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

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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"

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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		
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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

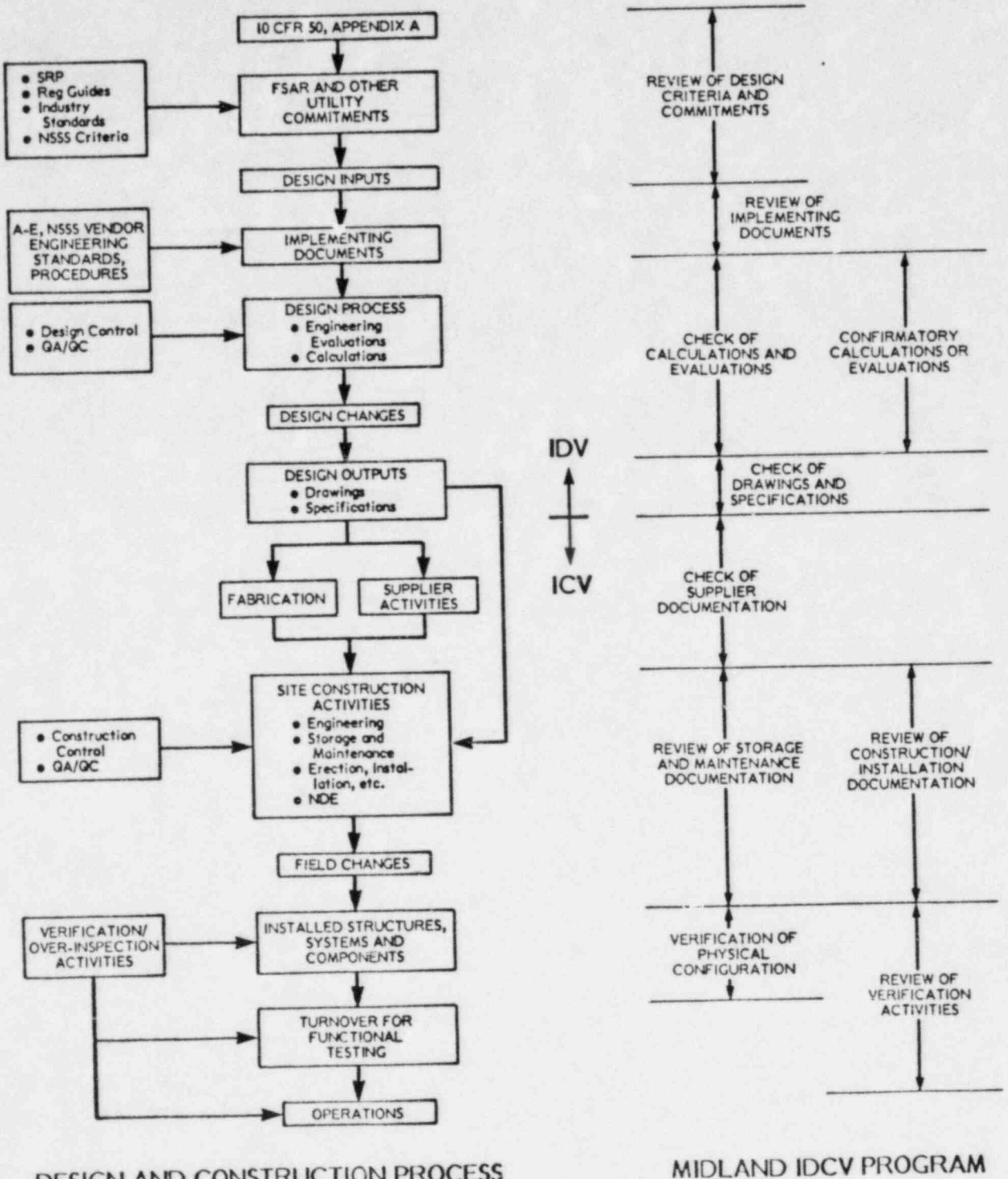
construction process and not on an evaluation of the process itself which is typical of the more common quality assurance audit. The "vertical slice" constitutes a carefully selected sample of two safety systems from which the results of the IDCV may be extrapolated to other similarly designed and constructed 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



DESIGN AND CONSTRUCTION PROCESS

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. 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 1.2-2a

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. AFW SYSTEM PROTECTION FEATURES					
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. STRUCTURES THAT HOUSE THE AFW SYSTEM					
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; or 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

