocument Control Cover Sheet - pg. 3; PI-Engineering Eval. Prep & Control - pg. 3.
2	2/15/83	Pages 12a, 13, 14a: designation of personnel who may potentially participate in the project and their functional areas of expertise.
		Appendix A, ECP-5.2 and 5.2QA, "Calculation Preparation and Control" and "Audit Checklist...", updated to include corporate revision. Includes reformatting, further detail and additional attachments.
		Appendix C, Resumes: addition of resumes for personnel who may potentially participate in the project.

PAGE REVISION RECORD

CONT. I.D. NO. 3201-004 PREPARED BY S. Alfaro DATE 2/15/83

REV. 2 DATE ______ CHECKED BY S. Lynd DATE 2/15/83

SUBJECT PQAP: Midland IDCV

PAGE	REV	PAGE	REV	PAGE	REV	PAGE	REV	PAGE	REV	PAGE	REV
cover		23		p3	3	p3	3	p3		Att C	
i		Fig 1		ECP-5.3		p4	3	PI-3201-002		PI-3201-010	
ii		Att A		p1	1	Att A	3	p1		p1	
iii		Att B-1		p2	1	Att B	3	p2		p2	
iv		Att B-2		p3	1	ECP-5.15		p3	1	p3	
1		Att B-3		p4	1	p1		p4		Att A	
2		Att B-4		p5	1	p2		Att A		Att B	
3		Att B-5		Att A	1	p3		Att B-1		App C	2
4		Att B-6		Att B	1	p4		Att B-2			
5		Att B-7		Att C 5.3QA		p5		Att B-3			
6		Att B-8		p1	1	p6		Att B-4			
7		Att B-9		p2	1	p7		Att B-5			
8		Att C		p3	1	p8		Att B-6			
9		App A		ECP-5.5		p9		Att C			
10		ECP-5.2		p1	3	p10		p1			
11		p1	3	p2	3	p11		p2			
12		p2	3	p3	3	Att A		p3			
12a	2	p3	3	p4	3	Att B		PI-3201-008			
13	2	p4	3	p5	3	App B		p1			
14		p5	3	p6	3	PI-3201-001		p2			
14a	2	p6	3	p7	3	p1		p3			
15		Att A	3	Att A	3	p2		p4			
16		Att B	3	Att B	3	p3	1	p5			
17		Att C	3	Att B contd	3	p4		p6			
18		Att D	3	Att C	3	Att A		p7			
19	1	Att E	3	Att D	3	Att B		p8			
20		Att F 5.2QA		ECP-5.6		Att C		Rept Flow Chart			
21		p1	3	p1	3	p1		Att A			
22		p2	3	p2	3	p2		Att B			

TERA CORPORATION

Technical Reviewer	Functional Areas of Expertise
Christian Mortgat	Engineering mechanics, earthquake engineering
Jorma 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 analysis and design, licensing, plant reliability analysis
Gary Smith	Civil engineering, design and analysis, hydraulics, project management
Douglas Witt	Nuclear power plant systems and mechanical design, safety analysis, equipment design, licensing, HELBA, thermal-hydraulics
Randy Cleland	Power plant mechanical design, piping/hanger design and construction, review and inspection of mechanical systems, construction supervision and management, results engineering
Patrick Longstreth	Project and construction management, administration, control and planning, contracting
George Trigilio	Design and analysis of waste treatment systems, health physics, radiological engineering
Stephen Schreurs	Engineering analysis computational methods, ECCS evaluation, waste management, licensing

Technical Reviewer	Functional Areas of Expertise
Farzin Ramezanbeigi	Structural and mechanical engineering, usage and interpretation of structural/mechanical computer codes
Christian Nelson	Nuclear power plant operations, design, safety analysis, seismic design evaluation, inspection program development

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.

Associate	Functional Areas
Louis Fusco	Nuclear systems engineering and licensing, equipment qualification, engineering and project management, nuclear power plant operations and management
James Owens	Nuclear and fossil power plant design and construction, nuclear steam supply systems design and construction, project management, control systems, safeguards, licensing
Stanley Kaut	Design review, construction, testing, operation and licensing of electrical power, instrumentation and control systems and equipment; project management, plant procedures development, quality assurance
Edward Beck	Nondestructive testing, Level III in radiography, ultrasonics, magnetic particle, liquid penetrant, materials testing
Robert Reneau	Nondestructive testing, Level II in radiography, ultrasonics, magnetic particle, liquid penetrant, materials testing

TO BE INSERTED WITHIN APPENDIX A OF THE PQAP

ENGINEERING CONTROL PROCEDURE

ECP- 5.2
REV.: 3 DATE: 1/7/83
PAGE 1 OF 6
SUBJECT: CALCULATION PREPARATION AND CONTROL
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 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 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.

2.2 Calculations shall be complete and orderly and shall include problem statement and input requirements such as assumptions, basic criteria, methodology, data and references, and applicable codes and standards. Major equation sources shall be given and the source or derivation of any uncommon equations introduced in the calculation.

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

2.4 All final calculations shall be made on standard Control Sheets (Attachment A) or on sheets stamped in the lower right corner with the Control Stamp (Attachment B) with all required information completed by the originator. A Calculation Cover Sheet (Attachment C) shall also be prepared and attached as sheet 0 of each final calculation prior to verification and approval.

2.5 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. Computer calculations shall be be controlled by ECP-5.4, when implemented by the PQAP.

3. VERIFICATION AND APPROVAL

3.1 Status

Calculations shall be designated as preliminary until verified by checking and approved by the Project Manager or his designated representative, or until he determines that such review and approval are not required. Preliminary calculations not upgraded to final calculation status shall be maintained in a separate file.

3.2 Verification

3.2.1 Each final calculation shall be checked by an individual who has qualifications at least sufficient to originate the calculation. The checker shall not (1) be the originator or

ENGINEERING CONTROL PROCEDURE

ECP- 5.2	SUBJECT: CALCULATION PREPARATION AND CONTROL
REV.: 3 DATE: 1/7/83	
PAGE 3 OF 6	PREPARED BY: APPROVED BY:

the originator's immediate superior, (2) have specified a singular calculational approach, (3) have ruled out certain considerations, or (4) have established the input for a certain aspect being verified.

3.2.2 The extent of verification required is a function of the importance of the calculation, its complexity, degree of standardization and relation to the state-of-the-art. Based on these considerations, the input, assumptions, and method of calculation may be reviewed as well as the reasonableness of the results. The depth of verification can range from a detailed check of the whole calculation to a limited check of the calculation approach and an alternative or simplified calculation technique.

3.3 Documentation of Verification

3.3.1 To provide a basis for project manager approval and future traceability, the extent and method of verification shall be clearly indicated by such methods as check marks on the original calculation and a description of the verification on the Calculation Cover Sheet or a separate sheet. The checker shall flag all errors. However, only the originator may alter the original calculation. In all cases when the propagation of the error is not corrected in the calculation or later in the design process, the originator shall clearly discuss its significance either on the cover sheet or on the original calculation.

3.3.2 In cases where only certain aspects of a calculation were verified either due to the perceived need (Section 3.2) or any limitations in the qualifications of the checker, this shall be stated explicitly on the Calculation Cover Sheet or attachments as necessary.

3.3.3 After checking, 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.

3.4 Approval

The calculation shall then be passed to the Project Manager or his designated representative for approval. The extent and method of verification must be reviewed and determined to be satisfactory prior to signoff. The Manager or his designated representative will sign only the cover sheet.

ENGINEERING CONTROL PROCEDURE

ECP- 5.2	SUBJECT: CALCULATION PREPARATION AND CONTROL
REV.: 3 DATE: 1/7/83	
PAGE 5 OF 6	PREPARED BY: APPROVED BY:

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:

XXXX-XX-XXX
- XXX — Sequence number
- XX — Subject file identifier*
- XXXX — Project identifier*

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

The Project Manager or his designee shall insert the control identification number on the cover sheet and each page of the final calculation.

4.2 Retention

The final calculation shall be indexed, Attachment D, and filed in the appropriate subject file. Calculations shall not be stored loosely but shall be filed in binders or contained in folders. Distribution shall not be made unless specific written instructions are issued to the contrary. Filing and distribution of final calculations shall be controlled by the Project Manager or his designated representative. Further controls resulting from contractual agreement or project specific needs may be stated in the PQAP.

5. REVISIONS

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

5.2 Superceded final calculations shall be so identified and transferred to a superceded calculation file. This action shall be noted by completing the "Superceded By" blanks on the Calculation Index for the superceded calculation. Superceded final calculations shall either be identified as such on each page or shall be securely bound with at least the cover page so identified.

5.3 Calculation packages may be revised by inserting replacement pages or additional pages with the revision number added to the Control I.D. number on these pages. Appropriate page numbers shall be supplied with subpage numbers used if necessary (e.g., 41A, 41B or 41.01, 41.02, etc.). The Page Revision Record, Attachment E, must be used to record all removed, replaced or revised pages and shall be attached to the Calculation Cover Sheet. Superceded pages shall be identified as such and transferred to a separate file.

6. QA AUDIT CHECKLIST

6.1 Audits of the implementation of this procedure shall be conducted by the PQAE using Audit Checklist ECP-5.2QA, Rev. 2, Attachment F.

TERA

SUBJECT ______________________

PROJECT NO. ______________________

CONTROL I.D. NO. ______________________

SHEET ______ OF ______ SHEETS

PREPARED BY ______________ DATE ______

CHECKED BY ______________ DATE ______

CONTROL STAMP

CONTROL ID NO

PREPARED BY/DATE

VERIFIED BY/DATE

PAGE _____ OF _____

CALCULATION COVER SHEET

SUBJECT ____________________

____________________ CONT. ID. NO. ____________

PROJECT ____________________ NO. OF SHTS. ____________

SUPERCEDES CALC. NO.

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

VERIFICATION

PURPOSE/INPUT REQUIREMENTS

SOURCES OF DATA, FORMULAE AND REFERENCES

(References may be listed on a separate sheet)

TERA CORPORATION

ATTACHMENT D

CALCULATION INDEX

CONT. ID. NO.	REV.	TITLE	DATE	SUPERCEDED BY	REV.	DATE

TERA CORPORATION

PAGE REVISION RECORD

CONT. I.D. NO. ______________ PREPARED BY _________________________ DATE ________

REV. _______ DATE ________ CHECKED BY __________________________ DATE ________

SUBJECT ____

PAGE	REV	PAGE	REV	PAGE	REV	PAGE	REV	PAGE	REV	PAGE	REV

ENGINEERING CONTROL PROCEDURE

ECP- 5.2 QA	SUBJECT: AUDIT CHECKLIST FOR CALCULATION PREPARATION AND CONTROL
REV.: 2 DATE: 1/7/83	
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 identified ________

2.3 Verification and approval signatures or initials? ________

2.4 Control and identification number per PQAP? ________

2.5 Extent of verification indicated? ________

2.6 Calculation indexed and filed in loose leaf binder or contained in folders? ________

2.7 Revisions processed in same manner as original? ________

2.8 Superseded calculations identified on index sheet properly identified and filed separately? ________

ENGINEERING CONTROL PROCEDURE

ECP- 5.2 QA	SUBJECT: AUDIT CHECKLIST FOR CALCULATION PREPARATION AND CONTROL
REV.: 2 DATE: 1/7/83	
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- 5.2 QA	SUBJECT: AUDIT CHECKLIST FOR CALCULATION PREPARATION AND CONTROL
REV.: 2 DATE: 1/7/83	
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:__________

TO BE INSERTED WITHIN APPENDIX C OF THE PQAP

DOUGLAS M. WITT
Senior Mechanical Engineer

Education

M.S.	Mechanical Engineering, Illinois Institute of Technology
B.S.	Mechanical Engineering, Illinois Institute of Technology

Summary of Experience

Mr. Witt has more than 15 years of experience in the nuclear engineering and consulting field. His project work in this area has included safety sequence analysis, licensing, system design, equipment design, pipe rupture analysis, and procurement. He has managed and participated in numerous projects for several corporate organizations with responsibility for technical services and financial management. In addition, he has provided special technical services for an advanced analysis group performing thermal hydraulic analysis for nuclear and fossil power plants, and has served as technical manager for a design organization of more than 100 engineers.

1983	Senior Mechanical Engineer, TERA Corporation.
1973-1982	Manager, Structural Design Division, EDS Nuclear. Responsible for structural design services for operating nuclear plant backfit and for design modification and analytical qualification associated with licensing upgrades.
	Manager, Advanced Analysis Section, EDS Nuclear. Managed analysis efforts to define thermal hydraulic forcing functions for plant structures and systems subjected to transients associated with both abnormal occurrences and anticipated operational conditions.
	Project Manager, EDS Nuclear. Provided technical direction on multi-discipline projects for construction-stage and operating nuclear plants. Projects included both PWRs and BWRs with integrated design and analysis activities including safety sequence analysis, licensing, system design, pipe rupture mitigation, piping system qualification and design.
1972 - 1973	Industrial Consultant, Argonne National Laboratory. Designed mechanical test facilities, and test programs for equipment and components utilized in the sodium fast breeder program.
1971 - 1972	Mechanical Engineer, Projects Group, Sargent and Lundy. Directed interfacing mechanical design efforts for safety-related systems within the NSSS vendor scope of supply.
1967 - 1971	United States Navy, Nuclear Power Program. Completed tour of duty as Director, Heat Transfer and Fluid Flow Division at the nuclear training command with responsibility for establishing qualifications and implementing a training and testing program to qualify personnel.

Registrations

Registered Professional Engineer - Mechanical Engineering, California and Illinois

Professional Affiliations

American Society of Mechanical Engineers

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RANDY S. CLELAND
Project Engineer

Education

M.A.	Business Administration, Sangamon State University
B.S.	Mechanical Engineering, Purdue University

Summary of Experience

Mr. Cleland has over ten years of experience in the design, construction, operation, and maintenance of power generation facilities with emphasis on mechanical engineering, construction management and results engineering.

1983 - Present Project Engineer - TERA Corporation. Responsible for providing construction management and plant operations support services.

1975 - 1983 Results Engineering Supervisor, Coffeen Power Station, Central Illinois Public Service Company. Responsible for coal fired power plant operating efficiency, instrument and control maintenance, and laboratory activities. Developed performance test procedures, periodic testing programs, equipment inspection procedures, and preventive maintenance programs. Recommended improvements in operating procedures and managed plant betterment projects.

Mechanical Engineer, Power Plant Construction. Responsible for review and monitoring of mechanical design portion of a major fossil fueled power plant and other operating station additions.

Area Construction Engineer, Power Plant Construction. Responsible for contractor management and monitoring of various construction activities for a major fossil fueled power plant.

1971 - 1975 Cooperative Engineer, Sargent and Lundy Engineers. Completed work-study program which included positions as draftsman, designer, assistant engineer, and mechanical engineer on nuclear and fossil power plant design projects.

Registration

Registered Professional Engineer - Illinois

Professional Affiliations

American Society of Mechanical Engineers
Tau Beta Pi, Engineering Honorary Society
Pi Tau Sigma, Mechanical Engineering Honorary Society

PATRICK LONGSTRETH
Senior Engineer - Project and Construction Management

Education

M.B.A.	Management, Golden Gate University, San Francisco
B.S.	Industrial Construction Management, Colorado State University

Summary of Experience

Mr. Longstreth has more than fourteen years experience in project and construction management. He has worked on a variety of projects including power plants, a fuel maintenance and examination facility, and a hazardous waste management facility. His experience has involved project management, administration, control and planning as well as contracting and claims. Mr. Longstreth also developed and implemented an Integrated Computerized Cost Reporting System for the Fast Flux Test Facility; the system included all Field Cost and Control Reports.

1981 - Present	Senior Engineer, TERA Corporation.
1967 - 1981	Assistant Estimator to Project Services Manager, Bechtel Group of Companies.
1980 - 1981	Project Engineer and Project Services Manager. Project Engineer for a Department of Energy Breeder Reactor Program at a fuel maintenance and examination facility. The project was a mechanical/electrical contract worth $40 million. As Project Services Manager was responsible for project services--accounting, administration, cost and schedule engineering, legal, and insurance--for IT Corporation's Louisiana Hazardous Waste Management Facility.
1977 - 1980	Manager of Planning and Scheduling, Hydro and Community Facilities Division. Was responsible for all aspects of planning and control on numerous hydroelectric, transportation, community, commercial, and infrastructure projects.
1974 - 1977	Manager of Planning and Scheduling, San Francisco Power Division. Responsible for planning functions on numerous power plant projects. Developed System Basis Scheduling Engineering/Procurement methods for the San Francisco Power Division.
1967 - 1974	Cost Engineer, Estimator. Worked on numerous power industry projects involving contracting, change orders, and claims.

Professional Associations

American Association of Cost Engineers
International Association of Professional Planners and Schedulers
Project Managers Institute

GEORGE JOSEPH TRIGILIO, JR.
Engineering Manager

Education

B.S. Chemical Engineering, Northeastern University, Boston, Massachusetts

Chemical Engineering Technology, Franklin Institute of Technology, Boston, Massachusetts

Summary of Experience

Mr. Trigilio has held numerous management and technical positions of increasing responsibilities. He is presently directs a multi-disciplined team of senior level professionals. Mr. Trigilio's technical expertise is in the design of waste treatment systems. He has worked extensively in the design and analysis of radioactive waste treatment systems for nuclear power plants and has been involved in the design, specification and purchase of waste treatment system components for numerous utility plants. In addition, he has supervised a research and development department and managed the technical and licensing requirements for a fleet of radioactive waste shipping casks used in the transportation of power plant wastes.

1979 - Present Engineering Manager - Waste Management Services Division, TERA Corporation. Responsibilities include all engineering aspects of the radwaste generation and disposal cycle with extensive involvement in the design and analysis of radwaste treatment systems, low-level waste storage facilities and the economic and engineering violability of volume reduction systems. During this time period a study was begun for the Nuclear Regulatory Commission which resulted in his authoring NUREG-2206 which represents a comprehensive completion and data base of volume reduction techniques for low-level radioactive waste.

1977 - 1979 Engineering Group Manager, Hittman Nuclear & Development Corporation, Columbia, Maryland. Responsibilities included department budgetary control, technical direction, and personnel supervision of: the Engineering Design; Research, Development and Testing; and the Planning/Scheduling and Document Control sections. Additionally, was Project Manager for a Shipping Cask project, with direct responsibility for all corporate radioactive waste shipping container design, safety analyses, and Nuclear Regulatory licensing certification.

1975 - 1977 Analysis Group Lead Engineer, Brown & Root, Incorporated, Houston, Texas. Responsible for supervising the development of a major program to simulate the operation of a Radioactive Waste Treatment system. Assisted in the preparation of an Environmental Report for licensing of a multiple-unit nuclear site, involving economic evaluation of power production alternatives and calculation of isotopic dispersion.

1972 - 1975	Engineer, Stone & Webster Engineering Corporation, Boston, Massachusetts. Responsible for determining the capital cost and operating economics of three processes for BTX extraction from reformatted and/or pyrolysis feed stocks. Assistant to the Head of Computational Methods Specialist. Prepared the specification for the purchase and assisted in the design of an Off-Gas treatment system. Co-authored a curve fitting program.

Professional Affiliations

American Institute of Chemical Engineers
American Nuclear Society
National Energy Coordinating Committee of the American Institute of Chemical Engineers (past member)
Board of Directors of Harris County Municipal Utility District #5 (past President)

STEPHEN F. SCHREURS
Project Manager, Waste Management Services Division

Education

B.S. University of Massachusetts, Chemical Engineering

Summary of Experience

Mr. Schreurs has nine years of nuclear experience in the area of radwaste processing, design, analysis and disposal. This experience has included both engineering analysis and group managerial responsibilities for private and governmental organizations. He has developed computerized analytical models of ECCS, CSS, and boron recovery systems. Mr. Schreurs has been involved in all facets of the nuclear waste problem, especially the immobilization and disposal of high-level and transuranic wastes and the solidification, packaging and disposal of low-level radioactive wastes.

1980	Project Manager, Waste Management Services Division, TERA Corporation. Primary responsibilities include radwaste system evaluation and analysis.
1977 - 1980	Project Manager, Performance Analysis Section, High-Level Waste Licensing Branch, Division of Waste Management, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission. Responsibilities included developing a capability to analyze the performance of a deep geologic nuclear waste repository. Mr. Schreurs assisted in the development of the proposed 10 CFR 60 regulation, along with the accompanying regulatory documents (i.e. regulatory guides and staff technical positions), and interfaced with other government agencies on matters concerning the performance assessment of repositories. He also monitored the technical aspects of contracts related to deep geologic repositories which were sponsored by other NRC offices.
1976 - 1977	Computational Methods Specialist and Sampling Systems Specialist, Process Engineering Specialty Group, Nuclear Industries Division, Stone and Webster Engineering Corporation. Major activities consisted of reviewing and updating specifications for buying sampling systems; laboratory testing of simulated nuclear plant radioactive wastes; preparation of sections pertaining to the processing systems for a PSAR of an Italian nuclear power plant; and modeling the CSS for redesign using eductors for pH control instead of injection pumps.
1972 - 1976	Computational Methods Specialist, Process Engineering Specialty Group, Nuclear Industries Division, Stone and Webster Engineering Corporation. Supervised the Computer Section of the Process Engineering Group. Responsible for modeling the complete radioactive waste system for BWRs (i.e. reactor core to drums); modeling and refining the existing computer program for the boron recovery systems in PWRs, and modeling other chemical process systems for nuclear power plants (e.g. waste evaporators and demineralizers). Further responsibilities included recruitment, managing the engineer-in-training program for the group, and teaching refresher courses in math for the Professional Engineers Exam.

Licenses

E.I.T. portion of professional engineer

Societies

American Institute of Chemical Engineers - Full Member

Publications

Schreurs, S.; "Overview of the High-Level and Transuranic Waste Branch Modeling Effort," U.S. Nuclear Regulatory Commission, 1978

Contributing author to "Technical Writing Style Guide," NUREG-0650, U.S. Nuclear Regulatory Commission, November 1979.

FARZIN RAMEZANBEIGI
Civil/Structural Engineer

Education

B.S.	Structural Engineering, San Francisco State University

Summary of Experience

1982 - Present	Civil Engineer, TERA Corporation. Responsibilities include usage and interpretation of structural computer codes such as SAP IV, SAP V, and ADLPIPE.
1982	Teaching Assistant, San Francisco State University. Responsible for assisting advisor in use of computerized systems for engineering applications.
1981 - 1982	Assistant, Billman Construction Corporation. Assisted owner of this small business in determining technical engineering requirements for residential buildings. Also performed a wide range of general construction duties.

2/83 (1)

CHRISTIAN C. NELSON
SENIOR REACTOR OPERATIONS ENGINEER

EDUCATION

B.S. Naval Engineering, U.S. Naval Academy

SUMMARY OF EXPERIENCE

Mr. Nelson has over twelve years of experience in the nuclear energy field. At the NRC he was responsible for maintaining an effective program for the inspection of operating nuclear power plants. He has managed numerous safety and environmental evaluations associated with operating nuclear power plants. He directed a multidisciplinary engineering team in reviewing implementation of TMI Lessons Learned at operating reactors. He has also been lead engineer in resolving several generic safety issues.

1983 - Present Senior Reactor Operations Engineer - TERA Corporation.

1975 - 1983 Operating Reactors Project Manager, Office of Nuclear Reactor Regulation, NRC. Responsible for directing and performing evaluations of licensing issues for numerous operating power plants. In particular coordinated safety evaluations for power upgrades, seismic design reviews and increases in spent fuel storage capacity. Responsible for resolution of various technical issues including PWR moderator dilution, station blackout procedures and natural circulation cooldown.

Senior Reactor Operations Engineer, Office of Inspection and Enforcement, NRC. Responsible for managing the operating reactor inspection program to assure proper emphasis on the priority among inspections, balance inspection requirements with manpower resources and integrate the inspection program with other NRC activities.

