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Chapter 17

QUALITY ASSURANCE

17.1 QUALITY ASSURANCE DURING DESIGN AND CONSTRUCTION

17.1.0 INTRODUCTION

Iowa Electric, as applicant and operator of the DAEC, has assumed full responsibility and authority for the project. Iowa Electric has traditionally performed its own plant design and construction supervision functions and is, therefore, familiar with sound design engineering principles, construction practices, and safe operating procedures.

To ensure that the following program objectives were met, Iowa Electric established a comprehensive quality assurance program encompassing the design, manufacturing, fabrication, and construction activities of the DAEC. The program was developed to meet the requirements of Appendix B to 10 CFR 50.

17.1.0.1 Program Objectives

The major objectives of Iowa Electric's Quality Assurance Program for the DAEC are the following:

1. To ensure that applicable codes, standards, and regulatory requirements and the design bases as defined in the PSAR and FSAR for all safety-related systems are correctly translated in drawings, specifications, procedures, and instructions.

2. To ensure that vendors and others responsible for the fabrication of equipment and the supply of material comply with the contract specification requirements relative to quality products.

3. To ensure that contractors and subcontractors responsible for construction and installation comply with the contract specification requirements relative to quality work.

4. To ensure that the required documentation of quality control performance is generated in proper sequence at the time of performance of the work and that such records are adequate and complete for the particular piece of equipment or class of work under consideration.

5. To provide a permanent quality control documentation file that is identifiable and retrievable for each item of equipment or structure in the plant that is defined as safety related.

6. To ensure that the proper control of plant systems is maintained during system checkout, startup, and operation of the DAEC.

17.1.0.2 Scope of Responsibility

To implement the Quality Assurance Program of the DAEC, specific areas of responsibility were delegated to several participating organizations.

General Electric Company (GE), the nuclear steam supply system (NSSS) supplier, was given the responsibility for the development and implementation of the necessary quality assurance program to cover the design and fabrication of applicable systems and equipment, including the reactor vessel, falling within its scope of supply.

Chicago Bridge and Iron Company (CB&I), the containment system supplier, was given the responsibility for the development and implementation of the necessary quality assurance program to cover the design, fabrication, and erection of the containment system.

Bechtel Corporation, the architect-engineer constructor, was given the responsibility for the development and implementation of the necessary quality assurance program to cover all safety-related systems and equipment within their balance-of-plant (BOP) scope of work. This included plant design, equipment and material fabrication and supply, construction activities, and project documentation. In addition, Bechtel was given the responsibility to audit the implementation of the quality assurance programs of GE and CB&I.

Iowa Electric had ultimate responsibility for the overall program. This responsibility was carried out by participating in and auditing the implementation of programs of the other participants.

17.1.0.3 Quality Control and Assurance Measures

Quality control and assurance measures were directed primarily toward safety-related structures and systems, associated subsystems, and components.

Quality control and assurance measures were imposed and enforced to control aspects of design, procurement, fabrication and manufacturing, handling and storage, construction and installation, shop and field inspection, preoperational testing and systems checkout, identification and control of materials, and records and documentation.

Attention was paid to vendor shop inspection and record audits on a selected basis as well as construction monitoring by Iowa Electric to ensure compliance with all applicable codes.

Iowa Electric traditionally has performed its own engineering and, consequently, was aware of the importance of a comprehensive quality assurance program to ensure the integrity of plant structures, systems, and components that contribute to the prevention or mitigation of the consequences of accidents that might otherwise cause a possibility of undue risk to the health and safety of the public, or, although not of direct NRC jurisdictional interests, long-term reliable operation.

Iowa Electric quality assurance personnel were an integral part of the review of designs, specifications, procurement documents, and changes to those documents during the design and construction of the DAEC.

Figures 17.1-1 and 17.1-2 show the system that was in use for the review and approval of drawings and specifications during construction. Revision and field changes followed the same cycle. The Iowa Electric quality assurance staff reviewed those documents relating to safety-related systems, structures, material components, and equipment.

"Final" or "ultimate" responsibility for any portion of the program belonged to Iowa Electric. "Initial" or "primary" responsibility belonged to the contractor performing the function in question. The term "principal contractors" refers to Bechtel, GE, and CB&I.