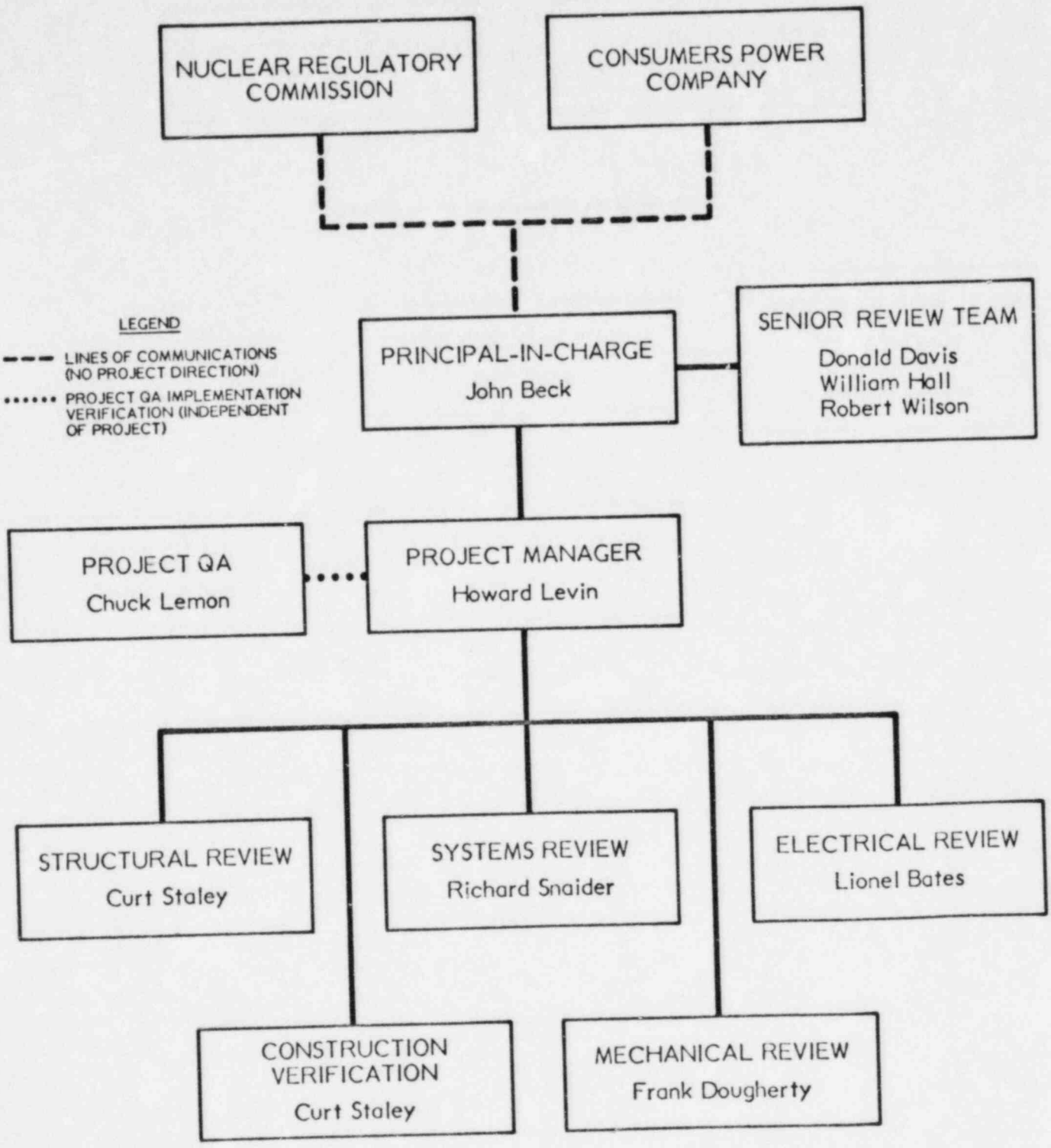


FIGURE 2.1-1

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 fre-

quently, 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. AFW SYSTEM PROTECTION FEATURES					
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. STRUCTURES THAT HOUSE THE AFW SYSTEM					
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 sheets 3A, revision 9, and 3B, revision 10. Specific interface points are as follows: 1

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 I.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 I.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 I.1-1 to assure that system operating limits appropriately reflect accident analysis considerations.

3.1.3.1.3 Single Failure - Topic I.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 I.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 I.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 I.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 I.9-1, Component Functional Requirements. Other design features applicable to remote operation will be reviewed under Topic I.16-1, Electrical Characteristics and Topic I.18-1, Instrumentation.

3.1.3.1.7 System Isolation/Interlocks - Topic I.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 I.3-1 will address these items as well.