Team Leader, Lessons Learned Implementation Review, NRC. Directed review of TMI Category A Lessons Learned implementation at all Combustion Engineering and early Westinghouse designed power reactors.

1970 - 1975 Officer, U.S. Navy. Served as engineering officer during four deterrent patrols and shipyard overhaul aboard a nuclear powered submarine. Qualified in submarines.

AWARDS

NRC Special Achievement Award for managing evaluation of GETR seismic issues and representing NRC evaluation at public hearing.

LOUIS L. FUSCO, JR.
Senior Associate Engineer

Education

B.S. Ocean Engineering, U.S. Naval Academy

Summary of Experience

Mr. Fusco has had over eight years of nuclear engineering experience, with emphasis on equipment qualification, systems engineering, licensing and project management.

Present	Senior Associate Engineer, TERA Corporation.
1981 - Present	Senior Engineer, Western OMTEC Corporation. Responsible for the preparation of field change instructions to operations and instruction sites.
1981	Staff Engineer, NUS Corporation. Assigned as on-site technical consultant to the Sacramento Municipal Utility District, in responding to the environmental qualification of Class 1E electrical equipment at Rancho Seco Nuclear Power Plant. Responsible for equipment inspection, record and test reviews, and vendor/client interface. Also responsible for nulcear engineering studies and evaluations in areas such as nuclear process system design and operation, seismic qualification, radioactive waste, shielding and licensing.
1980 - 1981	Senior Engineer, EDS Nuclear, Inc. Nuclear systems engineering and licensing lead responsible for the direction and supervision of up to eight engineers on three major projects. Review and preparation of FSAR chapters on electrical and control systems. Responsible for nuclear system piping rupture postulation with interaction analysis and protection of unacceptable scenarios. Responsible for NUREG-0660 reviews for nuclear utility clients.
1975 - 1980	Lieutenant, U.S. Navy. Qualified as engineer officer, officer of the deck and engineering officer of the watch on a nuclear-powered fast attack submarine. Major division officer assignments included: Main Propulsion Assistant, Damage Control Assistant, Reactor Controls Officer, Chemistry and Radiological Controls Officer, and Sonar Officer.

STANLEY W. KAUT
Associate Electrical Engineer

Education

B.S. Electrical Engineering, Rochester Institute of Technology

Summary of Experience

Mr. Kaut has had 20 years of diversified engineering experience with emphasis in design review, construction, testing, operation, licensing and quality assurance of electrical power, instrumentation and control systems and equipment. He has made continuous contributions to the nuclear power industry since his involvement with the BWR turnkey program. His experience with electrical power includes the installation, testing, and servicing of substations, motor control centers, switchgear, power trnasformers, motors, generators, D.C. battery systems, bus duct, cabling and related metering, and relaying. His experience with instrumentation and control includes the installation, testing, design, calibration, and maintenance of process systems and equipment that measure such variables as level, flow, pressure, temperature, and vibration; and of nuclear systems such as neutron monitoring, area and process radiation monitoring, and rod control. Mr. Kaut has also had significant experience with design review, plant procedures and Quality Assurance (QA). He has directed a technical group responsible for providing design review services to nuclear utilities. The services have been directed toward providing an independent assessment of plant safety, operability, maintainability, inspectability, and availability features. Mr. Kaut has developed procedure programs for several BWR and PWR power plants providing for the administrative control of plant personnel during startup testing, operation, maintenance or on-line surveillance testing. Mr. Kaut's involvement with quality (QA/QC) includes first-hand experience performing QC activities in manufacturing shops, electrical equipment installation sites and at nuclear power plant construction sites. He has been involved in the development and review of quality programs and procedures (including training) for AE's utilities, and manufacturing organizations. He has participated in many audits and is certified as a lead auditor.

Present	Associate Electrical Engineer, TERA Corporation.
1975 - Present	Manager, Systems Engineering, NUTECH.
1970 - 1975	Manager of Projects, Nuclear Services Corporation.
1963 - 1970	Field Engineer, General Electric Company.

Registration

Electrical Engineer, State of California
Nuclear Engineer, State of California
Control System Engineer, State of California

JAMES I. OWENS
Principal Associate Engineer

Education

B.S.E.E Iowa State University
Advanced Engineering Program, General Electric Company

Summary of Experience

Mr. Owens has had over 30 years of experience in the design and construction of power plants - fossil and nuclear. He was General Manager Production Engineering and Construction for a major utility with responsibility for generation planning, as well as design and construction of all production facilities. In this capacity he functioned as a member of the utility executive staff and worked with AEs, suppliers, NRC, other regulatory bodies and interfaced with the public. He has had major responsibility for cost and schedule performance.

1982 - Present	Principal Associate Engineer, TERA Corporation.
1979 - 1982	General Manager, Production Engineering and Construction, Delmarva Power & Light Company. Responsible for the design and construction of a 500MWe coal fired power plant and the conversion of a two unit oil fired plant to coal, as well as additions and improvements to the existing system.
1978 - 1979	Manager, Production Engineering & Construction, Delmarva Power & Light Company. Responsible for plannning new facilities and all preliminary engineering and licensing work on a 500MWe coal fired power plant.
1976 - 1978	Manager, Power Plant Design, Delmarva Power & Light Company. Responsible for the specification, bidding, and evaluation of twin unit Nuclear Steam Supply Systems and preliminary design of BOP.
1973 - 1976	Project Manager, Summit Nuclear Power Plant, Delmarva Power & Light Company. Staffed the Project Organization, negotiated contracts for the NSSS, Turbine Generator, and most major auxiliaries. Directed Preliminary Design and Licensing through the Construction Permit for twin HTGRs. Responsible for nuclear engineering for the station.
1950 - 1972	General Electric Company, Gibbs and Hill and General Atomic Company. Engineering and managerial assignments included development of control systems for Peach Bottom & Dresden Nuclear Power Plants and the Sea Wolf nuclear submarine, and preparation of PSARs for sixteen research and test reactors.

Professional Affiliations

Registered Professional Engineer, New York
Member, American Nuclear Society
Member, IEEE
Member, EPRI Nuclear Divisional Committee

EDWARD M. BECK
Principal Associate Engineer, Nondestructive Testing

Education

B.C.E. Auburn University

Summary of Experience

Mr. Beck has over 15 years experience in the area of nondestructive testing. He has been responsible for the direction and management of several major projects. He has distinguished himself by serving as Section Chairman and Director of the AWS and ASNT.

Present	Principal Associate Engineer, Nondestructive Testing
1978 - Present	Assistant Vice President, Corporate Consultant/Metals, Radiation Safety Officer for Carolinas. Responsible for the development of new techniques and services. Responsible to the Director of Engineering for the approval of all NDE procedures established in the Engineering Procedures Manual. Responsible to the Director of Engineering for approval of all NDE Level III candidates.
1976 - 1978	Manager of NDE Services - Charlotte Branch, Law Engineering Testing Company. Managed nondestructive testing services for the District. Responsible for Virginia and Carolinas.
1972 - 1975	Project Manager, Law Engineering Testing Company. Administered and controlled radiographic, magnetic particle, and dye penetrant investigations for the Brunswick Steam and Electric Plant. Responsible for the supervision of up to 25 engineering technicians.
1968 - 1972	Manager of the Nondestructive Testing Department, Georgia Division, Law Engineering Testing Company. Administered and controlled all work which included radiography, ultrasonic, and magnetic particle investigation, dye penetrant tests and in general, all metal inspection in building and construction.
1964 - 1967	Assistant to Chief of Operations, United States Public Service Commission.

Certifications/Registrations

Professional Engineer, North Carolina and New York
Level III ASNT certification in ultrasonic, radiographic, liquid penetrant and magnetic particle testing.

Professional Associations

American Welding Society - past Section Chairman and Director
American Society for Nondestructive Testing - past Section Director
American Society of Mechanical Engineers
American Institute of Steel Construction
American Society for Metals
Numerous technical committees and task forces

ROBERT A. RENEAU
Associate Engineer, Nondestructive Testing

Education

B.C.E. Georgia Tech

Summary of Experience

Mr. Reneau has ten years experience in the areas of nondestructive examination and material testing. He has been responsible for the direction and supervision of engineers and technicians performing radiographic, magnetic particle, liquid penetrant, and ultrasonic evaluations on several major industry and nuclear projects.

Present	Associate Engineer, Nondestructive Testing, TERA Corporation.
1980 - Present	Engineer, Law Engineering Testing Company. Technical responsibility for metals services of Charlotte, North Carolina branch.
1975 - 1980	Service Engineer, Westinghouse Electric Corporation. Provided technical assistance during disassembly, reassembly, and operation of power generation equipment including steam turbines and generators for utility and industrial customers in U.S. and abroad. In addition to technical responsibilities, duties included supervision, scheduling and cost accounting.
1974 - 1975	Project Manager, Law Engineering Testing Company. Responsible for supervision of engineering technicians performing radiographic, magnetic particle, and dye penetrant evaluations during construction of Brunswick Steam Electric Plant.
1973 - 1974	Branch Engineer. Law Engineering Testing Company. Technical responsibilities for soil and foundation engineering activities including the test pile programs and foundation investigations for the LMFBR.

Certifications/Registrations

Professional Engineer, North Carolina
Level II ASNT certification in radiographic, magnetic particle, liquid penetrant and ultrasonic testing.

Professional Assoications

American Welding Society
American Society for Metals
The American Institute of Plant Engineers

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

February 22, 1983

Docket Nos: 50-329 OM, OL
and 50-330 OM, OL

APPLICANT: Consumers Power Company

FACILITY: Midland Plant, Units 1 and 2

SUBJECT: REVISION 1 OF TERA CORPORATION'S PROJECT QUALITY ASSURANCE AND ENGINEERING PROGRAM PLANS FOR THE MIDLAND INDEPENDENT DESIGN AND CONSTRUCTION VERIFICATION PROGRAM

A letter of February 9, 1983, from the Tera Corporation transmits to the NRC copies of their Project Quality Assurance Plan, Revision 1, and Engineering Program Plan, Revision 1, for the Independent Design and Construction Verification Program to be performed on Midland Plant, Units 1 and 2. Revision 0 correction pages are also transmitted.

Copies of the February 9, 1983, letter and transmitted documents are enclosed for docketing and future reference purposes.

E. G. Adensam

for Darl S. Hood, Project Manager
Licensing Branch No. 4
Division of Licensing

Enclosures:
As stated

cc: See next page

8303040015

MIDLAND

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Vice President
Consumers Power Company
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Jackson, Michigan 49201

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Jackson, Michigan 49201

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Midland, Michigan 48640

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Assistant Attorney General
State of Michigan Environmental
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720 Law Building
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Route 10
Midland, Michigan 48640

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7910 Woodmont Avenue
Bethesda, Maryland 20814

Mr. R. B. Borsum w/o encl.
Nuclear Power Generation Division
Babcock & Wilcox
7910 Woodmont Avenue, Suite 220
Bethesda, Maryland 20814

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Chicago, Illinois 60602

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St Paul, Minnesota 55108

U.S. Nuclear Regulatory Commission w/o encl.
Resident Inspectors Office
Route 7
Midland, Michigan 48640

Ms. Barbara Stamiris, w/encl.
5795 N. River
Freeland, Michigan 48623

Mr. Paul A. Perry, Secretary w/o encl.
Consumers Power Company
212 W. Michigan Avenue
Jackson, Michigan 49201

Mr. Walt Apley w/o encl
c/o Mr. Max Clausen
Battelle Pacific North West Labs (PNWL)
Battelle Blvd.
SIGMA IV Building
Richland, Washington 99352

Mr. I. Charak, Manager w/o encl.
NRC Assistance Project
Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439

James G. Keppler, Regional Administrator
U.S. Nuclear Regulatory Commission,
Region III
799 Roosevelt Road
Glen Ellyn, Illinois 60137 w/o encl.

cc: Lee L. Bishop w/encl.
Harmon & Weiss
1725 I Street, N.W., Suite 506
Washington, D. C. 20006

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Michigan Public Service Commission
6545 Mercantile Way
P.O. Box 30221
Lansing, Michigan 48909

Mr. Paul Rau w/o encl.
Midland Daily News
124 McDonald Street
Midland, Michigan 48640

B'llie Pirner Garde w/encl.
Director, Citizens Clinic
for Accountable Government
Government Accountability Porject
Institute for Policy Studies
1901 Que Street, N.W.
Washington, D. C. 20009

Supplemental page to the Midland OM, OL Service List

cc: Commander, Naval Surface Weapons Center w/o encl.
ATTN: P. C. Huang
White Oak
Silver Spring, Maryland 20910

Mr. L. J. Auge, Manager w/o encl.
Facility Design Engineering
Energy Technology Engineering Center
P.O. Box 1449
Canoga Park, California 91304

Mr. Neil Gehring w/o encl.
U.S. Corps of Engineers
NCEED - T
7th Floor
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TERA

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February 9, 1983

Mr. J. G. Keppler, Administrator
Region III, Office of Inspection
and Enforcement
U.S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, IL 60137

Mr. D. G. Eisenhut, Director
Division of Licensing
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Midland Independent Design Verification Program

We are pleased to transmit for your review controlled copies of the Project Quality Assurance Plan (PQAP), Revision 1 and Engineering Program Plan (EPP), Revision 1, for the subject program. Mr. Keppler has been assigned copy 017 and Mr. Eisenhut copy 018.

Revision 0 corrected pages for each of these documents is enclosed for your information.

Sincerely,

Howard A. Levin

Howard A. Levin
Project Manager

Enclosure

cc: w/o enclosure
G. Keeley, CPC

HAL/sl

8303040024

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ENGINEERING PROGRAM PLAN
PROJECT INSTRUCTION PI-3201-009
MIDLAND INDEPENDENT
DESIGN AND CONSTRUCTION
VERIFICATION PROGRAM
PROJECT 3201

NOVEMBER 29, 1982
REVISION: 0

018
COPY NO.

8303040032

PROJECT INSTRUCTION

PI- 3201 - 009	SUBJECT: Engineering Program Plan Midland Independent Design and Construction Verification Program
REV.: 0 DATE: 11/29/82	
PAGE 1 of 80	PREPARED BY: APPROVED BY:

1.0 GENERAL

1.1 BACKGROUND AND PURPOSE

The Nuclear Regulatory Commission (NRC) issued a letter on July 9, 1982 which requested that Consumers Power Company (CPC) provide for an independent assessment of the design adequacy of the Midland plant. CPC responded to this request on October 5, 1982 by submitting an outline of the scope of a proposed independent review program. A public meeting was held on October 25, 1982 at the NRC's Bethesda, Maryland offices to discuss details of the proposed program. During this meeting, the NRC requested that the scope of the independent design assessment program be expanded, including an assessment of the quality of construction.

TERA Corporation has been selected by CPC and approved by the NRC to scope, manage, and implement the Midland Independent Design and Construction Verification (IDCV) Program. The selection of TERA is based upon the firm's technical qualifications, experience, and independence from the Midland project including all individuals who may contribute to the IDCV Program.

This project instruction, or Engineering Program Plan (the Plan), has been established to outline the scope, philosophy of review, methodology, independence requirements, organization, control, documentation, reporting, and quality assurance requirements for the Midland IDCV Program.

The IDCV approach selected is a review and evaluation of a detailed "vertical slice" of the Midland project with a focus on providing an overall assessment of the quality of the design and the constructed plant. Therefore, the primary emphasis of the IDCV evaluation is on the end results of the design and in Sections 1.3 and 3.1.2 of this Plan were incorporated to develop the initial matrix. The design areas of the IDV review matrix for the AFW system are divided into three major divisions: AFW system performance requirements, AFW system protection features, and structures that house the AFW system. The design areas addressed within each of these major divisions are discussed in Sections 3.1.3.1, 3.1.3.2, and 3.1.3.3 of this Plan, respectively. As previously mentioned, the identified review scope is subject to change depending upon the IDV program findings.

Because the AFW system sample selection interfaces with other systems, it is necessary to define the boundaries for items within the scope of the IDV. In general for the AFW system, the selection was made to include all components identified as being part of the AFW system on Bechtel P&ID drawing M439 sheets 3A and 3B, revision 9. Specific interface points are as follows:

PROJECT INSTRUCTION

PI- 3201 - 009

REV.: 0 DATE: 11/29/82

PAGE 25 of 80

SUBJECT: Engineering Program Plan Midland Independent Design and Construction Verification Program

PREPARED BY:

APPROVED BY:

AFW SYSTEM SAMPLE SELECTION BOUNDARIES

Interfacing System	Interface Point (component included in AFW)
Main Steam	Valves 074 and 077[1]
NSSS	Steam Generator Nozzles
Service Water A	Valve 283
Service Water B	Valve 282
Unit 2 Condensate Tank (from)	Valve 008
Condenser Hotwells	Valve 006
Unit 1 Condensate Tank (return)	Valve 019
Cooling Pond (return)	Valve 017
ac/dc Power System[2]	Breaker or fuse interfacing AFW components with power source
ESFAS	AFW actuation system and FOGG
Main FW Loop A	Valve 303
Vents and Drains	First Valve
HVAC	

NOTES:

1. P&ID M-432, Sheet 1A, Revision
2. Power supplies dedicated to AFW system are within sample selection boundaries.

ENGINEERING PROGRAM PLAN
PROJECT INSTRUCTION PI-3201-009
MIDLAND INDEPENDENT DESIGN AND CONSTRUCTION VERIFICATION PROGRAM
PROJECT 3201

FEBRUARY 9, 1983
REVISION: 1

018
COPY NO.

TERA CORPORATION
QUALITY ASSURANCE PROGRAM

Midland Independent Design and
Construction Verification
Program

Engineering Program Plan
3201-009

DOCUMENT REVISION RECORD

REV	DATE	DESCRIPTION OF CHANGES
1	2/9/83	Pg. 1 - Update status of NRC approval of TERA Corporation: deleted "and approved by the NRC", replaced with, "subject to NRC approval".
		Pg. 24- Update reference to P&ID M439: added, "revision 9" after 3A and changed rev. 9 to rev. 10 after 3B
		Pg. 25- Add System Selection Boundary for HVAC: add, "AFW pump room fan coolers and associated ductwork and supports"

TERA CORPORATION

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PROJECT INSTRUCTION

PI- 3201 - 009	SUBJECT: Engineering Program Plan Midland Independent Design and Construction Verification Program	
REV.: 1 DATE: 2/9/83		
PAGE 1 of 80	PREPARED BY:	APPROVED BY:

1.0 GENERAL

1.1 BACKGROUND AND PURPOSE

The Nuclear Regulatory Commission (NRC) issued a letter on July 9, 1982 which requested that Consumers Power Company (CPC) provide for an independent assessment of the design adequacy of the Midland plant. CPC responded to this request on October 5, 1982 by submitting an outline of the scope of a proposed independent review program. A public meeting was held on October 25, 1982 at the NRC's Bethesda, Maryland offices to discuss details of the proposed program. During this meeting, the NRC requested that the scope of the independent design assessment program be expanded, including an assessment of the quality of construction.

TERA Corporation has been selected by CPC, subject to NRC approval, to scope, manage, and implement the Midland Independent Design and Construction Verification (IDCV) Program. The selection of TERA is based upon the firm's technical qualifications, experience, and independence from the Midland project including all individuals who may contribute to the IDCV Program. 1

This project instruction, or Engineering Program Plan (the Plan), has been established to outline the scope, philosophy of review, methodology, independence requirements, organization, control, documentation, reporting, and quality assurance requirements for the Midland IDCV Program.

The IDCV approach selected is a review and evaluation of a detailed "vertical slice" of the Midland project with a focus on providing an overall assessment of the quality of the design and the constructed plant. Therefore, the primary emphasis of the IDCV evaluation is on the end results of the design and construction process and not on an evaluation of the process itself which is typical of the more common quality assurance audit. The "vertical slice" constitutes a carefully selected sample of two safety systems from which the results of the IDCV may be extrapolated to other similarly designed and constructed systems. Thus, the IDCV is intended to provide the necessary assurance to CPC, NRC, and the public that the Midland Plant is designed and constructed such that it is capable to function in accordance with its safety design bases and that applicable licensing commitments have been properly implemented.

1.2 OVERVIEW OF IDCV SCOPE

The Midland IDCV consists of two major components: the Independent Design Verification (IDV) Program and the Independent Construction Verification (ICV) Program. The Unit 2 auxiliary feedwater (AFW) system and the (second system - to be supplied) have been selected as applicable samples of the design engineering and construction efforts at the Midland plant. These systems were selected based upon the system selection criteria discussed in Section 1.3 of this Plan.

The scope of review corresponds directly to the design and construction chains, addressing major activities and outputs of the various contributing engineering and construction disciplines. Accordingly, the design and construction process, from concept to installation, hydros, functional and preoperational testing will be evaluated. Interfaces between CPC, Babcock and Wilcox (B&W), the nuclear steam system supplier (NSSS) vendor, Bechtel, the architect-engineer (A-E), and other contractors will be identified and evaluated relative to such items as the proper transfer and interpretation of design or construction information.