Iowa Electric's Quality Assurance Program was implemented through close cooperation and coordination between its Quality Assurance Manager and counterparts employed by the principal contractors.

General Electric prepared and used a quality assurance program satisfying the intent of 10 CFR 50 and its Appendix B for the safety-related items comprising the nuclear steam supply system. This program included the responsibility for the quality control programs of GE's subcontractors.

General Electric site quality assurance personnel continued to monitor activities up through fuel loading. After that, they were available for surveillance as required.

General Electric home office quality assurance personnel were active directly on the DAEC only until all material, equipment, fuel, and associated documentation were delivered. Home office quality assurance specialists were available as required for support.

Bechtel prepared and used a quality assurance program satisfying the intent of 10 CFR 50 and its Appendix B for the safety-related items comprising balance-of-plant. Bechtel was also the constructor for the DAEC, hence, its quality assurance program included the construction portion of the work. Bechtel had responsibility for the provision and use of satisfactory quality control programs by its subcontractors.

Bechtel site quality assurance personnel continued to monitor the activities of the construction force and audited the activities during preoperational testing and fuel-loading operations. They were onsite through initial operations to assist in the change to plant staff.

Bechtel home office quality assurance personnel remained active in the project through the completion of the design and construction phases. Quality assurance staff personnel were available throughout all phases to support field personnel.

Chicago Bridge and Iron prepared and used a quality assurance program satisfying the intent of 10 CFR 50 and its Appendix B for the safety-related pressure containment and suppression system. This program included responsibility for the quality assurance programs of its subcontractors and for the fabrication and construction of its part of the work.

Chicago Bridge and Iron's system for the control of quality integrated all activities that affected quality from the placement of the order throughout the various phases of design, procurement, fabrication, shipment, site construction, and testing. Its documented quality assurance programs consisted of a Corporate Program, a Chicago Plant Program, and a Construction Program, all approved by ASME and providing for independent inspection and certification by the Hartford Steam Boiler Inspection and Insurance Company.

Design specifications, stress reports, protection against overpressure, nameplates stamping, and data reports were in compliance with applicable ANSI and/or ASME Codes listed in Table 3.2-2 and the supplemental requirements specified.

Reference to "constructor" or "Bechtel Corporation" in this Chapter shall be understood to include their agents such as onsite inspection by subcontractor.

Final responsibility for the application of the DAEC Quality Assurance Program rested with Iowa Electric. This was accomplished by audit of the programs of all participants in the project by Iowa Electric or its delegated representative.

Iowa Electric delegated to Bechtel the function of auditing the quality assurance programs of GE and other prime contractors of Iowa Electric. Iowa Electric audited Bechtel with respect to (1) Bechtel's implementation of Bechtel's quality assurance programs and (2) Bechtel's audit of the quality assurance programs of GE and other prime contractors of Iowa Electric. Iowa Electric prepared written procedures that contained its internal instruction of employees with respect to the performance of their responsibilities under Iowa Electric's Quality Assurance Program.

Iowa Electric prepared written procedures to monitor the implementation of the responsibilities of its principal contractors under Iowa Electric's Quality Assurance Program. The procedures used included the following:

- Document review procedure.
- Bechtel home office audit procedure.
- Bechtel field audit procedure.
- Vendor audit procedure.
- Internal Iowa Electric audit procedure.
- Reporting practice.
- PSAR design change procedure.
- Nonconformity procedure.
- Significant deficiency procedure.
- Construction hold procedure.
- Shop inspection evaluation program.

These written procedures were contained in Iowa Electric's Project Procedures Manual. The basic quality assurance program philosophy and general guidelines constituted Iowa Electric's Quality Assurance Manual referred to hereafter in this chapter.

17.1.1 ORGANIZATION

17.1.1.1 Authorities and Duties of Persons and Organizations

17.1.1.1.1 Iowa Electric

Iowa Electric assumed the ultimate responsibility for the development, implementation, and execution of the DAEC Quality Assurance Program.

Iowa Electric delegated to its principal contractors the primary responsibility for establishing and implementing the quality assurance programs for their respective organizations within their scope of supply. However, Iowa Electric reviewed their programs and carried out appropriate audits and surveillance on a prearranged schedule to satisfy itself that its contractors had properly implemented their quality assurance program.