3.1.3.1.8 Overpressure Protection - Topic I.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 I.10-1, System Hydraulic Design.

3.1.3.1.9 Component Functional Requirements - Topic I.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 I.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 I.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 I.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 I.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 I.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 I.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 I.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 I.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 I.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 Contro. Systems - Topic I.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 qualifica-

tion 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 examinction 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-I

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-I

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.

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.1-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 Instrumentation and Control Systems and Components

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 (second system - to be supplied)

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 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 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 componeni 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

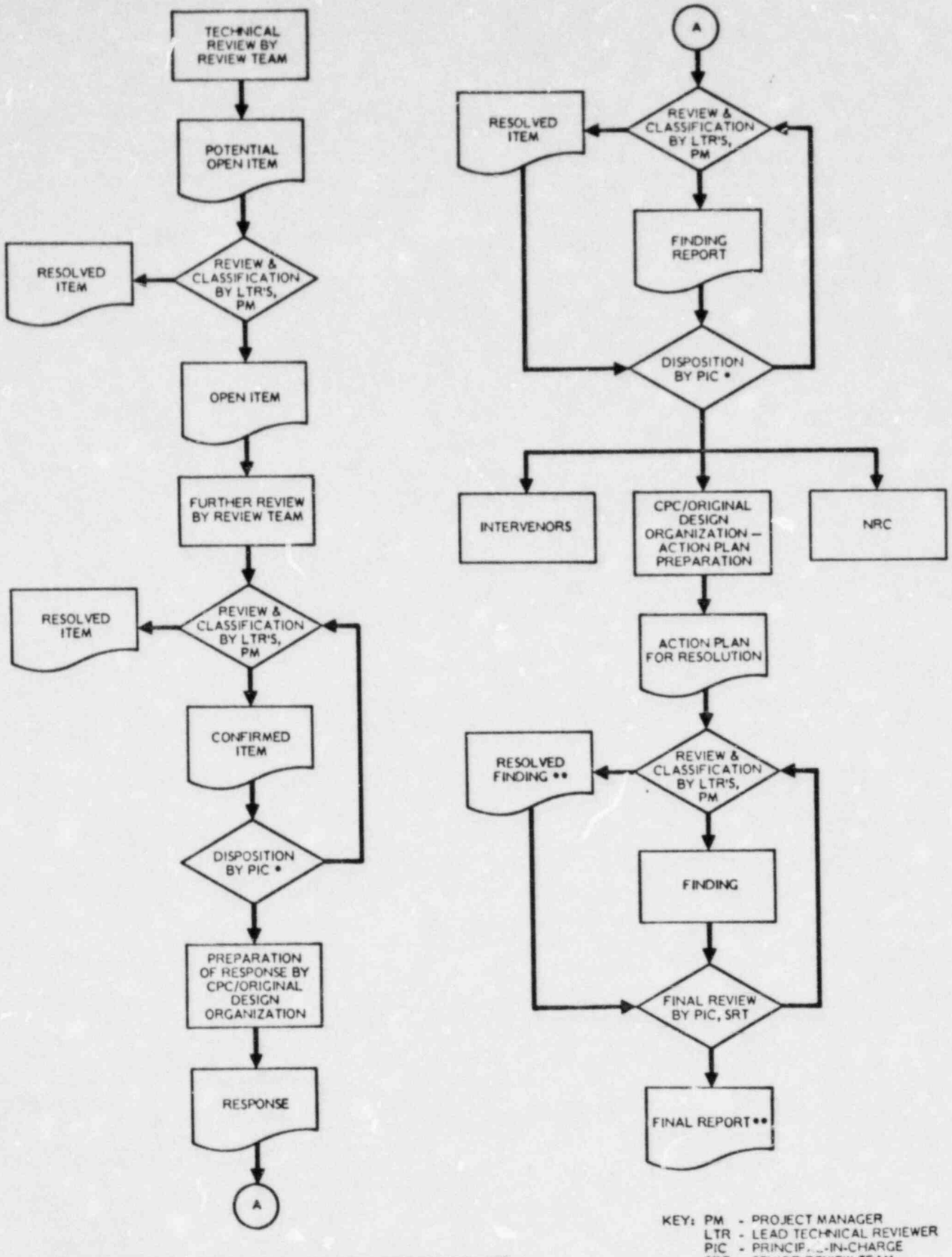
The system for IDCV reporting is shown graphically in Figure 5.2-1. This figure provides a diagram or flow chart of the report generation process and a summary of the sequence.

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 - PRINCIP[illegible]-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.

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.

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:

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.