INTER-RELATIONSHIP BETWEEN THE MIDLAND DESIGN AND CONSTRUCTION PROCESS AND THE MIDLAND IDCV PROGRAM

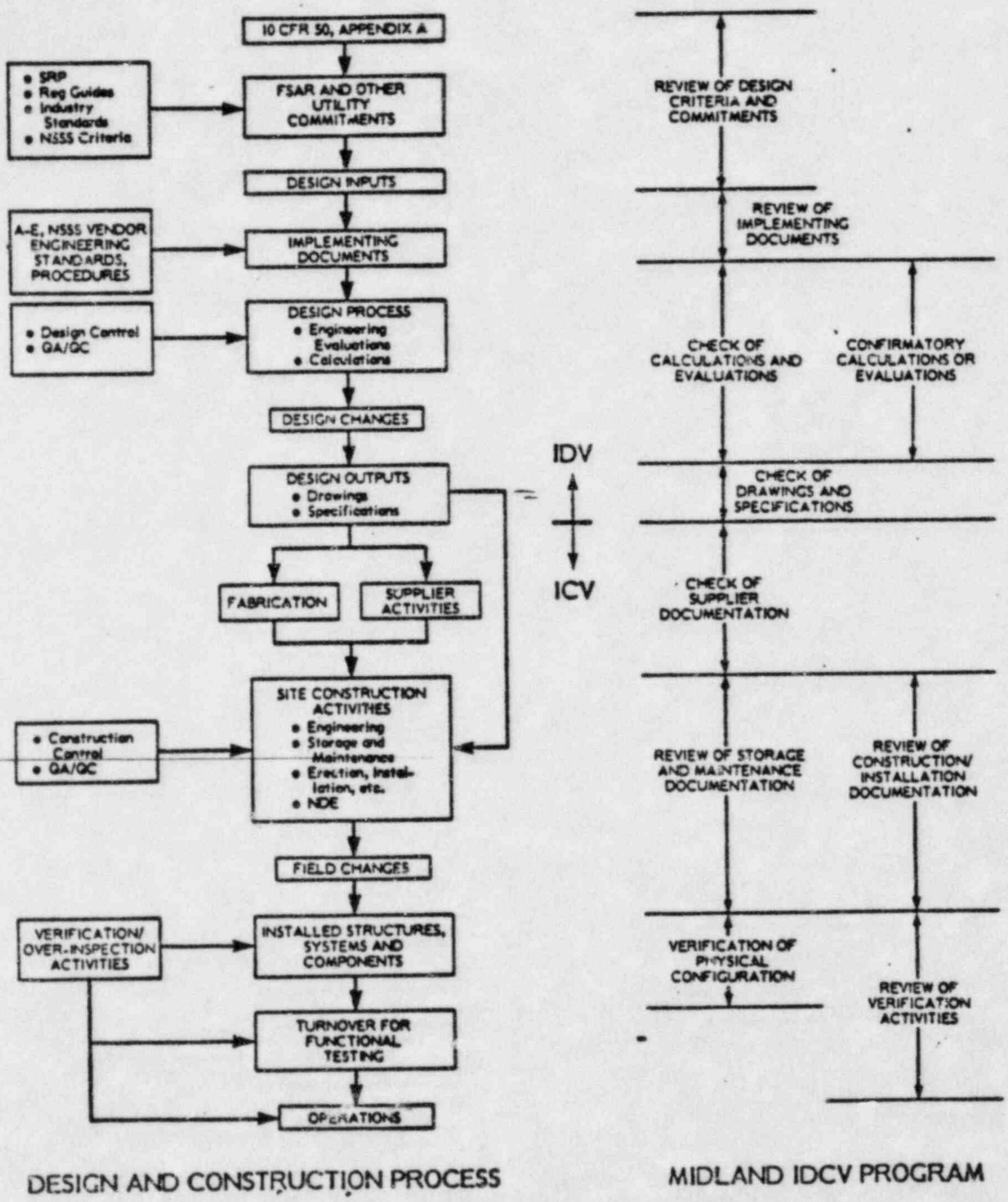

FIGURE 1.2-1

INITIAL SAMPLE REVIEW MATRIX FOR THE AUXILIARY FEEDWATER SYSTEM
MIDLAND INDEPENDENT DESIGN VERIFICATION PROGRAM

DESIGN AREA	SCOPE OF REVIEW				
	REVIEW OF DESIGN CRITERIA AND COMMITMENTS	REVIEW OF IMPLEMENTING DOCUMENTS	CHECK OF CALCULATIONS AND EVALUATIONS	CONFIRMATORY CALCULATION OR EVALUATION	CHECK OF DRAWINGS AND SPECIFICATIONS
I. <u>AFW SYSTEM PERFORMANCE REQUIREMENTS</u>					
SYSTEM OPERATING LIMITS	X	X	X		
ACCIDENT ANALYSIS CONSIDERATIONS	X				
SINGLE FAILURE	X	X	X		
TECHNICAL SPECIFICATIONS	X	X			
SYSTEM ALIGNMENT/SWITCHOVER	X	X			
REMOTE OPERATION AND SHUTDOWN	X				
SYSTEM ISOLATION/INTERLOCKS	X	X			
OVERPRESSURE PROTECTION	X				
COMPONENT FUNCTIONAL REQUIREMENTS	X	X	X		X
SYSTEM HYDRAULIC DESIGN	X	X	X		
SYSTEM HEAT REMOVAL CAPABILITY	X	X	X		
COOLING REQUIREMENTS	X				
WATER SUPPLIES	X	X			
PRESERVICE TESTING/CAPABILITY FOR OPERATIONAL TESTING	X				
POWER SUPPLIES	X	X			
ELECTRICAL CHARACTERISTICS	X				
PROTECTIVE DEVICES/SETTINGS	X	X			X
INSTRUMENTATION	X	X	X		X
CONTROL SYSTEMS	X	X	X		
ACTUATION SYSTEMS	X				
NDE COMMITMENTS	X				
MATERIALS SELECTION	X	X			

FIGURE I.2-2a

INITIAL SAMPLE REVIEW MATRIX FOR THE AUXILIARY FEEDWATER SYSTEM MIDLAND INDEPENDENT DESIGN VERIFICATION PROGRAM (CONTINUED)

DESIGN AREA	SCOPE OF REVIEW				
	REVIEW OF DESIGN CRITERIA AND COMMITMENTS	REVIEW OF IMPLEMENTING DOCUMENTS	CHECK OF CALCULATIONS AND EVALUATIONS	CONFIRMATORY CALCULATION OR EVALUATION	CHECK OF DRAWINGS AND SPECIFICATIONS
II. <u>AFW SYSTEM PROTECTION FEATURES</u>					
SEISMIC DESIGN	X				
• PRESSURE BOUNDARY	X	X	X	X	X
• PIPE/EQUIPMENT SUPPORT	X	X	X	X	X
• EQUIPMENT QUALIFICATION	X	X	X		X
HIGH ENERGY LINE BREAK ACCIDENTS	X				
• PIPE WHIP	X	X	X		X
• JET IMPINGEMENT	X				
ENVIRONMENTAL PROTECTION	X				
• ENVIRONMENTAL ENVELOPES	X	X	X	X	X
• EQUIPMENT QUALIFICATION	X	X	X		X
• HVAC DESIGN	X				
FIRE PROTECTION	X	X	X		
MISSILE PROTECTION	X				
SYSTEMS INTERACTION	X	X	X		
III. <u>STRUCTURES THAT HOUSE THE AFW SYSTEM</u>					
SEISMIC DESIGN/INPUT TO EQUIPMENT	X	X	X		X
WIND & TORNADO DESIGN/MISSILE PROTECTION	X				
FLOOD PROTECTION	X				
HELBA LOADS	X				
CIVIL/STRUCTURAL DESIGN CONSIDERATIONS	X				
• FOUNDATIONS	X	X	X		
• CONCRETE/STEEL DESIGN	X	X	X		X
• TANKS	X	X	X		

FIGURE 1.2-2b

INITIAL SAMPLE REVIEW MATRIX FOR THE AUXILIARY FEEDWATER SYSTEM
MIDLAND INDEPENDENT DESIGN VERIFICATION PROGRAM

SYSTEM/COMPONENT	SCOPE OF REVIEW				
	REVIEW OF SUPPLIER DOCUMENTATION	REVIEW OF STORAGE AND MAINTENANCE DOCUMENTATION	REVIEW OF CONSTRUCTION/ INSTALLATION DOCUMENTATION	REVIEW OF SELECTED VERIFICATION ACTIVITIES	VERIFICATION OF PHYSICAL CONFIGURATION
I. MECHANICAL					
• EQUIPMENT	X	X	X	X	X
• PIPING	X		X	X	X
• PIPE SUPPORTS	X		X	X	X
II. ELECTRICAL					
• EQUIPMENT	X	X	X	X	X
• TRAYS AND SUPPORTS	X				X
• CONDUIT AND SUPPORTS	X				X
• CABLE	X	X	X	X	X
III. INSTRUMENTATION AND CONTROL					
• INSTRUMENTS	X	X	X	X	X
• PIPING/TUBING	X				X
• CABLE	X				X
IV. HVAC					
• EQUIPMENT	X	X	X	X	X
• DUCTS AND SUPPORTS	X				X
V. STRUCTURAL					
• FOUNDATIONS	X		X		
• CONCRETE	X		X		X
• STRUCTURAL STEEL	X		X		X

FIGURE 1.2-3

Figure 1.2-1 shows the inter-relationship between the Midland design and construction process and the Midland IDCV program. Figures 1.2-2a, 1.2-2b and 1.2-3 present the IDCV scope in the form of matrices which identify the initial level of review and evaluation in each design or construction area respectively. It should be noted that the scope of review is dynamic and subject to change as more emphasis will be given to any items which are suspect to the review team or to identify the extent and root cause of identified findings. Accordingly, these matrices represent the initial IDCV "sample".

1.3 SYSTEMS SELECTION CRITERIA

The selection of the auxiliary feedwater system and the (second system - to be supplied) was based upon the following six criteria:

- Importance to Safety - The system should have a relatively high level of importance to the overall safety of the Midland Plant.
- Inclusion of Design and Construction Interfaces - The system should be one which involves multiple interfaces among engineering and construction disciplines as well as design and construction organizations, such as the NSSS vendor, architect engineer, constructor, and subtier contractors. The system should also be one where design or construction changes have occurred and thus provide the ability to test the effectiveness of the design and construction process exercised by principal internal and external organizations or disciplines in areas of design or construction change.
- Ability to Extrapolate Results - The system should be sufficiently representative of other safety systems such that the design criteria, design and construction control and change processes are similar so that extrapolation of findings to other systems can be undertaken with confidence.

- Diverse in Content - The major engineering and construction disciplines should all have input to the design of the system.

- Sensitive to Previous Experience - The system should be one which includes design or construction disciplines or interfaces which have previously exhibited problems and thus a test of the system should be indicative of any generic condition.

- Ability to Test As-Built Installation - The system configuration should be sufficiently completed that the as-built configuration can be verified against design.

Each system was selected after consideration of a number of other candidate systems. The Midland Plant probabilistic risk assessment (PRA) was utilized as a tool to assess the importance to safety on the basis of the contribution to overall plant risk. The profile for this criterion as well as each of the other five criteria was sufficiently high for the auxiliary feedwater system and the (second system - to be supplied) to justify their selection.

1.4 INDEPENDENCE REQUIREMENTS

The Midland IDCV program will be conducted in accordance with the "independence" criteria documented in a letter from Nunzio J. Palladino, Chairman, NRC, to the Honorable John D. Dingell, Chairman, Committee on Energy and Commerce, United States House of Representatives, dated February 1, 1982. The following criteria are excerpted from Enclosure 3 of this letter:

"The competence of the individuals or companies is the most important factor in the selection of an auditor. Also, the companies or individuals may not have had any direct previous involvement with the activities at Diablo Canyon (Midland) that they will be reviewing.

In addition, the following factors will be considered in evaluating the question of independence:

1) Whether the individuals or companies involved had been previously hired by PG&E (CPC) to do similar seismic (delete seismic) design work.

2) Whether any individual involved had been previously employed by PG&E (CPC) (and the nature of the employment).

3) Whether the individual owns or controls significant amounts of PG&E (CPC) stock.

4) Whether members of the present household of individuals involved are employed by PG&E (CPC).

5) Whether any relatives are employed by PG&E (CPC) in a management capacity.

In addition to the above considerations, the following procedural guidelines will be used to assure independence:

1) An auditable record will be provided of all comments on draft or final reports, any changes made as a result of such comments, and the reasons for such changes; <u>or</u> the consultant will issue only a final report (without prior licensee comment).

2) NRC will assume and exercise the responsibility for serving the report on all parties."

The individuals taking part in the Midland IDCV program meet the preceeding criteria and have signed a statement attesting to this fact.

TERA Corporation is under contract to CPC to provide the engineering services necessary to complete the Midland IDCV program. Prior to this contract, TERA has never been under contract to CPC.

The contract requires TERA to maintain an auditable record to document the process leading to findings as well as meetings to discuss findings. Section 4.0 of this Plan addresses documentation requirements which have been developed to meet obligations of the contract.

Section 5.0 of this Plan addresses the report generation process, during the IDCV program to report findings and at its conclusion as a final report. TERA will maintain an auditable record of all comments on the draft final report.

2.0 ORGANIZATION AND CONTROL

2.1 PROJECT ORGANIZATION

The project organization is addressed in Section 2.1 of the Project Quality Assurance Plan (PQAP), Midland Independent Design and Construction Verification Program, Project 3201. Figure 2.1-1 provides the project organization chart. Technical and administrative personnel (not shown) receive assignments directly from the Project Manager (PM). The PM serves as the point of contact with CPC. The Project Quality Assurance Engineers report to the Executive Vice President, TERA, but will work with the PM in resolving deficiencies or making recommendations.

PROJECT ORGANIZATION
MIDLAND INDEPENDENT DESIGN AND CONSTRUCTION VERIFICATION PROGRAM

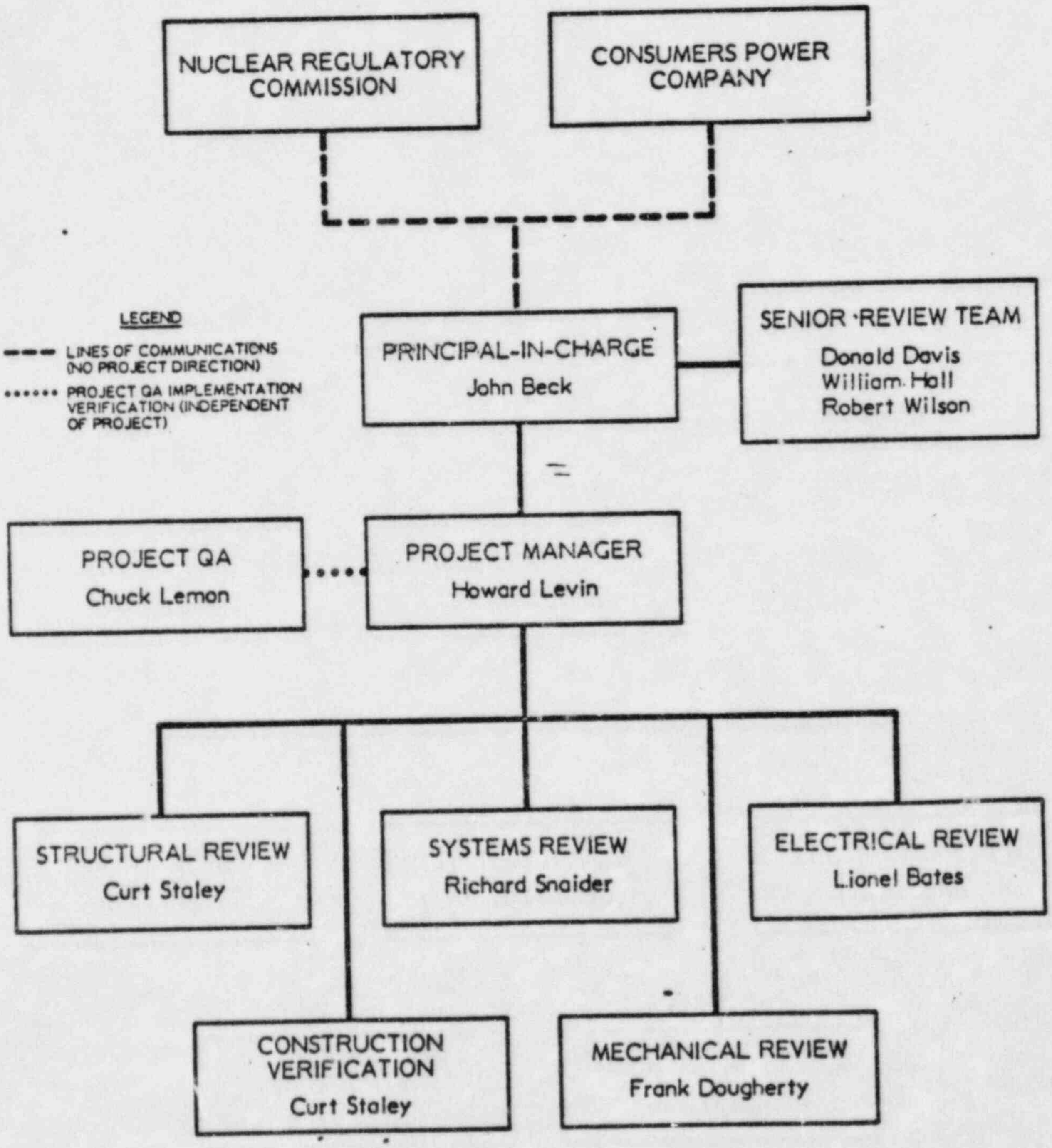

FIGURE 2.1-1

2.2 AUTHORITY AND RESPONSIBILITY

The project authority and responsibility is addressed in Section 2.2 of the PQAP, Project 3201, as augmented by various project instructions and engineering control procedures which are referenced in the PQAP.

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.

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.

The Project Manager is responsible for planning and overall management of all outside activities performed by subcontractors or Associates, 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.

As requested by the PIC, the Senior Review Team (SRT) is responsible for the review of Open, Confirmed or Resolved (OCR) Item Reports, Finding Reports, Finding Resolution Reports and Final Reports to assess the technical validity and significance of project team conclusions and the proper classification of OCRs and Findings. (These reports are defined in Section 5.0 of this Plan). 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.

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 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.

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.

2.3 ADMINISTRATIVE CONTROL

The project administrative control is addressed in Section 4.0 of the PQAP, Project 3201, as augmented by various project instructions and engineering control procedures which are referenced in the PQAP.

Procedures and instructions are addressed which will be implemented to control documentation generated on the Midland IDCV project which is subject to quality assurance and control measures or is required to provide an auditable record of the IDCV review process leading to Findings. The following documents are controlled; engineering evaluations, documents and reports, calculations, analyses, computer analyses, PQAP, quality assurance documents, personnel qualifications, correspondence, Open, Confirmed and Resolved Item Reports, Finding Reports, Finding Resolution Reports, Engineering Program Plan and external communications.

3.0 ENGINEERING PROGRAM PLAN METHODOLOGY

This section provides the overall method of approach for the IDV and ICV portions of the IDCV with particular emphasis on those features of the methodology which are common to both. Specific details of the methodology for the IDV and ICV are addressed below in Sections 3.1 and 3.2, respectively.

The initial review step includes the identification and review of pertinent documents to permit an understanding of the design and construction chains including the interrelationships between the organizations and suborganizations participating in the Midland project. Next, the design bases in the form of regulatory requirements and design criteria are identified and reviewed in parallel with a review of project design and construction related experience. The design bases review will provide an overall understanding of the plant and system design. The project design and construction experience review will be conducted to ensure that the IDCV program encompasses previously identified problem areas to verify that these have been adequately addressed and that they do not exist elsewhere in the same or similar form.

For the systems, components, and structures identified in Sections 3.1.3 and 3.2.3, detailed information which documents the implementation of the design and construction commitments will be identified, reviewed, and evaluated. The IDCV review and evaluation process will be documented in accordance with the procedures addressed in Section 4.0 of this Plan. The reporting of findings including the disposition of items potentially leading to findings will be reported in accordance with the procedures addressed in Section 5.0 of this Plan. The IDCV will be conducted in accordance with applicable provisions of 10 CFR 50, Appendix B, which are addressed in Section 6.0 of this Plan.

3.1 INDEPENDENT DESIGN VERIFICATION METHODOLOGY

ANSI N45.2.11 defines design verification as the "process of reviewing, conforming, or substantiating the design by one or more methods to provide assurance that the design meets specified inputs." Design inputs include design bases or criteria, regulatory requirements, codes and standards, and other design commitments. The IDV includes a determination of the design inputs; an evaluation of their accuracy, consistency, and adequacy; and an evaluation of the implementation of these commitments. The emphasis will be on making a determination of the overall quality of the design and an assessment of its compliance with licensing commitments. The review approach has been designed to be introspective in making this overall quality assessment by integrating the many design inputs and licensing commitments. This integrated assessment will ensure that all parameters have been considered which are important for the system in meeting its functional requirements.

The IDV methodology will utilize the applicable guidelines of ANSI N45.2.11. The methodology will include diverse approaches such as checking original calculations, conducting alternative confirmatory calculations, or checking design ouputs including drawings or specifications. Where independent calculations are utilized, the may incorporate methods which are either similar to or different from the original design. In certain instances these independent calculations will be "blind," in that the original design calculations will be compared to the independent calculations upon their completion, without prior review by the IDV analyst.

The categories to be reviewed for certain design areas include review of design criteria and commitments, review of implementing documents, checks of calculations and evaluations, confirmatory calculations or evaluations, and checks of drawings and specifications. These categories are defined in Section 3.1.1. As a rule, all design areas will not be reviewed in each of the preceding categories. For example, a design area for the AFW system is "heat removal capability." This item would not typically have drawings and specifications associated with it as a direct output. In other instances, it may be the judgment of the review team based upon experience that emphasis is not needed in certain categories for each design area.

The bases for sample selection are presented in Section 3.1.2, and the definition of the scope of review is provided in Sections 3.1.3 and 3.1.4 for the AFW system and (second system - to be supplied), respectively. The IDV will be conducted utilizing detailed checklists which are described in Section 3.1.5. Additional sampling and verification that may be conducted as a result of the IDV are discussed in Section 3.1.6.

3.1.1 CATEGORIES OF REVIEW: THE DESIGN CHAIN

The categories of review selected include the major design activities identified in the design chain. The IDV review categories included are:

- Review of design criteria and commitments
- Review of implementing documents

- Check of calculations and evaluations
- Confirmatory calculations or evaluations
- Check of drawings and specifications

Each of these categories is described in detail in sections 3.1.1.1 through 3.1.1.5 respectively. Checklists have been prepared for each of these categories to aid IDCV reviewers in the implementation of their review. These checklists are discussed in section 3.1.5.

3.1.1.1 Review of Design Criteria and Commitments

An identification and review of the design criteria and commitments concerning each specific design area will be performed. This review category provides the assurance that all necessary design inputs are considered in the IDV. The results of this review of design criteria and commitments are then used in subsequent stages where appropriate. The review of design criteria and commitments begins with an identification of appropriate criteria for the system. Such criteria may be determined from sources such as the FSAR, the docket file, 10 CFR 50, Appendix A, criteria suppplied by the NSSS vendor, industry codes and standards, and other documents which provide criteria for system design.

3.1.1.2 Review of Implementing Documents

Implementing documents are those design documents which translate the design inputs into working level documentation. Typically, implementing documents include design criteria documents, project procedures, standard design practices, specific plant design basis documents, drawings, and calculations. Most frequently, implementing documents are intermediate steps in the design process which are subsequently used to produce design outputs. It is important that design inputs are properly interpreted and documented in implementing documents. Therefore, the objective of the review is to determine the existence and general reasonableness of the documentation and whether the documentation correctly reflects the design inputs.

Design outputs are defined as documents such as drawings, specifications, and similar materials defining technical requirements for the fabrication, installation, or construction of the system. In some cases, the design process may reduce design outputs with intermediate documentation. In these cases, the design output documents are reviewed for the application of the design criteria and commitments as part of the check of drawings and specifications.

3.1.1.3 Check of Calculations and Evaluations

When specified, a detailed check of calculations and evaluations is made (i.e. inputs, assumptions, methodology, outputs, etc.). This activity follows the review of design criteria and commitments and the review of implementing documents. The check may take several forms, ranging from a number-by-number detailed mathematical check to a review and evaluation of outputs for reasonableness. The overall presentation of the sampled calculations and evaluations will also be reviewed to verify that all steps are clearly presented and consistent throughout. The IDV reviewer may, at his discretion, choose to conduct an alternative calculation as a means of confirming his judgment on the adequacy of the design calculation or evaluation. Where computer programs were used in the analysis, the reviewer will verify that appropriate inputs have been used in the calculation, and that the appropriate outputs have been identified. Additionally, it will be necessary to determine that the computer programs used have been verified in accordance with appropriate verification procedures.

3.1.1.4 Confirmatory Calculations or Evaluations

For selected areas, confirmatory calculations or evaluations will be performed. Generally, these evaluations will be made to confirm judgements relative to the review of areas which are suspect to the IDCV reviewer; however, "blind" confirmatory calculations will be undertaken in pre-selected areas to independently verify the original design calculations. Such confirmatory evaluations will be performed by obtaining the necessary input data and independent specification of calculation or evaluation objective. The reviewer will select and apply the appropriate techniques to achieve the end results. Such calculation methods will be performed without benefit if first reviewing the existing design calculational method. In order to preserve the "blind" nature of this approach, it will be necessary that a person other than the reviewer of the implementing documents perform the confirmatory calculation or evaluation. The confirmatory calculation or evaluation will be performed under procedures appropriate for the type of calculation or evaluation being performed. To the extent appropriate, the calculation or evaluation will be equivalent to that initially performed. After completion of the confirmatory calculation or evaluation, a comparison between the original calculation and the confirmatory methods will be made to determine whether differences exist. If differences occur, a determination will be made to assess whether these differences are due to the inherent nature of the calculation methods chosen or due to errors.

For example, differences may result due to the selection by the originator of simplifying or conservative assumptions. In the event that the original calculation is more conservative than the confirmatory calculation and meets design basis acceptance criteria, no further action will be necessary. On the other hand, if the confirmatory calculation uses more conservative methods, a check of the original calculation will be made to determine whether the difference in degree of conservatism is appropriate.

3.1.1.5 Check of Drawings and Specifications

Where appropriate, design outputs such as drawings and specifications will be reviewed and checked to assure that they accurately and consistently reflect that which has been called for in design documents such calculations. Drawings and specifications will also be reviewed to determine whether design change notices and field change notices have been incorporated. In cases where several related drawings exist, a cross-comparison among drawings will be made. Additionally, a review will be made of correspondence with vendors to determine the existence of deviations from the specifications and the approval by the design organization of such changes.