Figure 17.1-3 shows the relation of the DAEC Project Group with the Engineering Department. Figure 17.1-4 shows the interrelation for quality assurance purposes of the organizations for Iowa Electric, GE, and Bechtel (both as architect-engineer and constructor).

The following groups shown in Figure 17.1-3 had no responsibility for plant safety-related system design: System Planning, Transmission and Distribution Design, Engineering Services, Gas Systems, Power Plant and Substation Electrical Design, Relay and Communication Services, and Power Plant Design. These groups perform duties relating to other phases of company operations including systems planning, transmission and distribution, substation design, fossil plants, and gas operating.

The DAEC Project Group was responsible for the design of the safety systems of the plant. The Production Group performed a review function.

The Quality Assurance Organization was a separate group reporting to the Vice President, Engineering, as indicated in Figure 17.1-3. Its duties were related exclusively to the activities of the DAEC project. These duties were the establishment, implementation, and verification of the Quality Assurance Program for the DAEC.

When reference is made to "Iowa Electric's Quality Assurance Management Group," it means a group the size of which varied to accommodate changes in activity and work load as the program progressed from design through construction, pre-operational testing, startup, and operation. The size of this group varied from one during the early design stage and then grew to three augmented by engineering specialists, during construction. Similarly, the quality assurance staffs of other organizations, such as the engineer-constructor, the NSSS supplier, and the containment supplier varied in size and composition depending on the needs of the then current activity.

The projected number and location of Quality Assurance/ Quality Control personnel for the final phases of construction up to and including plant operation follows:

		Full - Time Only			
	Construction	Preoperational Testing	Fuel Load	Startup	Operation
Iowa Electric site	1	1	1	1	1
office	2	-	-	-	-
Bechtel site	6	2	2	1	-
office	1	-	-	-	-
General Electric site	1	1	1	-	-

The position of Quality Assurance Manager was filled by a graduate of an engineering school. He had 20 yrs of experience in design and/or construction of electric utility facilities and had acquired familiarity with codes, standards, and sampling techniques and their interpretation and application.

The title, "Manager of Manufacturing," encompassed many disciplines in addition to the actual "manufacturing" or "making" of parts and assemblies (called "Shop Operations" at GE).

Managers of Manufacturing had functional responsibilities typically assigned to a plant manager. Reporting to the Manager of Manufacturing were organization component managers responsible for such functions as manufacturing engineering, production scheduling and control, procurement, shop operations, and quality assurance.

The Quality Assurance Manager's responsibilities were those related to product characteristic generation, production scheduling, and the meeting of production schedules.

Quality assurance personnel had the authority to withhold shipment until quality requirements were satisfied.

17.1.1.1.2 Engineer-Constructor

17.1.1.1.2.1 Introduction

The Bechtel Nuclear Quality Assurance Manual (NQAM), Revision 4, was the basis for the quality assurance programs on Bechtel Power and Industrial Division nuclear projects. The guidelines for implementing and maintaining the Bechtel quality assurance program were contained in this document.

The general purpose of this quality assurance program was to ensure that materials, equipment, and workmanship that relate to public safety conformed to high standards of quality. Documentation was provided by the quality assurance program to confirm that the requirements had been met.

This section describes the policies, practices and procedures followed by Bechtel in implementing and maintaining an effective, documented quality assurance program during the design, procurement, and construction stages of the DAEC.

The quality assurance program herein described complied with 10 CFR 50, Appendix B, and applied to those safety-related essential structures, systems, and components for which Bechtel had responsibility for design, procurement, installation, or construction. It did not, unless specifically stated, encompass the quality assurance or quality control participation of other organizations.

Responsibilities and authorities of the organizations and individuals involved in the Bechtel quality assurance program are defined and the major structures, systems, and components covered by this program are identified.

The organization employed for the implementation of the Bechtel quality assurance program is shown in Figure 17.1-5. The program covered three main phases of project, namely: design, procurement, and construction. The personnel having functions related to quality assurance are listed for each phase.

1. Design Phase
   - Project Engineering Team.
   - Quality Assurance Engineer.
   - Chief Engineers and their technical staffs.
   - Engineering Manager.
   - Manager, Quality Assurance.
   - Quality Assurance Coordinator.
   - Metallurgical and Quality Control.