3.1.2 BASES FOR SAMPLE SELECTION

The criteria which have been applied to the selection of the AFW system and (second system - to be supplied) also apply to the selection of specific structures or components to be reviewed within each design area of the IDV, including the depth of review in each design area. As a rule, the selection is based upon engineering judgment, as statistical techniques are considered to be largely inappropriate for a design verification program. Senior members of the project team with requisite experience are responsible for selecting the sample and determining its size. This process provides greater assurance than a random sampling plan since the initial IDV sample is purposely biased towards typical problem areas. Furthermore, the initial sample is considered broad enough to ensure that significant deficiencies could not propagate through the AFW system or the (second system - to be supplied) without being detected.

In the course of designing a nuclear power plant, numerous reviews and evaluations are typically performed. These reviews and evaluations may result in the identification of areas requiring additional work. These reviews and evaluations reflect the project's design experience and are a valuable input to the refinement of the IDV scope and sample selection. In order to make use of this information, a review was made of the ongoing inspection programs, 50.55e reports, NRC inspection reports, audit reports, and similar documentation. Three criteria are used to modify the initial sample. The first criterion is that areas experiencing repeated design related problems would receive an increased level of review in the IDV program in order to verify that these problems have been adequately addressed and that they do not exist elsewhere in the same or similar form. The second criterion is that those areas which have not previously received extensive review activities would also be subjected to a higher frequency of sampling in order to achieve a sufficient degree of assurance of the adequacy of the design. The third criterion is that those areas where potential findings have been identified, additional sampling would be considered if appropriate to fully assess the extent and root cause.

3.1.3 DEFINITION OF REVIEW SCOPE FOR THE AFW SYSTEM

Section 3.1.1 identified the categories of review which essentially correspond to major activities of the design chain. When combined with a listing of each of the design areas, a matrix is formed which can be utilized to direct the conduct of the IDV effort for each system in the program. This matrix is shown on Figures 3.1-1a and 3.1-1b for the AFW system. A set of "X" marks are shown which indicate the review scope applicable to each design area. The criteria discussed

INITIAL SAMPLE REVIEW MATRIX FOR THE AUXILIARY FEEDWATER SYSTEM
MIDLAND INDEPENDENT DESIGN VERIFICATION PROGRAM

DESIGN AREA	SCOPE OF REVIEW REVIEW OF DESIGN CRITERIA AND COMMITMENTS	REVIEW OF IMPLEMENTING DOCUMENTS	CHECK OF CALCULATIONS AND EVALUATIONS	CONFIRMATORY CALCULATION OR EVALUATION	CHECK OF DRAWINGS AND SPECIFICATIONS
I. AFW SYSTEM PERFORMANCE REQUIREMENTS					
SYSTEM OPERATING LIMITS	X	X	X		
ACCIDENT ANALYSIS CONSIDERATIONS	X				
SINGLE FAILURE	X	X	X		
TECHNICAL SPECIFICATIONS	X	X			
SYSTEM ALIGNMENT/SWITCHOVER	X	X			
REMOTE OPERATION AND SHUTDOWN	X				
SYSTEM ISOLATION/INTERLOCKS	X	X			
OVERPRESSURE PROTECTION	X				
COMPONENT FUNCTIONAL REQUIREMENTS	X	X	X		X
SYSTEM HYDRAULIC DESIGN	X	X	X		
SYSTEM HEAT REMOVAL CAPABILITY	X	X	X		
COOLING REQUIREMENTS	X				
WATER SUPPLIES	X	X			
PRESERVICE TESTING/CAPABILITY FOR OPERATIONAL TESTING	X				
POWER SUPPLIES	X	X			
ELECTRICAL CHARACTERISTICS	X				
PROTECTIVE DEVICES/SETTINGS	X	X			X
INSTRUMENTATION	X	X	X		X
CONTROL SYSTEMS	X	X	X		
ACTUATION SYSTEMS	X				
NDE COMMITMENTS	X				
MATERIALS SELECTION	X	X			

FIGURE 3.1-1a

INITIAL SAMPLE REVIEW MATRIX FOR THE AUXILIARY FEEDWATER SYSTEM MIDLAND INDEPENDENT DESIGN VERIFICATION PROGRAM (CONTINUED)

DESIGN AREA	SCOPE OF REVIEW				
	REVIEW OF DESIGN CRITERIA AND COMMITMENTS	REVIEW OF IMPLEMENTING DOCUMENTS	CHECK OF CALCULATIONS AND EVALUATIONS	CONFIRMATORY CALCULATION OR EVALUATION	CHECK OF DRAWINGS AND SPECIFICATIONS
II. <u>AFW SYSTEM PROTECTION FEATURES</u>					
SEISMIC DESIGN	X				
• PRESSURE BOUNDARY	X	X	X	X	X
• PIPE/EQUIPMENT SUPPORT	X	X	X	X	X
• EQUIPMENT QUALIFICATION	X	X	X		X
HIGH ENERGY LINE BREAK ACCIDENTS	X				
• PIPE WHIP	X	X	X		X
• JET IMPINGEMENT	X				
ENVIRONMENTAL PROTECTION	X				
• ENVIRONMENTAL ENVELOPES	X	X	X	X	X
• EQUIPMENT QUALIFICATION	X	X	X		X
• HVAC DESIGN	X				
FIRE PROTECTION	X	X	X		
MISSILE PROTECTION	X				
SYSTEMS INTERACTION	X	X	X		
III. <u>STRUCTURES THAT HOUSE THE AFW SYSTEM</u>					
SEISMIC DESIGN/INPUT TO EQUIPMENT	X	X	X		X
WIND & TORNADO DESIGN/MISSILE PROTECTION	X				
FLOOD PROTECTION	X				
HELBA LOADS	X				
CIVIL/STRUCTURAL DESIGN CONSIDERATIONS	X				
• FOUNDATIONS	X	X	X		
• CONCRETE/STEEL DESIGN	X	X	X		X
• TANKS	X	X	X		

FIGURE 3.1-1b

in Sections 1.3 and 3.1.2 of this Plan were incorporated to develop the initial matrix. The design areas of the IDV review matrix for the AFW system are divided into three major divisions: AFW system performance requirements, AFW system protection features, and structures that house the AFW system. The design areas addressed within each of these major divisions are discussed in Sections 3.1.3.1, 3.1.3.2, and 3.1.3.3 of this Plan, respectively. As previously mentioned, the identified review scope is subject to change depending upon the IDV program findings.

Because the AFW system sample selection interfaces with other systems, it is necessary to define the boundaries for items within the scope of the IDV. In general for the AFW system, the selection was made to include all components identified as being part of the AFW system on Bechtel P&ID drawing M439 1
sheets 3A, revision 9, and 3B, revision 10. Specific interface points are as follows:

AFW SYSTEM SAMPLE SELECTION BOUNDARIES

Interfacing System	Interface Point (component included in AFW)	
Main Steam	Valves 074 and 077 [1]	
NSSS	Steam Generator Nozzles	
Service Water A	Valve 283	
Service Water B	Valve 282	
Unit 2 Condensate Tank (from)	Valve 008	
Condenser Hotwells	Valve 006	
Unit 1 Condensate Tank (return)	Valve 019	
Cooling Pond (return)	Valve 017	
ac/dc Power System [2]	Breaker or fuse interfacing AFW components with power source	
ESFAS	AFW actuation system and FOGG	
Main FW Loop A	Valve 303	
Vents and Drains	First Valve	
HVAC	AFW pump room fan coolers and associated ductwork and supports	1

NOTES:

1. P&ID M-432, Sheet 1A, Revision 5 1
2. Power supplies dedicated to AFW system are within sample selection boundaries.

In view of the fact that the design process involves a great number of individuals and organizations who may have contributed to the project engineering activities, it is necessary to define a reasonable set of limits on the scope of the IDV. Criteria were established by the project team to define the end points of the design chain applicable to this project. The majority of the design was performed by Bechtel. However, portions of the design may have been performed or affected by work performed by other organizations including, but not limited to, Babcock & Wilcox (B&W), engineering contractors, and equipment vendors. For the purposes of the verification program, the following limitations were applied. The information obtained by Bechtel from B&W does not receive, as part of the IDV program, an independent evaluation of the process by which B&W developed its data. The verification program verifies that data obtained from B&W are consistent and reasonable based upon engineering judgment. Equipment vendors are reviewed to verify that the documents with which they were supplied are accurate and current and that the results of their design efforts conform with the specified requirements given to them by Bechtel or CPC. Vendor documentation will be reviewed to determine that his product does, in fact, meet applicable requirements of the specifications. In the event that deviations are determined to exist, the appropriate IDCV Program reporting procedures will be applied. For engineering contractors, the scopes of work applicable to these contractors will be determined and, in general, they will be treated as if they were part of the Bechtel design organization. That is, they will not be treated like a vendor who is given a specification and is expected to deliver a product in conformance with that specification. They will be treated as part of a design organization which has similar responsibilities to other parts of the Bechtel project organization.

The following sections discuss the initial scope of review for each of the design areas.

3.1.3.1 AFW System Performance Requirements

The AFW system will be reviewed to assess its capability to perform as required by the design criteria and commitments. Included in the scope of this portion of review are design areas such as system operating limits, single failure, component functional requirements, electrical, instrumentation and control, and hydraulic design.

3.1.3.1.1 System Operating Limits - Topic 1.1-1

The specified system operating limits will be reviewed to determine whether they have been appropriately specified in consideration of functional performance requirements during normal (startup and shutdown), transient and accident conditions. These performance requirements will be generally based upon NSSS considerations. Specified limits such as heat removal requirements, pressure requirements, time constraints, and system logic will be reviewed. To accomplish the preceding, the review will consist of a design criteria and commitments review, a review of implementing documents, and a check of calculations and evaluations.

3.1.3.1.2 Accident Analysis Considerations - Topic 1.2-1

The FSAR accident analyses will be reviewed to identify those accidents in which the AFW may be involved either as a contributor or as an engineered safety system which helps mitigate the consequences of an accident. An evaluation will be made to determine if the system has been appropriately considered in these analyses and also to provide feedback into Topic 1.1-1 to assure that system operating limits appropriately reflect accident analysis considerations.

3.1.3.1.3 Single Failure - Topic 1.3-1

All "active" components (e.g. pumps, motor-operated valves etc.) of the AFW system will be reviewed to determine whether the failure of one component can incapacitate the system or whether the system has sufficient redundancy, including power supplies, to withstand a single failure. (This will include a review of the flow logic "matrix" (FOGG system) that is designed to prevent AFW flow to a depressurized steam generator, and provide steam flow to the turbine-driven pump only from the "good" generator). Automatic and manual initiation of the system will be reviewed. To accomplish the preceding, the review will consist of a design criteria and commitments review, a review of implementing documents, and a check of design evaluations.

3.1.3.1.4 Technical Specifications - Topic 1.4-1

The technical specifications will be reviewed to assure that important plant operating limits associated with the AFW system are appropriately and accurately specified, consistent with the intent of the NRC's Standard Technical Specifications.

3.1.3.1.5 System Alignment/Switchover - Topic 1.5-1

System alignment criteria and commitments under all modes of operation will be reviewed along with P&IDs and other implementing documents. Additionally, since the AFW system incorporates substantial switchover capability between Units 1 and 2 available water sources, all switchovers and potential alignments will be reviewed against applicable procedures (if available) to determine whether the system can meet design objectives. Any switchovers designed to occur automatically will be reviewed against single failure criteria as discussed previously. Switchovers requiring manual activities will be reviewed by determining time required versus time available to accomplish necessary actions.

3.1.3.1.6 Remote Operation and Shutdown - Topic 1.6-1

The criteria and commitments for safe shutdown from outside the control room will be identified and reviewed. Selected components employed to meet the remote operation requirements will be reviewed as described under Topic 1.9-1, Component Functional Requirements. Other design features applicable to remote operation will be reviewed under Topic 1.16-1, Electrical Characteristics and Topic 1.18-1, Instrumentation.

3.1.3.1.7 System Isolation/Interlocks - Topic 1.7-1

The AFW system criteria, commitments, and implementing documents will be reviewed to determine the adequacy of all isolation requirements and interlocks which have been designed to implement system performance requirements. The single failure review in Topic 1.3-1 will address these items as well.

3.1.3.1.8 Overpressure Protection - Topic 1.8-1

The AFW system criteria and commitments will be reviewed to assess the need for and incorporation of protective devices which may be required to prevent system overpressurization for modes of operation. This review will serve as input into Topic 1.10-1, System Hydraulic Design.

3.1.3.1.9 Component Functional Requirements - Topic 1.9-1

Selected mechanical, electrical, instrumentation and control (E,I&C) components specified and used in the AFW system will be reviewed for compliance to their functional requirements. The development of the functional requirements will be traced from the AFW system design criteria as dictated by licensing commitments, industry codes and standards, plant environmental conditions, and system performance requirements for the intended operating modes. The design criteria and commitments used for the AFW system will be checked to ensure the inclusion of all required design inputs. Component functional requirements design criteria include factors such as flow rate, allowable pressure drops, NPSH, voltage, device settings, and similar characteristics. The design process (calculations or analyses) used to translate the overall system design criteria into specific component specifications will also be reviewed. Finally, the validated component functional requirements will be compared to the component procurement specifications. Equipment seismic and environmental qualification will be considered separately.

3.1.3.1.10 System Hydraulic Design - Topic 1.10-1

A review of criteria and commitments and implementing documents will be made for the system hydraulic design. The system hydraulic design review will also include a detailed check of calculations and evaluations of the system hydraulic parameters. This activity will incorporate results obtained from the configuration verification effort which is part of the ICV. For example, line sizes, lengths of pipe, and numbers of pipe fittings will be checked in the ICV effort. These quantities will then be compared against the basis for calculations of pressure drop in various portions of the AFW system.

3.1.3.1.11 System Heat Removal Capability - Topic 1.11-1

Calculations and evaluations performed to demonstrate the adequacy of the system's heat removal capability will be checked. The scope includes a comparison between the results of the hydraulic design evaluation and the system requirements for heat removal.

3.1.3.1.12 Cooling Requirements - Topic 1.12-1

Cooling requirements for AFW mechanical and electrical components will be checked and a determination made that these heat loads have been considered as design criteria for the interfacing systems.

3.1.3.1.13 Water Supplies - Topic 1.13-1

The criteria established for water supply, from both safety and nonsafety sources, will be identified. A review will be made of implementing documents for proper use of these criteria.

3.1.3.1.14 Preservice Testing and Capability for Operational Testing - Topic 1.14-1

A determination will be made of the design criteria and commitments which exist for preservice testing and the capability for operational testing. The results of this determination will be used in the ICV portion of the IDCV, which will verify that the system has been constructed such that it can function in accordance with its design criteria and commitments.

3.1.3.1.15 Power Supplies - Topic 1.15-1

The power supplies functional requirements will be reviewed as described under Component Functional Requirements. As defined by the sample selection boundaries described in section 3.1.3, the consideration of power supplies will be limited to the sizing of circuit breakers, fuses and ac or dc power to AFW instrument loops. The power supply implementing documents will be checked to verify the proper consideration of system design criteria and commitments which dictate the required power supply ratings or sizing. The AFW system design requirements for separation, redundancy, and single-failure will also be determined for power supplies and the implementing documents reviewed for compliance.

3.1.3.1.16 Electrical Characteristics - Topic 1.16-1

The AFW system electrical characteristics as determined by design criteria and commitments will be reviewed to verify that all required commitments and criteria have been addressed. This will include a consideration of rating and fire protection properties of cable, cable separation, system electrical separation, cable sizing and voltage drop, and the sizing of electrical motor starters.

3.1.3.1.17 Protective Devices/Settings - Topic 1.17-1

Protective circuit breakers and fuses will be reviewed on a component basis as described above. The review process will identify the technical basis for fuse and selected breaker trip settings. The process will include a review of design criteria and commitments, component specifications, and implementing documents specifying the protective device settings for the selected protective devices.

3.1.3.1.18 Instrumentation - Topic 1.18-1

The instrumentation and alarms required to operate, monitor, and protect the AFW system; as determined by design criteria, commitments and expected plant operations, will be reviewed against that specified for the AFW system to verify adequacy. The calculations to determine instrument ranges and accuracies for normal plant operations, anticipated operational conditions, and for accident conditions will be checked for several representative instrument types to verify the adequacy of the specified ranges. Instrument circuit design will also be checked to verify proper circuit configuration for a sample of instrumentation loops.

Calculations for alarm set points or time delays for several representative devices (e.g. steam generator water level trip point) will be reviewed for compliance with design criteria. The implementing specifications or lists documenting the consideration of all the above factors will be reviewed to verify that the original design criteria are reflected in the devices chosen for review.

3.1.3.1.19 Control Systems - Topic 1.19-1

Design criteria and commitments governing the steam generator water level and AFW turbine control systems will be checked to verify the inclusion of necessary regulatory, industry, system performance requirements. Design specifications or other implementing documentation will be reviewed to verify that the necessary requirements were used as input to the control system design. This review will include a check of calculations or evaluations relative to control system performance, time response, component characteristics, and separation from actuation systems. Failure Modes Effects Analyses will be reviewed to verify that system failures are in the safe direction. Control system circuitry design (voltages, currents, polarity) will be reviewed to verify that selected components will function as intended in the control circuit.

3.1.3.1.20 Actuation Systems - Topic I.20-1

The auxiliary feedwater actuation system (AFWAS - which includes FOGG, feed only good generator) design criteria and commitments will be reviewed to verify the proper consideration of regulatory commitments, industry codes and standards, plant operational requirements and operator actions. The criteria will be applied to the actuation system from the sensors required for inputs relative to the AFW system to the actuation system output devices (relays).

3.1.3.1.21 Nondestructive Examination Commitments - Topic I.21-1

A determination will be made of the design criteria and commitments which exist for NDE of AFW system piping, components, and structures. The results of this determination will serve as input to the ICV portion of the IDCV which will review NDE records to verify quality construction.

3.1.3.1.22 Materials Selection - Topic I.22-1

This activity will include the review of criteria and implementing documents related to establishing the basis for the material specification process of selected structural elements, components, and a portion of the AFW piping system. Included will be a review of material selection requirements related to such factors as strength, toughness, hardness, compatability, electrical insulation properties, protective coatings, corrosion resistance, fire protection, and other chemical and physical requirements appropriate to the particular structure, component, or system.

3.1.3.2 AFW System Protection Features

In addition to the review of the capability of the AFW system to perform its required functions, a review will be made of external factors which could affect the capability of the system to achieve these functions. Included in the scope of this portion of the review are factors such as seismic design, high energy line break accidents (HELBA), environmental protection, fire protection, missile protection, and systems interaction. The following sections address these and other design areas related to system protection.

3.1.3.2.1 Seismic Design - Topic II.1-1

Seismic design criteria and associated commitments related to the AFW system will be reviewed, and the establishment of the proper basis for the associated design process will be confirmed. Included will be the review of seismic design parameters and methodologies which were utilized in the seismic design process for structures, systems, and components associated with the AFW system.

3.1.3.2.2 Seismic Design--Pressure Boundary - Topic II.2-1

This activity will include a review of the commitments, implementing documents, calculations, drawings, and specifications associated with the seismic design of a selected portion of the AFW piping system. The utilization of the proper design input, such as response spectra, piping and component weights, and other piping characteristics, will be verified. The ASME code evaluations will be reviewed to verify that pertinent acceptance criteria are met. Drawings and specifications will be reviewed for consistency with design calculations. Included will be an independent confirmatory seismic analysis of a selected portion of the piping system based upon independently verified as-built dimensions utilizing a verified computer program. Pipe stresses and support loads will be calculated. To preserve the "blind" nature of the confirmatory calculation, the individuals who perform the calculation will not have prior benefit or knowledge of the specific calculational approach followed by the original analysts. Upon completion, a comparison will be made between the original design and IDV calculated forces and stresses at key locations. Any discrepancies will be identified and their cause determined.

3.1.3.2.3 Seismic Design--Pipe/Equipment Support - Topic II.3-1

A review of a selected portion of the AFW system will be conducted to verify that selected pipe supports have been designed and specified in accordance with criteria and commitments. Included will be the review of design loads, load combinations, and the methods of analysis utilized. The associated design drawings and specifications will be reviewed for consistency. The support loads calculated during the confirmatory piping analysis of Topic II.2-1 will be compared to the design loads for all supports in the selected portion of the AFW system. Several support types (e.g., snubber, rigid restraint, anchor, spring hanger, etc.) will then be sampled, and an independent confirmatory analysis will be made to verify the capability of the original design organization to properly design and size these supports given the design loads. This analysis will be based upon independently verified as-built dimensions. In addition, the design calculations, drawings and specifications associated with the anchorage and support of selected AFW system equipment will be reviewed for conformance to requirements.

3.1.3.2.4 Seismic Design--Equipment Qualification - Topic II.4-1

This activity will include the review of commitments, implementing documents, calculations, drawings, and specifications associated with the seismic qualification of selected equipment. Qualification requirements including response spectra, load combinations, and equipment functional criteria will be reviewed. The review will include the following types of AFW system equipment of representative complexity such as: electrical-motor control center, motor-operated valve, and electrical panel; mechanical-AFW pump, motor-operated valve and heat exchanger.

3.1.3.2.5 High Energy Line Break Accidents - Topic II.5-1

HELBA criteria and associated commitments related to the AFW system will be reviewed, and the establishment of the proper basis for the associated design process will be confirmed. Included will be a review of HELBA design parameters and the methodologies which have been utilized in the HELBA design process for structures, systems, and components associated with the AFW system.

3.1.3.2.6 HELBA/Pipe Whip - Topic II.6-1

Design criteria, implementing documents, calculations, drawings, and specifications associated with pipe whip resulting from postulated high energy line breaks will be reviewed. Included will be the review of the definition of the methodology employed in determining postulated pipe break locations, the magnitude of associated pipe whip loads, and the techniques utilized for pipe restraing design. In addition, calculations for selected AFW system pipe rupture restraints will be reviewed, including the associated drawings and specifications for consistency with these calculations.

3.1.3.2.7 HELBA--Jet Impingement - Topic II.7-1

The design criteria and commitments applicable to preventative protective measures taken to assure acceptable consequences due to postulated jets will be reviewed. This topic will be reviewed in conjunction with Topic II.6-1, Pipe Whip, and Topic III.4-1, HELBA Loads, and will be considered in the evaluation of Topic III.7-1, Concrete/Steel Design.

3.1.3.2.8 Environmental Protection - Topic II.8-1

The design criteria and commitments applicable to all issues related to the plant's environmental protection will be reviewed.The environmental protection review will consist of a determination of the appropriate environmental envelopes, the qualification requirements for equipment to these envelopes, and the HVAC design criteria which are necesary to assure that the environmental envelopes will not be exceeded.

3.1.3.2.9 Environmental Envelopes - Topic II.9-1

The environmental envelope design criteria will be determined by a review of existing criteria and commitments and a review of the system arrangement. These environmental envelopes will be verified by a review of implementing documents and a check of calculations and evaluations which were used to determine the environmental parameters. Drawings and specifications for AFW equipment will be checked for consistency with the environmental envelope specified. In addition, a confirmatory calculation or evaluation will be performed to verify the environmental envelope specification for one portion of the AFW system.

To preserve the "blind" nature of the confirmatory calculation, the individuals who perform the calculation will not have prior benefit or knowledge of the specific calculational approach followed by the original analysts. Upon completion, a comparison will be made between the original design and IDV environmental envelopes at key locations. Any discrepancies will be identified and their cause determined.

3.1.3.2.10 Environmental/Equipment Qualification - Topic II.10-1

Equipment qualification requirements will be reviewed to determine whether the correct enviornmental envelopes were specified and given these envelopes, whether the qualification methods specified were adequate to demonstrate that the component would meet its functional requirements. The review will include the following types of AFW system equipment of representative complexity such as electrical insulation, connectors, transmitters and motor-operated valves.

3.1.3.2.11 HVAC Design - Topic II.11-1

Requirements imposed upon the HVAC system design as a result of the need to meet evironmental envelope or equipment qualification parameters will be checked. This will be achieved by a verification of the design interface between the AFW system design and the HVAC's system design.

3.1.3.2.12 Fire Protection - Topic II.12-1

The applicable fire protection criteria will be determined for the AFW system. A review will be made of fire protection evaluations to determine whether the fire protection system meets the necessary requirements for the AFW system. Included in the review will be the designation of fire zones, rating of barriers, combustible content of zones and the existence of detection and suppression capabilities for an AFW pump room. The scope of this review includes fires within the AFW room and fires external to the room which would effect the function of equipment in the room.

3.1.3.2.13 Missile Protecton - Topic II.13-1

A review of criteria and commitments will be made of the potential missiles which could affect the AFW system and the protection provided for those systems. The review includes missiles external to the AFW system and those that could be generated within the AFW system and will serve as input to Topic III.7-1, Concrete/Steel Design.

3.1.3.2.14 Systems Interaction - Topic II.14-1

As part of the overall systems review, the potential for systems interaction and means of prevention thereof will be reviewed. The review will include an examination of criteria utilized to analyze potential systems interactions, whether they be physical (electrical, mechanical, hydraulic), or spatial (thermal, fluid, mechanical, radiation). The procedures and results for the Midland systems interaction walkdowns will also be reviewed and, if possible, ongoing walkdowns will be observed. Human factors or inherent failure modes (common manufacturer, similar technology, equal aging or wear) will not be considered a part of the systems review.

3.1.3.3 Structures that House the AFW System

Many safety-related plant structures such as the containment, auxiliary and diesel generator buildings, and the intake structure support the functioning of the AFW system or its support systems. The overall criteria and commitments applicable to the design of these safety related structures will be reviewed and evaluated. Selected features and design areas from one or more of these structures will be isolated for a more in-depth review in the following topics.

3.1.3.3.1 Seismic Design/Input to Equipment - Topic III.1-1

This activity will include the review of commitments, implementing documents, calculations, drawings, and specifications related to the development of seismic design input for a portion of the AFW system and components in the auxiliary building. Included will be a review of seismic input parameters such as seismic design spectra, damping, material properties, and boundary conditions, including soil-structure interaction. The methodology utilized for the location of the mass points and the computation of masses and equivalent member properties will be reviewed. Parameter variation studies will also be reviewed to verify that the variance of important input parameters and modeling assumptions has been appropriately considered. The scope of this activity will include the review of the dynamic analysis of the building, the time history analysis and the generation of floor response spectra for both horizontal directions and the vertical direction. The utilization of proper floor response spectra for the specification of selected AFW system components and the selected portion of the AFW system will be verified.

3.1.3.3.2 Wind and Tornado Design/Missile Protection - Topic III.2-1

Criteria and commitments for wind loading, tornado effects, and missile protection will be reviewed to verify the proper basis is established for the design process. Included will be the review of the criteria associated with wind pressure loading, tornado wind loading, tornado depressurization effects, tornado missiles, and other related requirements. Loading combinations, methodologies of analysis, associated allowable stresses or conditions, and other specified criteria will be included in this review activity. The results of this review will be considered in evaluation of Topic III.7-I, Concrete and Steel Design.

3.1.3.3.3 Flood Protection - Topic III.3-1

This activity will include the review of criteria and commitments related to establishing the basis for flood protection from sources both external and internal to the plant. The criteria associated with the specification of the design flood level and the methods to be utilized to provide the necessary flood protection will be reviewed. Included will be the review of the criteria associated with the determination of postulated pipe break locations, the methodologies to be utilized in determining flow rates and resulting water levels, loading combinations, allowable stresses or conditions, and other related criteria. The results of this review will be considered in evaluation of Topic III.7-I, Concrete and Steel Design.

3.1.3.3.4 HELBA Loads - Topic III.4-1

Criteria and commitments for high energy line break accident loads will be reviewed to verify that the proper basis is established for the design process. Included will be the review of the criteria for jet impingement and pipe whip loading on structures and components related to the AFW system. The review will address loading combinations, methodologies of analysis, associated allowable stresses or conditions, and other related criteria. The results of this review will be considered in evaluation of Topic III.7-I, Concrete and Steel Design.

3.1.3.3.5 Civil/Structural Design Considerations - Topic III.5-1

Civil/structural design criteria and associated commitments related to the AFW system will be reviewed, and the establishment of the proper basis for the associated design process will be confirmed. Included will be the review of design parameters and the methodologies utilized in the design process for structures and affected systems and components associated with the AFW system.

3.1.3.3.6 Foundations - Topic III.6-1

Included in this activity will be the review of criteria, implementing documents, and calculations associated with the design of selected foundations associated with structures housing the AFW system. The review will address design criteria, methodologies of analysis and calculations associated with each type of foundation loading including dead, live, tornado and seismic loadings.

3.1.3.3.7 Concrete and Steel Design - Topic III.7-1

This activity will include the review of criteria, implementing documents, calculations, drawings, and specifications associated with the reinforced concrete and structural steel design of selected structural elements associated with the AFW system. Structural elements, including a major load bearing shear wall and a floor diaphram will be selected that require consideration of a broad spectrum of loadings such as dead, live, wind, tornado, seismic, flood, and HELBA loads. The review will address design criteria, methodologies of analysis and calculations associated with each type of loading with emphasis on a verification that these items have been considered in a realistic manner. Loading combinations, allowable stresses or conditions, and other applicable criteria will be reviewed. Drawings and specifications for the selected structural elements will be reviewed against design calculations for consistency.

3.1.3.3.8 Tanks - Topic III.8-1

This activity will include the review of criteria, implementing documents, and calculations associated with the design of a selected AFW system tank. All applicable loadings will be reviewed, such as dead, live, wind, tornado, seismic (including fluid dynamics effects), flood, and HELBA loads, as applicable. The review will address tank design criteria, methodologies of analysis, and the associated calculations. Loading combinations, allowable stresses or conditions, and other applicable criteria will be reviewed.

3.1.4 DEFINITION OF REVIEW SCOPE FOR (second system - to be supplied)

3.1.5 DEVELOPMENT OF IDV PROGRAM CHECKLISTS

Generic checklists were developed for each of the review scope categories discussed in previous sections utilizing guidance contained in ANSI N45.2.11 and the construction review program guidelines published by INPO. For each of the scope design areas shown in Figure 3.1-1, the reviewer develops a specific checklist incorporating generic checklists as appropriate. In most cases, the specific checklist is derived from the generic checklist by addition of specific requirements applicable to the design area being reviewed. In some cases, it may be appropriate to use only a portion of the generic checklist or to develop a unique checklist.

In each case, the checklist prepared by the reviewer will be checked by the lead technical reviewer for the area. (Note that if the lead technical reviewer prepares a checklist, it is permissible for him to both originate and check the contents of the checklist). During their review process, the lead technical reviewers examine the checklist for interfaces with other IDV areas and perform a general review of the completeness and adequacy of the proposed checklist. The LTR's review is to be coordinated with the project manager as necessary to resolve questions which cut across discipline lines. In the event that the Project Manager or Lead Technical Reviewers have comments on the checklist, the checklist preparer and those having comments will discuss the comments and reach an appropriate resolution. After reaching concurrence in the adequacy of the checklist, the LTR will indicate his approval and the checklist will be available for use by the reviewer.

The reviewer, having an approved checklist, can then proceed with the reveiw process for this specified area, in accordance with Project Instruction PI-3201-001, Engineering Evaluation Preparation and Control. In performing the engineering evaluation, the reviewer will document the information which he used in order to complete the checklist. Such information will include the data or revision number of the document, the document number, an indication of the source of the document (e.g., whether the document was obtained from an individual, a file, or the records center).

3.1.5.1 Development of Checklists for Review of Design Criteria and Commitments

The generic checklist for review of design criteria and commitments was developed considering questions such as:

- What are the design inputs for the design area under review?
- Do any of these design inputs affect other design areas?

- Do any of these design inputs affect systems outside the scope of AFW or vice versa?
- Are the design inputs for this design area complete?
- Are the identified design inputs for this design area consistent?
- Are the design inputs adequately defined to allow implementation for the design area?

For each design area the lead technical reviewer will supplement the generic checklist with appropriate additional questions.

3.1.5.2 Development of Checklists for Reviews of Implementing Documents

The generic checklist for reviews of implementing documents was developed considering questions such as:

- What is the identity of the implementing document being reviewed? (List document identification such as title, revision number, date, etc.)
- Which design inputs does the document implement?
- Are design interface requirements specified?
- Have the design inputs been correctly interpreted and incorporated in this implementing document?
- Is this implementing document consistent with other implementing documents being reviewed for this area?
- Are assumptions and limitations on the use of the document adequately defined?
- Were appropriate quality assurance requirements specified?

For each design area the lead technical reviewer will supplement the generic checklist with appropriate additional questions for each implementing document.

3.1.5.3 Development of Checklists for Checks of Calculations and Evaluations

The generic checklist for checks of calculations and evaluations was developed considering questions such as:

- What is the identity of the calculation or evaluation being checked?
- What is the purpose of the calculation or evaluation?
- Are the data sources identified?
- Are the assumptions listed?
- Have the assumptions been verified?
- Was the calculation or evaluation checked and approved within the originating organization in accordance with procedures?
- Are the equations and methods specified?
- Are the equations and methods appropriate for the intended purpose?
- Were verified computer programs used?
- Are the calculations or evaluation results reasonable?
- Have design outputs been compared to the acceptance criteria to allow verification that design requirements have been satisfactorily accomplished?

For each design area the lead technical reviewer will supplement the generic checklist with appropriate questions for each calculation or evaluation checked.

3.1.5.4 Development of Checklists for Checks of Drawings and Specifications

The generic checklist for checks of drawings and specifications was developed considering questions such as:

- What is the identity of the drawing or specification (e.g. number, revision number, date)?
- Does the drawing or specification reflect the design inputs?
- Is the drawing or specification consistent with related calculations or evaluations?
- Has this drawing or specification been checked by the originating organization in accordance with procedures?
- Is the drawing or specification complete?
- Where appropriate, have adequate handling, storage cleaning, and shipping requirements been specified?
- Where appropriate, has adequate allowance been made for inservice inspection, maintenance, repair, and testing?

For each design area, the lead technical reviewer will supplement the generic checklist with appropriate questions for each drawing or specification being reviewed.

3.1.6 PLAN FOR ADDITIONAL SAMPLING AND VERIFICATION

Additional sampling or verification within the scope of the IDV or outside the scope into other systems will be conducted if discrepancies are found. The level of additional sampling or verification will be based upon the nature of the discrepancy. In all cases when discrepancies are found, an introspective evaluation will follow to identify the extent and root cause. The root cause may either be random or systematic (generic). The additional review will attempt to verify whether the discrepancy is restricted to the specific system, component, or structure under review; restricted to work by a specific design organization; or if the discrepancy cuts across many interfaces and applies to similarly designed systems, components, and structures. As a rule, mathematical errors will not precipitate additional sampling and verification unless these are found in significant numbers, leading to significant deficiencies or a compounding of errors. Judgement in making this assessment will be required on case-by-case basis.

3.2 INDEPENDENT CONSTRUCTION VERIFICATION METHODOLOGY

The Independent Construction Verification (ICV) Program will consist of a review and evaluation of the quality of construction of selected components and structures associated with the AFW system and the (second system - to be supplied). The construction activities to be reviewed include the major activities of the construction chain. These include the fabrication, storage, maintenance, installation or construction, and verification activities associated with the acceptance of the system or component, as further defined in Section 3.2.1 herein. The emphasis will be on making a determination of the overall quality of construction and an assessment of its compliance with licensing commitments.

The review will be conducted to varying stages of construction completion depending upon the specific system, component, or structure under review. The methodology will include diverse approaches such as checking of records, hands-on inspection of hardware, or possibly confirmatory testing, if required. The basis for the sample selection is presented in Section 3.2.2, and the definition of the scope of review is provided in Sections 3.2.3 and 3.2.4 for the AFW system and (second system - to be supplied), respectively. In many instances, included will be a complete verification of the as-built configuration against design documents and other applicable requirements. Where possible, systems and components selected for the Independent Design Verification Program will be utilized for review in the ICV Program, thereby providing verification of the complete chain from criteria and commitments through to the constructed and verified product.

The ICV Program will be conducted utilizing detailed checklists described in Section 3.2.5. Additional sampling, verification, and testing activities that may be conducted as a result of the ICV Program are discussed in Section 3.2.6.

3.2.1 CATEGORIES OF REVIEW: THE CONSTRUCTION CHAIN

The categories of review include the major construction activities identified in the construction chain. The ICV review categories included are:

- Review of supplier documentation
- Review of storage and maintenance documentation
- Review of construction/installation documentation
- Review of selected verification activities

- Verification of physical configuration

Each of these review categories is described in further detail in the following sections.

3.2.1.1 Review of Supplier Documentation

For those components requiring fabrication or manufacture, selected supplier documentation and other associated information including shop inspection documentation will be reviewed against design output documents to ensure conformance with requirements. Supplier documentation will include such items as drawings, calculations, test reports, certified material property reports, storage and installation requirements, operations and maintenance requirements, and other major supplier documentation and data applicable to the component. For selected components, included will be the review of supplier seismic and environmental qualification documentation against requirements defined in the design process.

3.2.1.2 Review of Storage and Maintenance Documentation

A review of site documentation will be performed to verify that requirements related to storage, including both in-storage and in-place maintenance have been met. Included will be the review of receipt inspection documentation. Requirements to be reviewed will include such parameters as temperature and humidity, cleanliness, lubrication, shaft rotation, energization, etc. Where possible, existing warehousing and maintenance documentation will be reviewed and associated activities observed to provide additional verification that components have been properly stored and maintained during the construction process.

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3.2.1.3 Review of Construction/Installation Documentation

A major factor in the evaluation of the quality of construction is the review of those items constructed or installed on site. The review of documentation associated with the construction/installation process will be conducted to verify that the applicable requirements have been met. Included in this review will be verification of the utilization of proper documents in the process such as design output requirements, erection specifications, installation requirements, construction procedures and other specified construction codes and standards, as applicable. Design changes, field modifications, and other input related to final as-built drawings will be reviewed. Included will be the review of documentation associated with such items as concrete materials, concrete, the welding process, bolting activities, NDE, etc. Inspection requirements, including personnel qualification and training, reports, and associated documentation will also be included in the review. Where possible, selected on-going construction/installation activities will be observed to provide additional information for the evaluation of this process.

3.2.1.4 Review of Selected Verification Activities

Verification activities conducted subsequent to the construction/installation/inspection activity will be reviewed and evaluated. Included will be over-inspection activities associated with cable separation verification, bolt hardness testing verification, the pipe support reinspection program, the Construction Completion Program; as well as routine cold hydro testing, functional and preoperational testing, and other specified preservice system and component testing programs. Associated requirements, plans, test reports, etc. will be reviewed and, where possible, these verification activities will be observed in order to provide additional information and data to support evaluations.

3.2.1.5 Verification of Physical Configuration

Field verification of the as-built configuration of selected components of a portion of the AFW system will be conducted to ensure conformance with requirements. Verification will address such aspects as identification, approximate physical dimensions, location, orientation, name plate data, grounding, use of proper materials, insulation, weld quality, and other features of the configuration as applicable to the component or system. Configuration verification will range from the review of general features for some components or systems to a 100% detailed dimensional verification of other selected components or systems, as defined further in subsequent sections herein.

3.2.2 BASES FOR SAMPLE SELECTION

The selection of a sample for the ICV will generally follow the criteria discussed in Section 3.1.2 of this Plan for the IDV; with the exception that certain ICV activities may utilize statistical methods. These methods may be applied in establishing sample sizes and statistical levels of confidence for the assessment of repetitive production activities such as concrete and steel properties or welding records. This program will be developed and documented during the preparation of the associated detailed review checklists.

The primary means of sample selection will be engineering judgment of the ICV reviewers. As with the IDV, the initial sample will be biased towards problems that have previously arisen in the industry. This sample will be refined by incorporating specific Midland project information to verify that the ICV encompasses previous problem areas and, thereby, serve as a verification that associated problems have been or are in the process of being adequately addressed and that they do not exist elsewhere in the same or similar form.

3.2.3 DEFINITION OF REVIEW SCOPE FOR THE AFW SYSTEM

The ICV review categories corresponding to the major activities of the construction chain were defined in Section 3.2.1. Presented in this section is an identification of the selected components and the associated level of construction completion of each to be reviewed. For the AFW system the scope of review is defined in the matrix in Figure 3.2-1, where the "X" designates the review scope applicable to each component. The criteria discussed in Sections 1.2 and 3.2.2 of the Plan were utilized to develop this initial matrix. The review areas of the ICV are divided into major divisions by component type: mechanical, electrical, instrumentation and control, HVAC and structural. The initial scope of review of each component within these major divisions is discussed in the sections that follow. As previously mentioned, the identified review scope is subject to change depending upon the ICV program findings.

3.2.3.1 Mechanical Systems and Components

An evaluation of the quality of construction of selected mechanical systems and components will be conducted. Included in the scope of this portion of the review are selected mechanical equipment, piping and pipe supports associated with the AFW system.

3.2.3.1.1 Mechanical Equipment - Topic I.I-Ic

A review of the complete construction chain including verification of the physical configuration will be conducted for the three major mechanical components selected for detailed review in the IDV. The fabrication documentation review will encompass all major supplier documentation, including functional requirement and environmental and seismic qualification documents.

INITIAL SAMPLE REVIEW MATRIX FOR THE AUXILIARY FEEDWATER SYSTEM
MIDLAND INDEPENDENT DESIGN VERIFICATION PROGRAM

SYSTEM/COMPONENT	SCOPE OF REVIEW				
	REVIEW OF SUPPLIER DOCUMENTATION	REVIEW OF STORAGE AND MAINTENANCE DOCUMENTATION	REVIEW OF CONSTRUCTION/ INSTALLATION DOCUMENTATION	REVIEW OF SELECTED VERIFICATION ACTIVITIES	VERIFICATION OF PHYSICAL CONFIGURATION
I. **MECHANICAL**					
• EQUIPMENT	X	X	X	X	X
• PIPING	X		X	X	X
• PIPE SUPPORTS	X		X	X	X
II. **ELECTRICAL**					
• EQUIPMENT	X	X	X	X	X
• TRAYS AND SUPPORTS	X				X
• CONDUIT AND SUPPORTS	X				X
• CABLE	X	X	X	X	X
III. **INSTRUMENTATION AND CONTROL**					
• INSTRUMENTS	X	X	X	X	X
• PIPING/TUBING	X				X
• CABLE	X				X
IV. **HVAC**					
• EQUIPMENT	X	X	X	X	X
• DUCTS AND SUPPORTS	X				X
V. **STRUCTURAL**					
• FOUNDATIONS	X		X		
• CONCRETE	X		X		X
• STRUCTURAL STEEL	X		X		X

FIGURE 3.2-1

Included will be the review of the stresses in equipment and supports, including anchorages, as applicable. Storage/maintenance and construction/installation documentation will be reviewed and, where possible, selected associated activities will be observed. Verification documentation associated with all major preservice equipment and related system testing programs will be reviewed and where possible verification activities including actual tests will be observed. The as-built configuration review will include verification of equipment identity, principal features, name plate data, location, orientation, and support characteristics, as applicable. Conformance with design documents (including P&ID's, isometrics and equipment location drawings), supplier documents and associated installation requirements will be verified.

3.2.3.1.2 Piping - Topic I.2-Ic

This activity will include the review of all major piping fabrication documentation associated with the portion of the AFW piping system selected for review in the IDV. Vendor drawings, material certification, shop welding and NDE documentation, as applicable will be reviewed. All major construction/installation documentation will be reviewed including installation specifications, welding and NDE documentation and all associated inspection reports. Verification documentation related to all preservice testing programs will be reviewed and where possible associated activities will be observed. A field survey of the as-built configuration of the selected portion of the AFW system will be conducted to verify routing, location (to tape measure accuracy), piping diameter, cleanliness and other major piping characteristics. Conformance with the applicable design, supplier and other installation requirements will be confirmed.

3.2.3.1.3 Pipe Supports - Topic I.3-Ic

A review of the quality of construction will be conducted for the pipe supports associated with the portion of the AFW piping system selected for detailed review in the IDV. For those supports selected for review in the IDV, fabrication and installation documentation will be reviewed. Verification documentation including that associated with the pipe support reinspection program will be reviewed and where possible these activities will be observed. Verification documentation associated with all major preservice system testing will also be reviewed and will be observed where possible. Physical verification will include a 100% verification of the identity, location, and orientation of all pipe supports within the selected portion of the AFW piping system. In addition, complete dimensional verification of design details will be made for those supports selected for detailed review in the IDV. Dimensional verification will encompass weld size, quality and location, base plate size and thickness, anchor bolt size and location, and other principal features, as applicable.

3.2.3.2 Electrical Systems and Components

An evaluation of the quality of construction of selected electrical systems and components will be conducted. Included in the scope of this review are selected electrical equipment, cable trays and supports, conduits and supports, and electrical cable associated with the AFW system.

3.2.3.2.1 Electrical Equipment - Topic II.1-Ic

A review of the complete construction chain including verification of the physical configuration will be conducted for the major electrical components (e.g. motor control center, motor operated valve, electrical panel) and cable selected for detailed review in the IDV. The fabrication documentation review will encompass major supplier documentation, including functional requirement and environmental and seismic qualification documents. Included will be the review of the stresses in equipment and supports, including anchorages, as applicable. Storage/maintenance and construction/installation documentation will be reviewed and, where possible, selected associated activities will be observed. Verification documentation associated with major preservice equipment and related system testing programs will be reviewed and, where possible, verification activities including actual tests will be observed. The as-built configuration review will include verification of equipment identity, principal features, name plate data, location, orientation, and support characteristics, as applicable. Conformance with design documents (including single line diagrams, P&ID's, and equipment location drawings), supplier documents and associated installation requirements will be verified.

3.2.3.2.2 Cable Trays and Supports - Topic II.2-Ic

This activity will include a review of all major fabrication documentation and as-built verification of a selected portion of a cable tray and support system associated with a major AFW electrical system. Layout and installation drawings, material cerifications, and other applicable documentation will be reviewed. A field survey of the selected portion will be conducted to verify location (to tape measure accuracy) routing, tray characteristics, and support location and configuration. Conformance with applicable design, supplier and other installation requirements will be confirmed. Proper cable assignment to trays, tray cleanliness and tray fill will be selectively verified.

3.2.3.2.3 Conduits and Supports - Topic II.3-Ic

This activity will include a review of all major fabrication documentation and a field verification of a selected portion of a conduit and support system associated with a major AFW electrical system. The scope of review will be similar to that of the electrical tray and support review discussed in the preceding section. The conduit size and fill will be selectively verified.

3.2.3.2.4 Cable - Topic II.4-Ic

A review will be conducted of all major supplier documentation associated with the cable of a selected portion of a major AFW electrical system. The fabrication documentation review will encompass cable material certifications, insulation certifications, stranding and color coding characteristics and other applicable documentation. The as-built configuration of a selected portion of the system will be verified including identification, visual inspection, routing, separation, tiedown, terminations and other principal characteristics as applicable. The cable terminations will be reviewed for proper lugging and lugging tool documentation. Cable pull documentation will be reviewed to verify compliance with pull tension limits. Cable meggor and continuity checks will be reviewed to verify installed cable integrity. Conformance with applicable design, supplier and other installation requirements will be confirmed.

3.2.3.3 <u>Instrumentation and Control Systems and Components</u>

A review of the quality of construction of selected instrumentation and control (I & C) systems and components will be conducted. This review will include selected instruments, piping and tubing, and wiring associated with the AFW system.