2. Procurement Phase
   - Project Engineering Team.
   - Quality Assurance Engineer.
   - Chief Engineers and their technical staffs.
   - Engineering Manager.
   - Manager, Quality Assurance.
   - Quality Assurance Coordinator.
   - Metallurgical and Quality Control.
   - Shop Inspectors.

3. Construction Phase
   - Project Engineering Team.
   - Quality Assurance Engineer.
   - Chief Engineers and their technical staffs.
   - Engineering Manager.
   - Manager, Quality Assurance.
   - Quality Assurance Coordinator.
   - Metallurgical and Quality Control.
   - Project Superintendent.
   - Project Field Engineer.
   - Quality Control Engineer.
   - Field Engineers.
   - Construction Superintendents.
   - Material Supervisor.

The authority and duties of the personnel involved in the various phases of the quality assurance program are described below.

17.1.1.1.2.2 Project Engineering Team

The Project Engineering Team had primary responsibility for implementing the quality assurance program. The team prepared drawings, specifications, purchase requisitions, and bid evaluations in accordance with the quality requirements. They also prepared and implemented the Q-List and Design Control Check List, review fabrication and inspection procedures, and shop inspection reports. Through the Quality Assurance Engineer, the team provided surveillance of field engineering, quality control, and construction activities.

17.1.1.1.2.3 Quality Assurance Engineers

The Quality Assurance Engineer was the field representative of the Project Engineering Team and received supervision and technical support from the Project Engineer. However, the Quality Assurance Engineer was assigned by and reported to the Quality Assurance Coordinator on administrative matters. Before the commencement of construction, he was stationed in the home office to assist the Project Engineer and Design Supervisors in the implementation of the quality assurance program.

At the jobsite, the Quality Assurance Engineer performed quality assurance surveillance of field activities including engineering, quality control, and construction activities. He reviewed and accepted inspection reports, performed audits of the field quality assurance/quality control documentation files, and monitored the overall quality control program.

The Quality Assurance Engineer had the authority to stop Bechtel field work or request the stoppage of subcontractor work in the event of nonconformance with drawings, specifications, and procedures established for structures, systems, and units on the Q-List. He also served as the field contact for Iowa Electric's quality assurance organization and others concerned with quality assurance in the field.

To maintain continuity in the program, another Quality Assurance Engineer was permanently stationed in the home office to assist the Project Engineer in planning and implementing the program.

17.1.1.1.2.4 Chief Engineers

The Bechtel organization provided for a Chief Engineer for each discipline (e.g., civil, mechanical) to provide technical support and coordination of the engineering design supervisors. Since the engineering effort for the project was under the sole direction of the Project Engineer, the Chief Engineers qualified for the necessary independent review of engineering.

The Chief Engineers provided independent documented review for all items on the Design Control Check Lists. In so doing, they coordinated and ensured necessary

technical review by specialists and consultants. Chief Engineers were allowed to delegate review to qualified specialists on their staffs.

17.1.1.1.2.5 Engineering Manager

The Engineering Manager provided management guidance and surveillance of nuclear project engineering activities. His functions related to quality assurance involved verification through project reviews that project engineering was carrying out its quality assurance responsibilities as well as other design responsibilities.

17.1.1.1.2.6 Manager, Quality Assurance

The Manager, Quality Assurance, was responsible for the overall direction of the quality assurance program, including formulating and implementing policy, administration, and coordination of the program and administrative and technical supervision of the Quality Assurance Engineers and Coordinators. He was responsible for providing the overall coordination of the Engineering, Procurement, and Construction Departments in quality assurance activities to effectively implement the program.

The Supervisor, Quality Assurance was responsible for daily direction of the program and acted for the Manager, Quality Assurance, in his absence.

17.1.1.1.2.7 Quality Assurance Coordinator

The Quality Assurance Coordinator reported to and assisted the Quality Assurance Supervisor in carrying out and implementing all activities related to the quality assurance program. His responsibilities included coordinating and assigning Quality Assurance Engineers, reviewing and evaluating project quality assurance programs, and auditing the performance of the various programs. He provided an independent channel for Quality Assurance Engineer communications to management.

17.1.1.1.2.8 Metallurgical Quality Control

The quality assurance aspects of metallurgy and welding activities were coordinated by metallurgy and quality control services. Their functions included the preparation of specifications and procedures for materials, fabrication, and nondestructive testing plus providing technical consultation and guidance for the Engineering, Procurement, and Construction Departments. In addition, they provided welding and inspection training services at the jobsite.