3.2.3.3.1 Instruments - Topic III.1-Ic

A complete review of the construction chain including verification of the physical configuration will be conducted for selected instruments of a major AFW I&C system. All major documentation will be reviewed including that received from the supplier, storage/maintenance (including calibration) and installation instructions. In addition, the verification documentation associated with preservice I&C system testing programs (e.g. calibration, response time, circuit continuity, trip set points, etc.) will be reviewed and activities observed where possible. The as-built configuration will be verified including instrument identity, name plate data, location, mounting conditions, and other principal characteristics, as applicable. Conformance with design documents and specifications, supplier requirements and installation requirements will be verified.

3.2.3.3.2 Piping/Tubing - Topic III.2-Ic

This activity will include a review of all major fabrication documentation and an as-built verification of piping and tubing associated with a selected portion of a major AFW I&C system. Material certifications and other applicable documentation will be reviewed against design requirements. A field survey of the selected portion will be conducted to verify routing, supports, size, slope and valve types. Conformance with applicable design, supplier and other installation requirements will be verified. Preservice hydro test results will be reviewed.

3.2.3.3.3 Cable - Topic III.3-Ic

A review will be conducted of all major supplier documentation associated with the cable of a selected portion of a major AFW I&C system. The fabrication documentation review will encompass cable material certifications, insulation certifications, stranding and color coding characteristics and other applicable documentation. The as-built configuration of the selected portion of the system will be verified including routing and terminations (correct tools for lugging, proper crimp and lug size). Conformance with applicable design, supplier and other installation requirements will be confirmed. Continuity test results will be reviewed to verify circuit integrity.

3.2.3.4 HVAC Systems and Components

An evaluation of the quality of construction of selected HVAC systems and components will be conducted. Included in the scope of this portion of the review are selected HVAC equipment, ducts and supports associated with the AFW system.

3.2.3.4.1 HVAC Equipment - Topic IV.I-Ic

A review of the complete construction chain including verification of the physical configuration will be conducted for a major HVAC component, one of the three major mechanical components selected for detailed review in the IDV. The fabrication documentation review will encompass all major supplier documentation, including functional requirement and environmental and seismic qualification documents. Included will be the review of the stresses in equipment and supports, including anchorages, as applicable. Storage/maintenance and construction/installation documentation will be reviewed and, where possible, selected associated activities will be observed. Verification documentation associated with all major preservice equipment and related system testing programs will be reviewed and where possible verification activities including actual tests will be observed. The as-built configuration review will include verification of equipment identity, principal features, name plate data, location, orientation, and support characteristics, as applicable. Conformance with design documents (including P&ID's and equipment location drawings), supplier documents and associated installation requirements will be verified.

3.2.3.4.2 HVAC Ducts and Supports - Topic IV.2-Ic

This activity will include a review of all major fabrication documentation and as-built verification of a selected portion of a duct and support system associated with a major AFW HVAC system. Vendor drawings, material cerifications, and other applicable documentation will be reviewed. A field survey of the selected portion will be conducted to verify (to tape measure accuracy) routing, duct characteristics, and support location and configuration. Conformance with applicable design, supplier and other installation requirements will be confirmed.

3.2.3.5 Structural Components

The quality of construction of plant structures will be evaluated based upon a review of selected structural components. Included in the scope of this portion of the review are selected foundations, concrete structural elements and structural steel components of the structures which house the AFW system.

3.2.3.5.1 Foundations - Topic V.1-Ic

This activity will include the review of fabrication and construction/installation documentation associated with building foundations selected for detailed review in the IDV. The fabrication documentation review will encompass all major supplier documentation including material certifications, rebar placement drawings, and other applicable documentation. Construction/installation documentation to be reviewed will include concrete materials documentation, concrete cylinder test results, inspection reports and other applicable documentation. Conformance with design documents, supplier requirements and associated construction/installation requirements will be verified.

3.2.3.5.2 Concrete Components - Topic V.2-Ic

A review of fabrication and construction/installation documentation will be conducted and the as-built configuration will be verified for major concrete structural elements selected for detailed review in the IDV. The documentation review will encompass all major supplier and construction/installation documentation associated with reinforcing steel, inserts and penetrations, and concrete documentation of a selected portion of each component. A field survey will be conducted to verify overall element dimensions (including thickness), location and size of major openings and selected penetrations, and principal characteristics of selected inserts. Conformance with applicable design, supplier and other installation requirements will be confirmed.

3.2.3.5.3 Structural Steel Components - Topic V.3-Ic

This activity will include the review of major fabrication and construction/installation documentation and an as-built verification of the structural steel components selected for detailed review in the IDV. The fabrication documentation review will encompass shop detail drawings, material certifications, welding documentation, and other major supplier documentation. Construction/installation documentation will address field welding, bolting (torque) and other applicable documentation. A field survey will be conducted to verify, where possible, major element characteristics including member size, plate thickness, weld size, and bolt pattern and size for a selected connection of each member. Conformance with applicable design, fabricator and other installation requirements will be confirmed.

3.2.4 DEFINITION OF REVIEW SCOPE FOR THE <u>(second system - to be supplied)</u>

3.2.5 DEVELOPMENT OF ICV PROGRAM CHECKLISTS

Generic checklists were developed for each of the review scope categories discussed in previous sections utilizing guidance as applicable contained in applicable ANSI documents, the construction review program guidelines published by INPO and other industry standards. For each of the construction review scope areas shown in Figure 3.2-1, the reviewer develops a specific checklist incorporating generic checklists as appropriate. In most cases, the specific checklist is derived from the generic checklist by addition of specific requirements applicable to the construction area being reviewed. In some cases, it may be appropriate to use only a portion of the generic checklist or to develop a unique checklist.

In each case, the checklist prepared by the reviewer will be checked by the lead technical reviewer for the area. (Note that if the lead technical reviewer prepares a checklist, it is permissible for him to both originate and check the contents of the checklist). During their review process, the lead technical reviewers examine the checklist for interfaces with other ICV areas and perform a general review of the completeness and adequacy of the proposed checklist. The LTR's review is to be coordinated with the project manager as necessary to resolve questions which cut across discipline lines. In the event that the Project Manager or Lead Techncial Reviewers have comments on the checklist, the checklist preparer and those having comments will discuss the comments and reach an appropriate resolution. After reaching concurrence in the adequacy of the checklist, the LTR will indicate his approval and the checklist will be available for use by the reviewer.

The reviewer, having an approved checklist, can then proceed with the review process for this specified area, in accordance with Project Instruction PI-3201-001, Engineering Evaluation Preparation and Control. In performing the evaluation, the reviewer will document the information which he used in order to complete the checklist. Such information will include component identification, the date or revision number of the associated documents, the document number, and an indication of the source of the information (i.e., where data and any associated documents were obtained).

3.2.5.1 Development of Checklists for Review of Supplier Documentation

The generic checklist for review of supplier documentation was developed considering questions such as:

- What is the identity of the supplier documentation being reviewed (including P.O. number, supplier name, component name and identification number)?
- Has the documentation been reviewed and accepted by the appropriate organization in accordance with procedures?
- Is the documentation complete?
- Does the documentation comply with purchase specification requirements?

- Where appropriate, does seismic and environmental qualification documentation comply with purchase specification requirements?
- Have the necessary shipping, handling, storage, installation, and maintenance requirements been specified by the supplier and are these consistent with purchase specification requirements?

For each type of system, component or structural element the lead technical reviewer will supplement the generic checklist with appropriate additional questions, as applicable.

3.2.5.2 Development of Checklists for Review of Storage and Maintenance Documentation

The generic checklist for review of storage and maintenance documentation was developed considering questions such as:

- What is the identity of the storage and maintenance documentation being reviewed, including document type (receipt inspection, in-storage/in-place maintenance records, etc.) and document identification (document title, revision, date)?
- What is the identity of the component being reviewed (name, identification number)?
- Does the documentation for the receiving process include component review against purchase specification requirements?
- Are nonconforming items properly identified, processed and closed out?
- Does the maintenance program meet the necessary requirements specified for the component relative to humidity, cleanliness, lubrication, shaft rotation, energization, etc., as applicable?

For each type of system, component or structural element the lead technical reviewer will supplement the generic checklist with appropriate additional questions, as applicable.

3.2.5.3 Development of Checklists for Review of Construction and Installation Documentation

The generic checklist for review of construction and installation documentation was developed considering questions such as:

- What is the identity of the construction/installation documentation being reviewed, including type (concrete, welding, bolting, NDE, etc.) and identification (title, revision, date)?
- What is the identity of the system, component or element and its physical location in the plant?
- Are all appropriate construction/installation procedures and instructions identified?
- Are the current revisions of drawings, specifications and other requirements utilized in the work?
- Does the documentation include verification that the work has been performed by properly qualified personnel?
- For those activities observed, do the construction/installation activities conform to requirements?
- Have the necessary inspections been performed?
- Has the work been performed utilizing the proper tools/equipment? Have such tools/equipment been properly calibrated in accordance with procedures?
- Have the rework activities been performed in accordance with requirements?

- Have deviations from design/supplier requirements been properly documented, processed and closed out in accordance with procedures?

For each type of system, component or structural element the lead technical reviewer will supplement the generic checklist with appropriate additional questions, as applicable.

3.2.5.4 Development of Checklists for Review of Selected Verification Activities

The generic checklist for review of selected verification activities was developed considering questions such as:

- What is the identity of the verification activity being reviewed (cable separation verification, pipe support reinspection, bolting study, pre-service test, including type, etc.)?
- What is the identity of the system, component or element(s) included in the verification activity under review?
- What is the identity of the verification activity documentation being reviewed (program plan, procedures, instructions, etc.)?
- What is the quality-related objective of the verification activity and does the activity as specified/documented meet the objective?
- Where verification activities are observed, do the activities comply with requirements and are they properly documented?
- Are nonconformances properly identified, processed and closed out?

For each type of system, component or structural element the lead technical reviewer will supplement the generic checklist with appropriate additional questions, as applicable.

3.2.5.5 Development of Checklists for Review of Verification of Physical Configuration

The generic checklist for review of verification of physical configuration was developed considering questions such as:

- What is the identity of the system, component or structural element being reviewed (name, identification number, location in plant, reference design documents)?
- Has the system, component or element been properly tagged/marked for identification in accordance with requirements?
- On the basis of visual inspection, has the component been properly constructed/installed and has it been maintained and protected during the construction process in accordance with requirements?
- Does the configuration comply with design requirements, including physical dimensions, location, orientation, name plate data, grounding, use of proper materials, insulation, routing, etc., as applicable?
- Have deviations from design requirements been properly identified, processed and closed out in accordance with procedures?

For each type of system, component or structural element the lead technical reviewer will supplement the generic checklist with appropriate additional questions, as applicable.

3.2.6 PLAN FOR ADDITIONAL SAMPLING, VERIFICATION, AND TESTING

The initial sampling and verification within the scope of the ICV is based upon an evaluation of documentation to verify the quality of both inaccessible (e.g. rebar placement) and accessible systems, components and structures. The quality of accessible items will be further verified by visual inspection or measurement as appropriate.

Additional sampling or verification within the scope of the ICV or outside the scope into other systems will be conducted if discrepancies are found. The level of additional sampling or verification will be based upon the nature of the discrepancy. In all cases when discrepancies are found, an introspective evaluation will follow to identify the extent and root cause. The root cause may either be random or systematic (generic). The additional review will attempt to verify whether the discrepancy is restricted to the specific system, component, or structure under review; restricted to work by a specific construction organization; or if the discrepancy cuts across many interfaces and applies to similarly constructed systems, components, and structures.

At first, the additional sampling and verification will be directed at an evaluation of additional documentation; however, if this documentation is incomplete or insufficient to identify the extent and root cause of discrepancies; inspection or testing will be considered, as appropriate. If required to supplement internal resources, TERA may consider subcontracting a portion of any required inspection or testing services (e.g. non-destructive examination, materials testing, etc.) to a qualified organization that meets the independence requirements of Section 1.4 of this Plan.

4.0 DOCUMENTATION

Auditable records must be maintained to document substantive elements of the IDCV review and evaluation process, to document technical conclusions including the status of disposition of items associated with the review process leading to findings, to document the revision of records, and to establish quality assurance measures necessary to provide adequate confidence and assurance of the quality of services. The following sections establish documentation requirements for engineering evaluations, calculations, field verification, and external communications. Section 5.0 of this Plan establishes the requirements for reporting documentation. Section 6.0 of this Plan establishes the QA documentation requirements.

4.1 DOCUMENTATION OF ENGINEERING EVALUATIONS, CALCULATIONS, AND FIELD VERIFICATION RESULTS

Engineering evaluations, calculations, and field verification results provide the bases for all substantive conclusions reached in the IDCV. These items provide the "trail" of information which supports IDCV conclusions; both positive and negative, whatever the case may be. While the reporting mechanism established in Section 5.0 of this Plan addresses the documentation of reporting requirements which are generally applicable to negative conclusions, it is equally vital that positive conclusions be justified and documented in an auditable form as well.

The requirements for preparation and control of engineering evaluation documentation required for the Midland IDCV are contained in Project Instruction PI-3201-001, Engineering Evaluation Preparation and Control. Engineering evaluations are required for tasks such as design criteria evaluation, commitment compliance evaluation, design evaluation, construction records evaluation, and field verification.

The requirements for preparation and control of calculation documentation, including computer analyses documentation, required for the Midland IDCV are contained in Engineering Control Procedure ECP-5.2, Calculation Preparation and Control. Calculations are prepared as required to verify designs, design parameters, design criteria, performance parameters, evaluate data, and otherwise provide quantitative information in accordance with accepted analytical and mathematical methods. Calculations are intended to assist IDCV reviewers in reaching necessary conclusions relative to the quality of the Midland plant design.

4.2 DOCUMENTATION OF EXTERNAL COMMUNICATIONS

The requirements for the preparation and control of documentation for external communications are contained in Project Instruction PI-3201-010, External Communications: Preparation of Contact Log Sheets. Under prescribed circumstances, oral communications and meetings that include discussions with parties external to the IDCV review organization must be documented to provide an auditable record of information which may have an impact on IDCV conclusions and the preservation of an independent process in reaching these conclusions. Accordingly, external communications which address the following subjects should be documented consistent with the provisions of PI-3201-010:

- IDCV scope of review
- Confirmed items (i.e., potential findings)

- Findings
- Findings resolution

Additionally, any information or data having a bearing or potential bearing on IDCV conclusions which may be obtained verbally during telecons or meetings should be documented consistent with the provisions of PI-3201-010; however, the IDCV reviewer is encouraged to subsequently seek written documentation to the same effect from the external party.

Findings and findings resolution shall not be discussed with external parties without the consent of the Project Manager. The project manager is responsible for notifying CPC at least one week prior to meetings where findings or findings resolution must be discussed. This is required so that NRC can be notified that such meetings will be taking place.

5.0 PROGRAM REPORTING

5.1 TYPES OF REPORTS

The following types of reports will be prepared in the IDCV:

- Open, Confirmed, and Resolved (OCR) Item reports
- Finding reports
- Finding resolution reports
- Final report

OCR reports document the disposition of the IDCV review process leading to either findings or the resolution of items which have surfaced during the review, but have been resolved after considering additional information.

Finding reports document verified deviations in the 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 or field installation. 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.

Finding Resolution reports document the conclusions of the review process which has been undertaken to resolve findings and completely close out any concern about the findings. 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.

The IDCV Final report documents all substantive conclusions reached in the IDCV, including the process leading to these conclusions. Both positive and negative conclusions will be identified to provide a balanced perspective and to document a complete record. While the overall IDCV objective is to verify the quality of the Midland project design and construction efforts identifying any deficiencies, it is necessary to have a record which documents items that have been dismissed (i.e., positive conclusions) as the bases for these conclusions are equally important.

5.2 REPORTING PROCESS

5.2.1 REPORTING SYSTEM

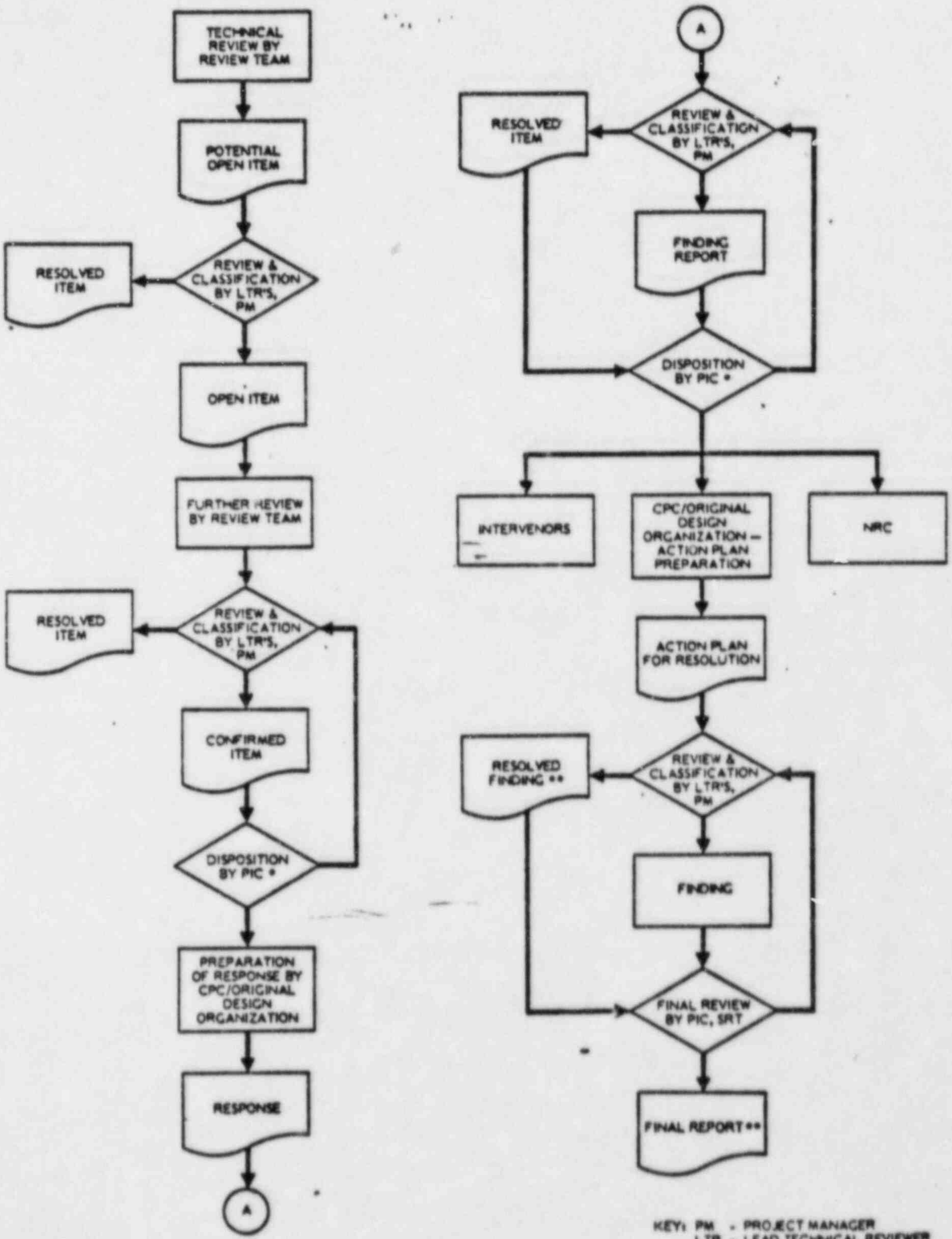
The system for IDCV reporting is shown graphically in Figure 5.2-1. This figure provides a diagram or flow chart of the report generation process and a summary of the sequence.

Upon initial technical review, Potential Open Items may be identified by an IDCV reviewer. This determination will be based upon his judgment that a potential deviation exists in implementation of design criteria, design or construction commitments, and design or construction procedures, thus requiring additional investigation or confirmatory analysis by the IDCV review team. Upon documenting his determination, the IDCV reviewer forwards a preliminary OCR report to his Lead Technical Reviewer (LTR) who reviews it with the project team (Project Manager and all LTRs). If the project team concurs with the reviewer's determination, the Potential Open Item becomes an Open Item which is formally controlled. The project team may resolve the Potential Open Item, thus requiring reclassification of the item as a Resolved Item and modification of the OCR report reflecting this change which is then formally controlled.

The Open Item will be reviewed further by the review team until such a point that available information has been depleted. At this time, the IDCV reviewer will prepare a Resolved Item report or a Confirmed Item report which documents his determination after further review. A Confirmed Item is judged to be an apparent finding by the review team and requires further action to provide documentation that may not have been available to the IDCV review team. His

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

FIGURE 5.2-1

recommendation is forwarded to his LTR who reviews the classification and makes a recommendation to the project team. The project team may agree with the LTR's recommendation at which point the Resolved Item report or Confirmed Item report becomes final. Alternatively, the project team may review the classification and require further work by the IDCV reviewers. All final OCR reports are forwarded to the Principal-in-Charge (PIC) for his concurrence, disposition, and determination whether a formal review is required by the Senior Review Team (SRT). In all cases, the SRT receives a copy of the OCR report irrespective of whether they are requested to undertake a formal review.

The PIC may agree with the project team's classification and recommend that the Project Manager forward Confirmed Item reports to CPC with carbon copies to the appropriate design organizations, or he may request a review by the SRT to assist him in making his determination. Alternatively, or in parallel, he may request that the project team or review team conduct further review.

The LTRs and IDCV reviewers will then review the additional information received from CPC/original design organization and make a determination whether the item becomes a Resolved Item or a Finding. The LTRs will make the recommendation to the project team who will review the classification. The project team may agree with the LTR's recommendation, at which point the Resolved Item report or Confirmed Item report becomes final. Alternatively, the project team may review the classification and require further work by the IDCV reviewers. Upon completion of this process, the OCR report or Finding report is forwarded to the PIC by the Project Manager for a similar review process as has been previously described. After his review and any required review by the SRT, the PIC will direct the Project Manager to forward Finding reports to CPC/original design organization, recognized intervenors, and the NRC.

CPC/original design organization will respond with an action plan for resolution of the issues identified. The project team will review the response and determine whether the issue has been resolved. If so, a Finding Resolution report will be issued by the project team for review by the PIC in a similar fashion as has been previously described. Alternatively, the Finding may not be resolved, at which point it will remain open and documented in the Final report. It must be noted that this eventuality is not anticipated since closure must be sought by the involved organizations. The final report will document all IDCV conclusions as discussed previously.

5.2.2 REPORT PREPARATION AND DISTRIBUTION

The preparation and control of OCR reports, Finding reports, and Finding Resolution reports is addressed in Project Instruction PI-3201-008, Preparation and Control of Open, Confirmed, and Resolved Item Reports, Finding Reports, and Finding Resolution Reports. Section 3.0 of PI-3201-008 provides instructions for report preparation, and Section 5.0 addresses the distribution of these reports.

The Final report will include documentation of all conclusions, including references to applicable documents that support these conclusions. A draft Final report will be transmitted to CPC and NRC for their review. Resolution of their comments will be documented in an auditable manner. A copy of the draft Final report will be sent to recognized intervenors. It should be noted that CPC and NRC comments are intended to be of a clarification nature or to correct misinformation. Upon TERA resolution of the comments, the Final report will be issued and distributed to CPC, NRC, and recognized intervenors.

5.2.3 INTERCHANGE OF INFORMATION

The requirements of Section 4.2 are not intended to prohibit the informal interchange of information between IDCV personnel and external parties. These communications are essential to the IDCV review process. However, the items in Section 4.2 require documentation for the reasons cited. Furthermore, to preserve the independence of the IDCV reivew process, it is important that IDCV personnel maintain discretion in the dissemination of information bearing on findings to outside parties until such a time that this information is final. This procedure will prevent confusion and foster credibility to the IDCV review process.

5.3 IDENTIFICATION AND EVALUATION OF DESIGN/CONSTRUCTION PROBLEMS

It is the duty of all IDCV personnel to identify any deficiency known to him that may be significant to the public health and safety. He shall be permitted to conduct all reasonable evaluations necessary to make a determination of the significance of suspected items. IDCV personnel are responsible for presenting their conclusions in a manner that other technically qualified personnel may understand and independently verify. Furthermore, it is the responsibility of IDCV personnel to assess the significance of their conclusions and attempt to understand the extent and root cause of findings. Any deviation of the above should be brought to the attention of the Project Manager.

6.0 QUALITY ASSURANCE

6.1 APPLICABLE REQUIREMENTS

The Midland IDCV shall be performed in accordance with applicable quality assurance requirements of the NRC's regulation 10 CFR 50, Appendix B. Furthermore, the IDCV will comply with:

- NRC Regulatory Guide 1.28 (6/7/72) including Sections 1, 2, 3, 5, 7, 17, and 18 of ANSI N45.2-1971
- NRC Regulatory Guide 1.64 (Revision 1, 2/75) including Sections 1, 2, and 6 of ANSI N45.2.11-1974

These requirements are implemented by the TERA Corporate Quality Assurance Plan (QAP), Revision 3 (January 1, 1980) and the Midland IDCV Project Quality Assurance Plan (PQAP), Revision 0 (November 11, 1982).

6.2 VERIFICATION OF COMPUTER CODES

All computer codes utilized by IDCV analysts shall be verified as follows:

- Program Verification - The quality of the code should be determined from a comparison of the code generated solutions with known solutions of selected problems.
- Facility Verification - Given that the generic quality of the code has been determined, the capability to reproduce known results utilizing hardware and software available to TERA must be determined.

Program verifcation may be completed by external parties; however, facility verification is the responsibility of TERA and must be so demonstrated.

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

Prepared by: Howard A. Levin
Howard A. Levin
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Verified by: Charles E. Lemon
Charles E. Lemon
Project Quality Assurance Engineer
TERA Corporation

Approved by: John W. Beck
John W. Beck
Principal-in-Charge
Vice President
TERA Corporation

Approved by:
Robert W. Feiton
Executive Vice President
TERA Corporation

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TERA CORPORATION

TERA CORPORATION
QUALITY ASSURANCE PROGRAM

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

TERA CORPORATION

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

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

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APPENDICES

PROJECT QUALITY ASSURANCE PLAN

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I. 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 identity 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 Associates, 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.

2.2.6 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 broad 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 mechamics, 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 Martore	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, electrical 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).

PROJECT QUALITY ASSURANCE PLAN

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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

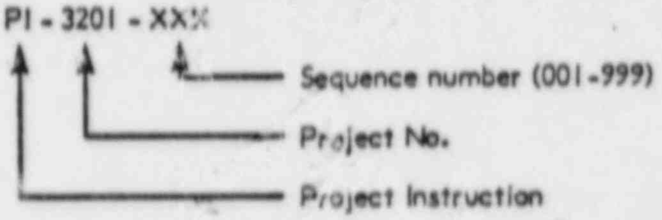
Open, Confirmed and Resolved Item Reports, Finding Reports and Finding Resolution Reports are controlled in compliance with the requirements of Project Instruction PI-3201-008; Preparation of Open, Confirmed and Resolved Item Reports, Finding Reports and Finding Resolution Reports."

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

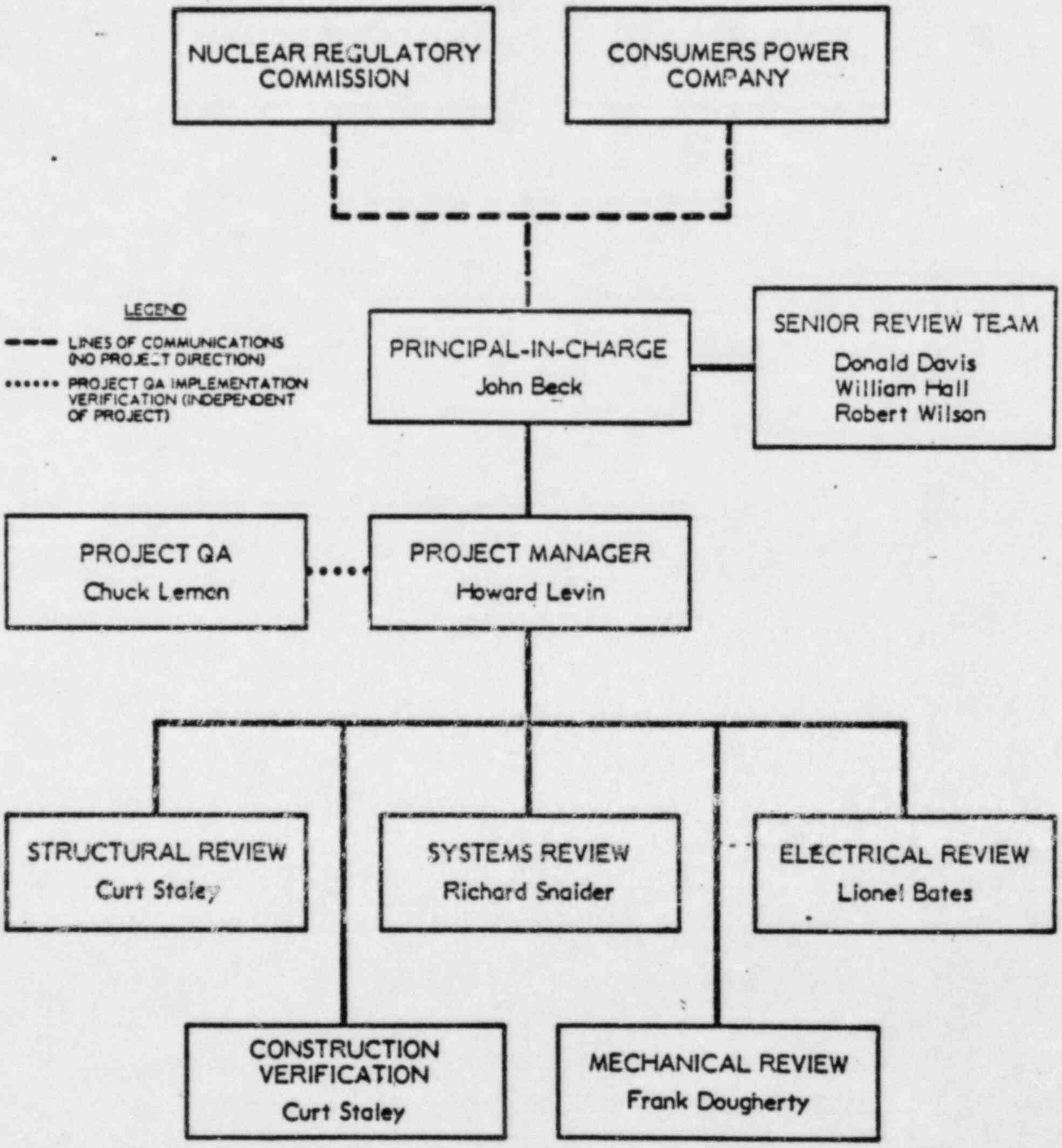


FIGURE I

ATTACHMENT A, PQAP-3201

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

ATTACHMENT B-1
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 (TERA to CPC, NRC)

Sequence No.	Date	From	To	Subject

ATTACHMENT B-2
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 (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

ATTACHMENT B-4
PQAQ-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 (Misc.)

Sequence No.	Date	From	To	Subject

ATTACHMENT B-5
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 (CPC to Bechtel)

Sequence No.	Date	From	To	Subject

ATTACHMENT B-6
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 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

ATTACHMENT B-8
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 (CPC to NRC)

Sequence No.	Date	From	To	Subject

ATTACHMENT B-9
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 (Bechtel to TERA)

Sequence No.	Date	From	To	Subject

ATTACHMENT C
PQAP-3201

CORRESPONDENCE CONTROL

I.D. NO. CC-______-______

TERA CORPORATION

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 I 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:

```
XXX-XXX-XX
 ↑   ↑   ↑
 │   │   └─Sequence number
 │   └─────Subject file identifier*
 └─────────Project identifier*
```

*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 ____

Attachment C

CALCULATION INDEX

CALCULATION CONT. ID. NO	TITLE	DATE	SUPERCEDED BY	DATE

TERA CORPORATION

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.

ENGINEERING CONTROL PROCEDURE

ECP-5.3	SUBJECT: DRAWING PREPARATION AND CONTROL
REV.: 1 DATE: 7/1/81	
PAGE 3 OF 5	PREPARED BY: APPROVED BY:

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.

ENGINEERING CONTROL PROCEDURE

ECP-5.3	SUBJECT: DRAWING PREPARATION AND CONTROL
REV.: 1 DATE: 7/1/81	
PAGE 4 OF 5	PREPARED BY: APPROVED BY:

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.

PROJECT DRAWING INDEX

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

TERA CORPORATION

ENGINEERING CONTROL PROCEDURE

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

Attachment B (cont'd)

TABLE OF CONTENTS (CONT.)

Attachment C

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

TERA CORPORATION

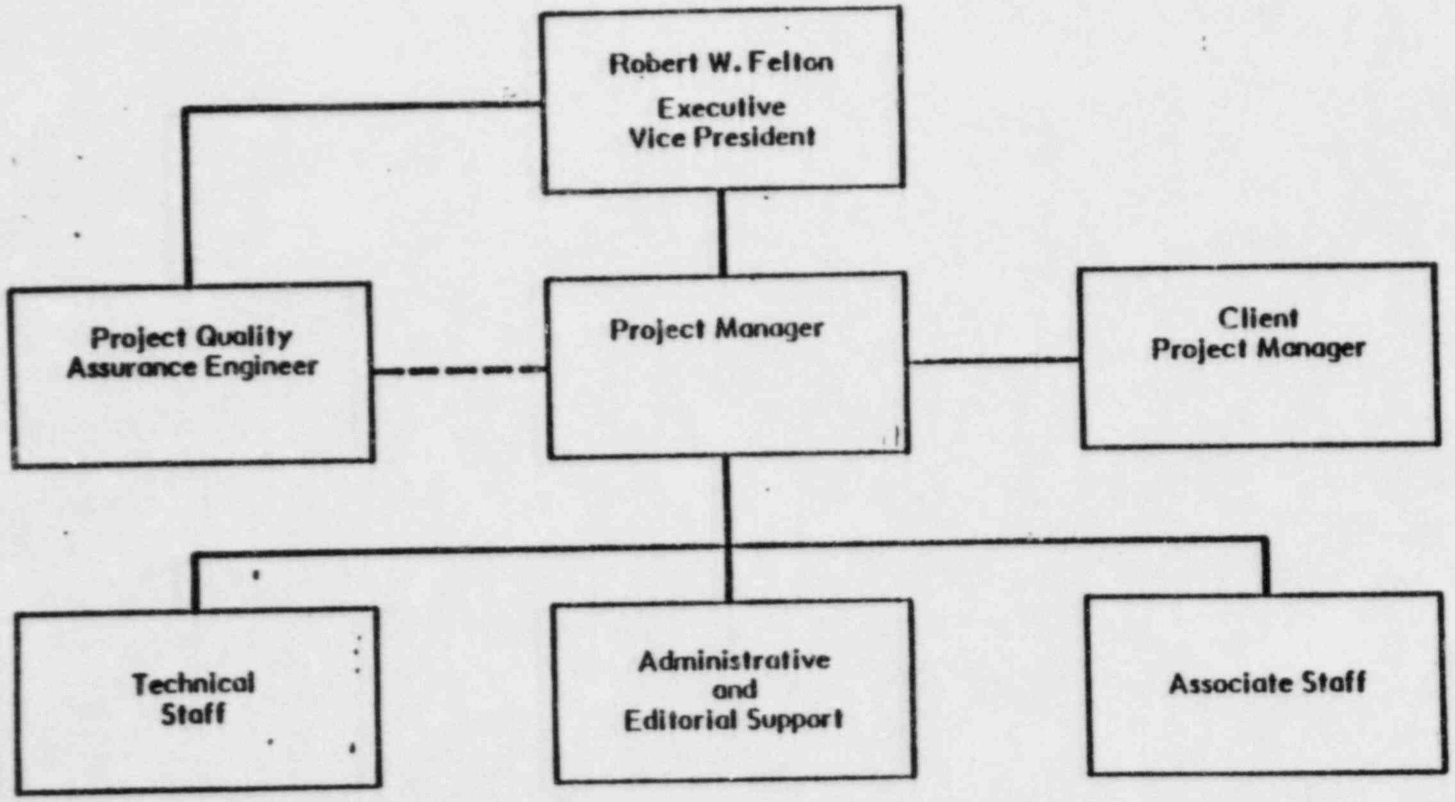


FIGURE I

PROJECT ORGANIZATION

ENGINEERING CONTROL PROCEDURE

ECP-5.6
REV.: 3 DATE: 7/1/81
PAGE 1 OF 4

SUBJECT:
QUALITY ASSURANCE AUDITS

PREPARED BY:
APPROVED BY:

I. 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.

ENGINEERING CONTROL PROCEDURE

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

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.

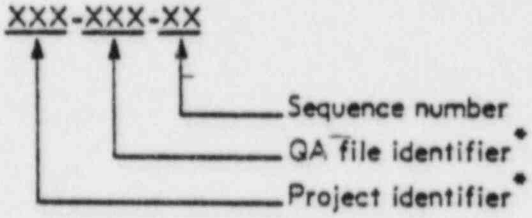
6. FOLLOW-UP ACTIONS

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 ____________ NAME ____________ TITLE ____________ DATE

AUDITED BY ____________ NAME ____________ TITLE ____________ DATE

ISSUED BY ____________ NAME ____________ TITLE ____________ DATE

DISTRIBUTION

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

ACTION VERIFIED BY ______________________ NAME ________ DATE

ISSUED 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:
REV.: 0 DATE: 7/1/81	CORRECTIVE ACTION
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 requested 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.

ENGINEERING CONTROL PROCEDURE

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

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 designted representative.

ECP-5.15

Attachment A

DIN:

PROJECT NUMBER:

PROJECT TITLE:

CLIENT:

DATE:

CORRECTIVE ACTION REPORT

TO: ORGANIZATION:	FROM: TITLE:	CAR NO.

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

CORRECTIVE ACTION REPORT

TERA CORPORATIO

Attachment A

DIN: ______________ ____

PROJECT NUMBER: ______________

PROJECT TITLE: ______________

CLIENT: ______________

DATE: ______________

CORRECTIVE ACTION REPORT

TO: ORGANIZATION:	FROM: TITLE:	CAR NO.

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

CORRECTIVE ACTION REPORT

TERA CORPORATION

Attachment B

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

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 I of each final engineering evaluation prior to verification and approval.

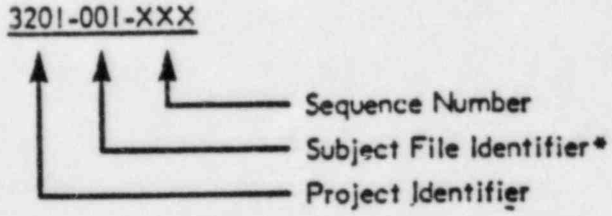
3.0 VERIFICATION AND APPROVAL

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).

ATTACHMENT A, PI 3201-001

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)

TERA CORPORATION

ATTACHMENT B, PI 3201-001

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.

TERA CORPORATION

ATTACHMENT C, PI-3201-001

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:	APPROVED BY: John W. R

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:

3201-XXX-X-XXX

Sequence Number
Report Type Identifier 1
Subject File Identifier*
Project Identifier*

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).

ATTACHMENT A, PI-3201-002

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)

TERA CORPORATION

ATTACHMENT B-1, PI-3201-002

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.

TERA CORPORATION

ATTACHMENT B-2, PI-3201-002

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.

TERA CORPORATION

ATTACHMENT B-3, PI-3201-002

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.

TERA CORPORATION

ATTACHMENT B-4, PI-3201-002

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.

TERA CORPORATION

ATTACHMENT B-5, PI-3201-002

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.

ATTACHMENT C, PI-3201-002

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 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 - 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 construction 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 reclassification 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 reassessment 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.

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 6 of 8	PREPARED BY: APPROVED BY:

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.

PROJECT INSTRUCTION

PI-3201-008
REV.: 0 DATE: 11/11/82
PAGE 7 of 8
SUBJECT: Preparation and Control of Open, Confirmed and Resolved Item Reports, Finding Reports and Finding Resolution Reports
PREPARED BY:
APPROVED BY:

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.

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 8 of 8	PREPARED BY: APPROVED BY:

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.

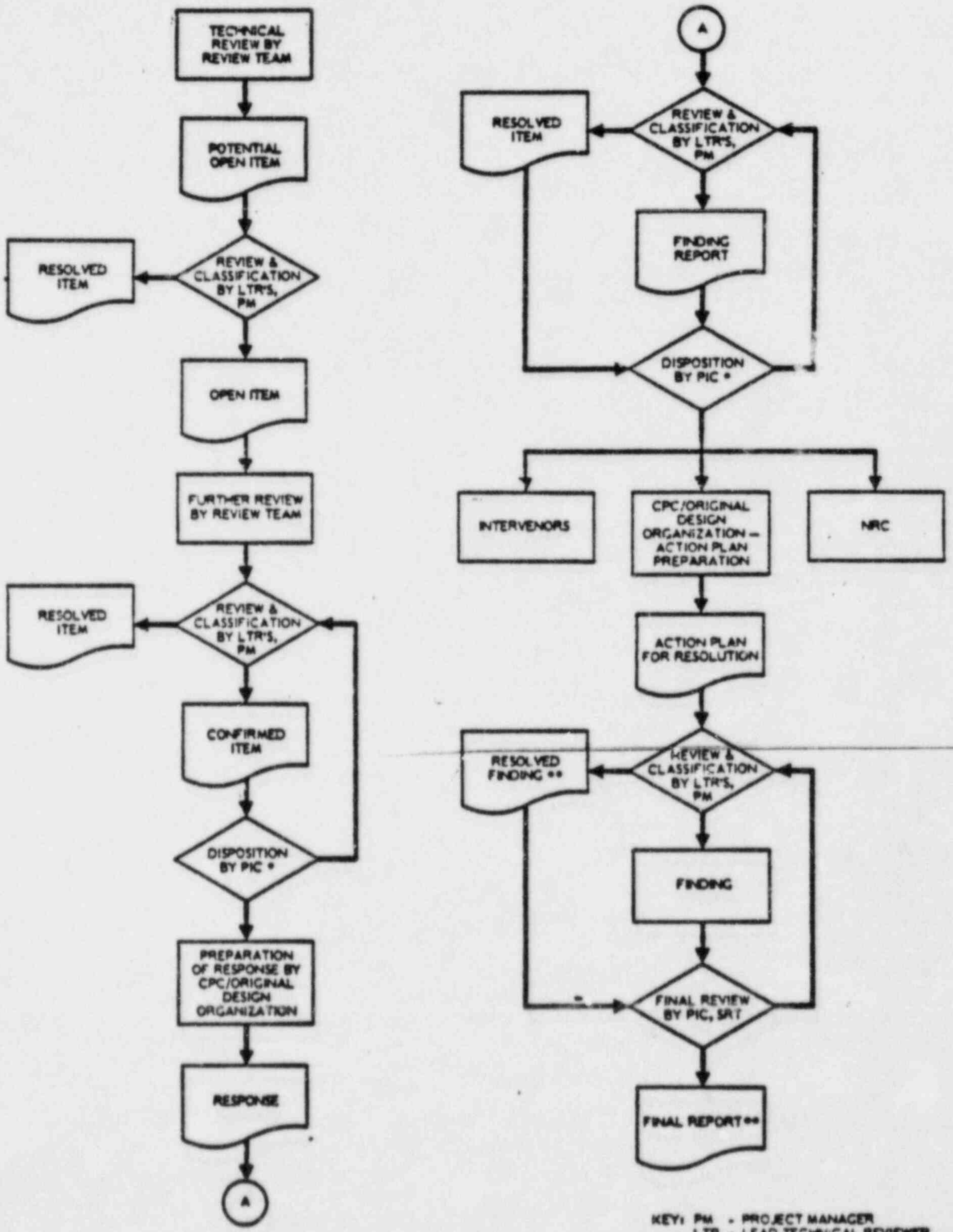
5.3 It shall be the responsibility of the Project Manager to determine when there is a need to have a meeting with the project team, CPC and the original design or construction organization to discuss findings or resolution of findings. He shall then notify CPC at least one week prior to the meeting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



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

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

ATTACHMENT A, PI-3201-008

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
REV.: 0 DATE: 11/11/82
PAGE 1 of 3
SUBJECT: External Communications: Preparation of Contact Log Sheets
PREPARED BY:
APPROVED BY: John W. Beck

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: John W. Reed

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: ______

ATTACHMENT B, PI-3201-010

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.

TERA CORPORATION

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

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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 1 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.

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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 Regulation, 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*, 1st 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.

11/4/82

TERA CORPORATION

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, construction, 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 construction 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

11/08/82

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-cuthor 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(II-I)-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 1 and 2; Crystal River 3; Calvert Cliffs 1 and 2; Oconee 1, 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 I (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 I (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

MIDLAND INDEPENDENT DESIGN VERIFICATION PROGRAM

OCTOBER 25, 1982

TERA CORPORATION

MIDLAND INDEPENDENT DESIGN VERIFICATION
PROGRAM GOALS

PRIMARY GOAL

- PROVIDE AN INDEPENDENT EVALUATION OF THE QUALITY OF THE MIDLAND PLANT DESIGN

OBJECTIVES

- EVALUATE QUALITY OF DESIGN BY EVALUATING A SAMPLE (VERTICAL SLICE) OF ENGINEERED SYSTEMS, COMPONENTS AND STRUCTURES SUCH THAT RESULTS MAY BE EXTRAPOLATED TO SIMILARLY DESIGNED FEATURES WITH A HIGH DEGREE OF CONFIDENCE
- ADDRESS DESIGN CONTROL PROGRAMMATIC AREAS (E.G. DESIGN INPUTS/OUTPUTS, INTERFACES, PROCESS, CHANGES, ETC.)
- EVALUATE DESIGN FEATURES BY UTILIZING A COMBINATION OF METHODS SUCH AS:
  - REVIEW OF DESIGN CRITERIA, REGULATORY AND LICENSING COMMITMENTS
  - CHECK OF ANALYSES, CALCULATIONS AND EVALUATIONS
  - CONFIRMATORY ANALYSES, CALCULATIONS AND EVALUATIONS
  - CHECK OF DRAWINGS AND SPECIFICATIONS
- COMPARE INSTALLATION AGAINST AS-BUILT DRAWINGS (configuration check)
  (Not really checking circuits)

TERA CORPORATION

~ 60 man weeks
of effort to begin with

SYSTEM SELECTION CRITERIA

- IMPORTANCE TO SAFETY

- INCLUSION OF DESIGN INTERFACES

  - INVOLVES MULTIPLE DESIGN INTERFACES AMONG ENGINEERING DISCIPLINES AND DESIGN ORGANIZATIONS

- ABILITY TO EXTRAPOLATE RESULTS

  - DESIGN CRITERIA, DESIGN CONTROL PROCESS ARE SIMILAR TO OTHER SAFETY SYSTEMS

- DIVERSE IN CONTENT

  - SYSTEM INCLUDES DIVERSE FEATURES, THUS REQUIRING DESIGN INPUT FROM MAJOR ENGINEERING DISCIPLINES

- SENSITIVE TO PREVIOUS EXPERIENCE

  - PREVIOUSLY EXHIBITED PROBLEMS CAN BE TESTED

- ABILITY TO TEST AS-BUILT INSTALLATION

TECHNICAL REVIEW TASKS

- IDENTIFICATION OF DESIGN CHAIN INCLUDING DESIGN ORGANIZATIONS, THEIR INTERFACES AND DESIGN PRACTICES
- REVIEW OF 50.55e REPORTS, NONCONFORMANCE REPORTS, NRC REGION III AND IV INSPECTION REPORTS, CPC DESIGN QA MONITORING REPORTS
- DEVELOPMENT OF DETAILED REVIEW PROGRAM CHECKLIST
- IDENTIFICATION AND COLLECTION OF INFORMATION (PROCEDURES, SPECIFICATIONS, DRAWINGS, CALCULATIONS, ETC.)
- REVIEW OF DESIGN CRITERIA AND COMMITMENTS
  - IDENTIFICATION OF UNIQUE FEATURES, CIRCUMSTANCES, OR DESIGN CHANGES ASSOCIATED WITH EACH DESIGN AREA
  - REFINEMENT OF SCOPE
- DESIGN REVIEW
  - REVIEW OF IMPLEMENTING DOCUMENTS
  - CHECK OF ANALYSES, CALCULATIONS, AND EVALUATIONS
  - CONFIRMATORY CALCULATIONS OR EVALUATIONS
  - CHECK OF DRAWINGS AND SPECIFICATION
  - VERIFICATION OF CONFIGURATION
- IDENTIFICATION OF POTENTIAL FINDINGS

TECHNICAL REVIEW TASKS
(CONTINUED)

- EVALUATION OF SIGNIFICANCE OF FINDINGS
- SENIOR REVIEW TEAM EVALUATION
- FORWARDING OF FINDINGS TO DESIGN ORGANIZATIONS AND EVALUATION OF THEIR RESPONSE
- DOCUMENTATION/REPORTING

SCOPE OF DESIGN REVIEW

- REVIEW OF DESIGN CRITERIA AND COMMITMENTS
    - REGULATIONS
    - LICENSING COMMITMENTS
    - DESIGN OUTPUTS WHICH SERVE AS CRITERIA INPUTS TO OTHER DESIGN AREAS
- REVIEW OF IMPLEMENTING DOCUMENTS
    - EXISTENCE OF IMPLEMENTING DOCUMENT (E.G. PROJECT INSTRUCTIONS, DISCIPLINE DESIGN INSTRUCTIONS, CALCULATIONS/EVALUATIONS ETC.)
    - DESIGN CRITERIA PROPERLY DEFINED AND INTERPRETED
    - CLOSEOUT (CALCULATIONS/EVALUATIONS SIGNED OFF IN ACCORDANCE WITH INSTRUCTIONS)
- CHECK OF ANALYSES, CALCULATIONS AND EVALUATIONS
    - SAMPLING CHECK OF ORIGINAL ANALYSES, CALCULATIONS OR EVALUATIONS; REVIEW OF
        - DESIGN INPUTS (INCORPORATION OF DESIGN CRITERIA, CONFORMANCE WITH COMMITMENTS, TRANSFER OF INFORMATION)
        - ASSUMPTIONS

SCOPE OF DESIGN REVIEW
(continued)

  - METHODOLOGY (INCLUDING ANALYTICAL TECHNIQUES, EVALUATION PROCEDURES)
  - VALIDATION AND USE OF COMPUTER CODES
  - REVIEW OF OUTPUTS
  - COMPLIANCE WITH CODES, STANDARDS, NRC GUIDANCE

- CONFIRMATORY CALCULATIONS OR EVALUATIONS
  - "BLIND" INDEPENDENT RE-ANALYSIS OR RE-EVALUATION FOR SELECTED DESIGN AREA(S)
  - INDEPENDENT RE-ANALYSIS OR RE-EVALUATION FOR DESIGN AREA THAT MAY BE SUSPECT ON BASIS OF A REVIEW OF ORIGINAL CALCULATIONS OR EVALUATIONS
  - ALTERNATIVE TECHNIQUES, SIMPLE BOUNDING EVALUATIONS OR DETAILED ANALYTICAL TECHNIQUES MAY BE EMPLOYED
- CHECK OF DRAWINGS AND SPECIFICATIONS
  - VERIFICATION THAT THE DRAWING OR SPECIFICATION REFLECTS DESIGN REQUIREMENTS SPECIFIED IN THE DESIGN CALCULATIONS OR EVALUATIONS

SCOPE OF DESIGN REVIEW
(continued)

- VERIFICATION OF CONFIGURATION
  - INSTALLATION OF SYSTEM IN ACCORDANCE WITH P&IDs
  - INSTALLATION OF COMPONENTS AND PIPING IN ACCORDANCE WITH ARRANGEMENT DRAWINGS AND ISOMETRICS (APPROXIMATE LOCATION AND ORIENTATION)
  - INSPECTION OF SELECTED FEATURES FOR COMPLIANCE WITH DESIGN DETAILS (APPROXIMATE DIMENSIONS)
  - VERIFICATION THAT EQUIPMENT PART NUMBERS AGREE WITH DRAWINGS AND SPECIFICATIONS

PRELIMINARY MIDLAND INDEPENDENT DESIGN VERIFICATION REVIEW MATRIX FOR THE AUXILIARY FEEDWATER SYSTEM

DESIGN AREA	SCOPE OF REVIEW					
	REVIEW OF DESIGN CRITERIA AND COMMITMENTS	REVIEW OF IMPLEMENTING DOCUMENTS	CHECK OF CALCULATIONS AND EVALUATIONS	CONFIRMATORY CALCULATION OR EVALUATION	CHECK OF DRAWINGS AND SPECIFICATIONS	VERIFICATION OF CONFIGURATIONS
I. <u>AFW SYSTEM PERFORMANCE REQUIREMENTS</u>						
SYSTEM OPERATING LIMITS	X	X	X			
ACCIDENT ANALYSIS CONSIDERATIONS	X					
SINGLE FAILURE	X	X	X			
TECHNICAL SPECIFICATIONS	X					
SYSTEM ALIGNMENT/SWITCHOVER	X	X				
REMOTE SHUTDOWN	X					
SYSTEM ISOLATION/INTERLOCKS	X	X				
OVERPRESSURE PROTECTION	X					
COMPONENT FUNCTIONAL REQUIREMENTS	X	X	X		X	
SYSTEM HYDRAULIC DESIGN	X	X	X			
SYSTEM HEAT REMOVAL CAPABILITY	X	X	X			
COOLING REQUIREMENTS	X					
WATER SUPPLIES	X	X				
PRESERVICE TESTING/CAPABILITY FOR OPERATIONAL TESTING	X					
POWER SUPPLIES	X	X				
ELECTRICAL CHARACTERISTICS	X					
PROTECTIVE DEVICES/SETTINGS	X	X			X	
INSTRUMENTATION	X	X	X		X	
CONTROL SYSTEMS	X	X	X			
ACTUATION SYSTEMS	X					
NDE	X					
MATERIALS SELECTION/TRACEABILITY	X					

PRELIMINARY MIDLAND INDEPENDENT DESIGN VERIFICATION REVIEW MATRIX FOR THE AUXILIARY FEEDWATER SYSTEM (CONTINUED)

DESIGN AREA	SCOPE OF REVIEW					
	REVIEW OF DESIGN CRITERIA AND COMMITMENTS	REVIEW OF IMPLEMENTING DOCUMENTS	CHECK OF CALCULATIONS AND EVALUATIONS	CONFIRMATORY CALCULATION OR EVALUATION	CHECK OF DRAWINGS AND SPECIFICATIONS	VERIFICATION OF CONFIGURATIONS
II. <u>AFW SYSTEM PROTECTION FEATURES</u>						
SEISMIC DESIGN	X					
• PRESSURE BOUNDARY	X	X	X	X	X	
• PIPE/EQUIPMENT SUPPORT	X	X	X	X	X	X
• EQUIPMENT QUALIFICATION	X	X	X		X	X
HIGH ENERGY LINE BREAKS	X					
• PIPE WHIP	X	X				
• JET IMPINGEMENT	X					
ENVIRONMENTAL PROTECTION	X					
• ENVIRONMENTAL ENVELOPES	X	X	X	X	X	
• EQUIPMENT QUALIFICATION	X	X	X		X	X
• HVAC DESIGN	X					
FIRE PROTECTION	X	X	X			
MISSILE PROTECTION	X					
SYSTEMS INTERACTION	X					
III. <u>STRUCTURES THAT HOUSE THE AFW SYSTEM</u>						
SEISMIC DESIGN/INPUT TO EQUIPMENT	X	X	X		X	
WIND & TORNADO DESIGN/MISSILE PROTECTION	X					
FLOOR PROTECTION	X					
HELB LOADS	X					
CIVIL/STRUCTURAL DESIGN CONSIDERATIONS	X					
• FOUNDATIONS	X	X	X			
• CONCRETE/STEEL DESIGN	X	X	X			
• TANKS	X	X	X			

CONFIRMATORY ANALYSES, CALCULATIONS OR EVALUATIONS

PIPE STRESS EVALUATION

- SCOPE
  - PIPING PROBLEM FROM AFW PUMP 6" Ø DISCHARGE LINE
  - MODEL DEVELOPED FROM FIELD VERIFIED DRAWINGS
  - DEADWEIGHT, PRESSURE AND SEISMIC LOADS CONSIDERED
  - HIGHER STRESSED POINTS COMPARED TO DESIGN ANALYSIS

PIPE SUPPORT

- SCOPE
  - SEVERAL SUPPORTS ASSOCIATED WITH PIPING VERIFICATION TO BE SAMPLED (E.G. SNUBBER, RIGID RESTRAINT, SPRING HANGER)
  - FIELD VERIFICATION TO BE PERFORMED
  - STRESS CALCULATION FOR SAMPLED SUPPORTS BASED UPON PIPING VERIFICATION LOADS
  - LOAD COMPARISON TO DESIGN LOADS FOR REMAINDER OF SUPPORTS ASSOCIATED WITH PIPING VERIFICATION

CONFIRMATORY ANALYSES CALCULATIONS OR EVALUATIONS

(continued)

ENVIRONMENTAL ENVELOPE EVALUATION

- SCOPE
  - TEMPERATURE/PRESSURE/HUMIDITY ENVIRONMENT FOR A SELECTED COMPARTMENT OUTSIDE CONTAINMENT
  - MODEL DEVELOPMENT TO INCLUDE INDEPENDENT VERIFICATION OF INPUT PARAMETERS (E.G. VENT AREAS, COMPARTMENT VOLUMES, ETC.)
  - ENVELOPE COMPARED TO DESIGN ENVELOPE USED FOR THE QUALIFICATION OF EQUIPMENT AND STRUCTURE

CRITERIA FOR ISSUING A FINDING

- LICENSING CRITERIA OR COMMITMENTS ARE NOT MET
- DESIGN METHODOLOGY DEFICIENCY (E.G. FAILURE TO USE ACCEPTED ANALYTICAL APPROACH, USE OF INCORRECT INPUTS, ETC.)
- QUALITY ASSURANCE PROGRAM AND DESIGN CONTROL IMPLEMENTATION NONCONFORMANCE
- INDEPENDENT CALCULATION RESULTS DIFFER FROM DESIGN ANALYSIS
- DIFFERENCE BETWEEN DESIGN OUTPUT AND THAT WHICH IS CALLED FOR IN A PROCUREMENT SPEC
- DIFFERENCE IN FIELD CONFIGURATION VERSES AS-BUILT DRAWINGS

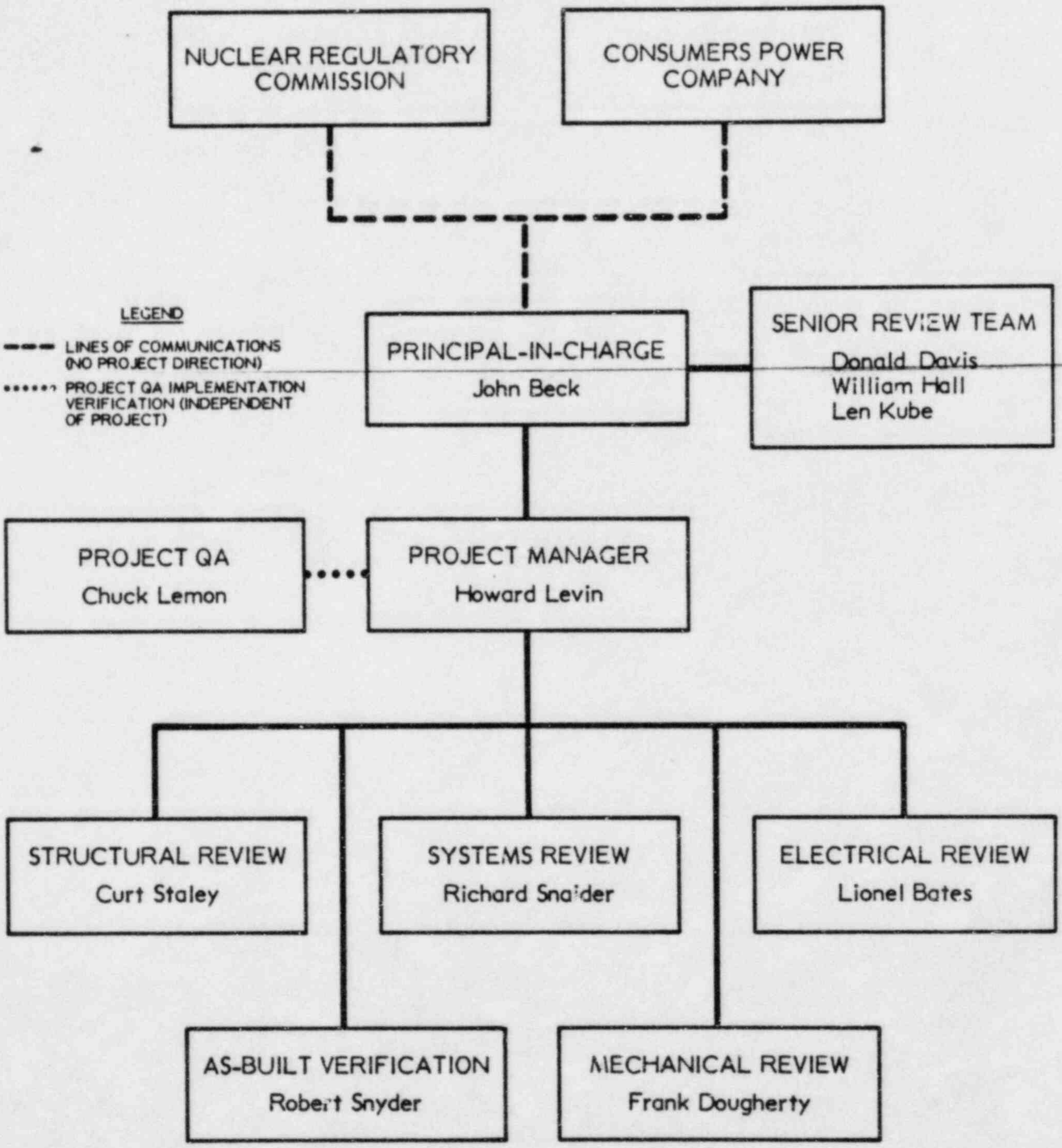
TREATMENT OF FINDINGS

- CLASSIFICATION OF FINDINGS BY LEAD REVIEWER
  - OPEN - POTENTIAL FOR BECOMING CONFIRMED FINDING
  - CONFIRMED - JUDGED TO BE AN APPARENT ERROR NECESSITATING ADDITIONAL INVESTIGATION (E.G. FURTHER DOCUMENTATION, ANALYSES, DESIGN/CONSTRUCTION CHANGES)
  - RESOLVED - ONGOING REVIEW OF ADDITIONAL INFORMATION LEADS TO CLOSEOUT OF FINDINGS (ROOT CAUSE IDENTIFIED AND IMPACT ASSESSED)
- INTEGRATED REVIEW BY PROJECT TEAM UNDER DIRECTION OF PROJECT MANAGER
  - FURTHER TECHNICAL REVIEW TO CLARIFY, EXPAND OR REASSESS
  - REVIEW OF CLASSIFICATION
- PREPARATION OF ERROR REPORTS
- SENIOR REVIEW TEAM REVIEW
  - POSSIBLE IDENTIFICATION OF NEED FOR CLARIFICATION, EXPANSION OF REVIEW OR REASSESSMENT
  - EVALUATION OF SAFETY SIGNIFICANCE
- FORWARDING OF FINDINGS AND ERRORS TO CPC AND ORIGINAL DESIGN ORGANIZATIONS FOR THEIR REVIEW AND RESPONSE
- REVIEW OF DESIGN ORGANIZATION RESPONSE TO ERROR REPORTS

ADDITIONAL VERIFICATION AND SAMPLING

- UNDERTAKEN FOR FINDINGS CLASSED "OPEN" FOR RECLASSIFICATION TO "CONFIRMED" OR "RESOLVED"
- ROOT-CAUSE IDENTIFICATION
  - RANDOM ERROR
  - SYSTEMATIC ERROR
- DETERMINATION OF EXTENT
- IMPROVEMENT OF LEVEL OF CONFIDENCE
- BOTH INPO AND IDV FINDINGS WILL BE CONSIDERED

PROJECT ORGANIZATION
MIDLAND INDEPENDENT DESIGN VERIFICATION



KEY PERSONNEL
MIDLAND INDEPENDENT DESIGN VERIFICATION PROGRAM

- PROJECT DIRECTION

JOHN BECK, PRINCIPAL-IN-CHARGE
NUCLEAR POWER PLANT OPERATIONS AND CORPORATE MANAGEMENT, LICENSING, ENGINEERING AND PROJECT MANAGEMENT

HOWARD LEVIN, PROJECT MANAGER
NUCLEAR POWER PLANT STRUCTURAL, MECHANICAL DESIGN AND CONSTRUCTION, EQUIPMENT QUALIFICATION, OPERATING REACTOR SAFETY, LICENSING, PROJECT MANAGEMENT

- SENIOR REVIEW TEAM

DONALD DAVIS, TERA
NUCLEAR SAFETY AND LICENSING, PLANT AND REACTOR SYSTEMS, THERMAL-HYDRAULIC ANALYSIS, ACCIDENT ANALYSIS

WILLIAM J. HALL, UNIVERSITY OF ILLINOIS
ENGINEERING ANALYSIS AND DESIGN, STRUCTURAL ENGINEERING, STRUCTURAL MECHANICS AND DYNAMICS, SOIL MECHANICS, FRACTURE MECHANICS, ENGINEERING CRITERIA DEVELOPMENT FOR MAJOR PROJECTS

LEONARD KUBE, MAC
NUCLEAR SAFETY AND LICENSING, QUALITY PROGRAMS, PROJECT MANAGEMENT

KEY PERSONNEL
(continued)

- DESIGN REVIEW TEAM

CURT STALEY, LEAD STRUCTURAL REVIEWER
NUCLEAR POWER PLANT STRUCTURAL, MECHANICAL DESIGN, CONSTRUCTION PROJECT MANAGEMENT AND CONTROL

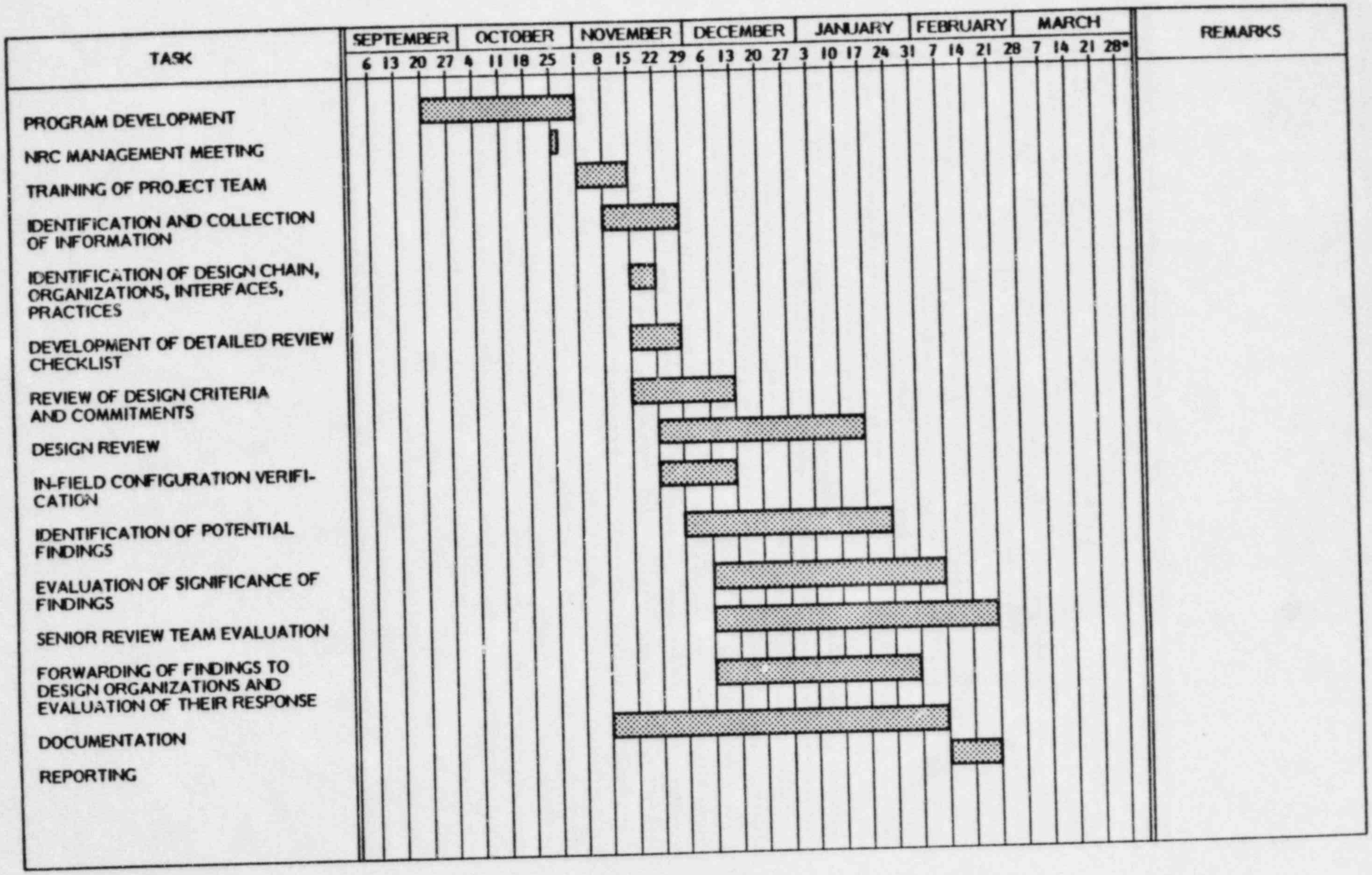
FRANK DOUGHERTY, LEAD MECHANICAL REVIEWER
NUCLEAR POWER PLANT MECHANICAL DESIGN, QUALITY ASSURANCE, SAFETY AND RELIABILITY ANALYSIS, SYSTEM DESIGN/CRITERIA DEVELOPMENT

RICHARD SNAIDER, LEAD SYSTEMS REVIEWER
NUCLEAR POWER PLANT OPERATIONS, MAINTENANCE AND DESIGN, SYSTEMS ENGINEERING, LICENSING PROJECT MANAGEMENT, MECHANICAL ENGINEERING

ROBERT SNYDER, LEAD FIELD VERIFICATION
NUCLEAR POWER PLANT DESIGN AND CONSTRUCTION, PROJECT MANAGEMENT, START-UP AND OPERATIONS

LIONEL BATES, LEAD ELECTRICAL REVIEWER
NUCLEAR POWER PLANT ELECTRICAL, INSTRUMENTATION AND CONTROL SYSTEMS DESIGN, EQUIPMENT QUALFICATION, PLANT OPERATIONS AND MAINTENANCE

SCHEDULE FOR MIDLAND INDEPENDENT DESIGN VERIFICATION



- DATES BEGIN ON MONDAY