17.1.1.1.2.9 Shop Inspectors

The Shop Inspectors were responsible for shop qualification inspections, in-process inspection of work suppliers' shops, checking of documentation, and final inspection and release of equipment for shipment. Their activities were carried out in accordance with the Procurement Department Inspection Manual and as supplemented by the drawings, specifications, and additional instructions provided by engineering.

17.1.1.1.2.10 Project Field Engineers

The Project Field Engineer's duties included the supervision of quality control inspection at the jobsite. In carrying out this assignment, he assigned qualified field engineers to perform quality control inspections. He supervised the preparation of inspection checklists, verified accuracy and completeness of inspection reports, and ascertained that defects were removed and that repairs were carried out in accordance with applicable specifications, instructions, and procedures.

17.1.1.1.2.11 Quality Control Engineer

The Quality Control Engineer reported to and assisted the Project Field Engineer in carrying out quality control inspection responsibilities. He normally was assigned responsibility for the review of inspection reports, coordination, training, and advising field engineers in the performance of quality control inspection assignments, coordination of testing laboratories, and maintenance of the field quality control/quality assurance files.

17.1.1.1.2.12 Field Engineers

Field Engineers were responsible for engineering and inspection work at the construction site. They did not supervise construction work that was done by the superintendents who were an independent group.

Field Engineers carried out the inspection assignments and were responsible for completing the appropriate inspection forms. Field Engineers/Inspectors functioned on a disciplinary basis (e.g., mechanical equipment, civil/structural, electrical/power, instrumentation/control, and welding/metallurgy). They had access to the necessary design drawings, applicable codes, and sampling and testing procedures pertaining to their inspection assignments.

17.1.1.1.2.13 Material Supervisor

The Material Supervisor was assigned by the Procurement Department and received project direction from the Project Superintendent.

The Material Supervisor was responsible for the normal receiving, inspection, and storage of material and equipment before installation. He performed his quality-related duties in accordance with the NQAM, the field procurement procedures, and additional instructions provided by the Engineering and the Procurement Departments.

17.1.1.1.3 NSSS Supplier

The GE Nuclear Energy Division (NED) staff of technical personnel experienced in the nuclear industry supplied designs or design specifications appropriate for nuclear applications for NED-manufactured or procured equipment. Quality control organizations directed or audited the quality-related work for NED-manufactured products, for vendor-supplied materials and components, and for field installation. NED quality-related preoperational testing and startup activities were planned by engineering components within the NED.

Line components with assigned quality assurance/quality control responsibilities conducted continued audits of their activities to ensure compliance with the quality system within their assigned responsibility scope. A BWR quality assurance staff component was responsible for conducting overall quality system audits to ensure the integration of, and compliance with, the quality system within the various NED organizational components contributing to the BWR business.

Figure 17.1-6 is an abbreviated NED organization chart showing specifically the quality-related functions concerned with supplying BWR nuclear systems and components. The managers of the Atomic Power Equipment Department (APED), Nuclear Fuel Department (NFD), Reactor & Fuels Manufacturing Operation (R&FMO), Nuclear Power Generation Control Department (NPGCD), and Nuclear Safety & BWR Quality Assurance Operation reported directly to the NED General Manager.

The manager of the Nuclear Safety & BWR Quality Assurance Operation had the responsibility for integrating the quality programs for the BWR business. A BWR Quality Assurance Operation was the staff component assigned the responsibility for establishing, documenting, and directing an overall quality system and for integrating, measuring, and auditing the quality-related work across the entire spectrum of the BWR business as conducted by line components.

A BWR Quality Council, with the Manager, BWR Quality Assurance, as Chairman, provided for inter-Division communication and integration of quality assurance policies, procedures, and practices. The BWR Quality Council consisted of representatives from each of the contributing organizational components of the BWR business and regularly met to review the status of the overall quality system and to provide management reports of quality-related activities.

On this project, liaison with Iowa Electric on quality-related matters was through the Project Manager in APED.

The Manager, APED Design Engineering, was responsible for establishing quality requirements for systems and components within the NED scope of supply. The respective quality control line organizations had responsibility for ensuring compliance with these quality requirements.

Table 17.1-1 identifies the NED management that had responsibilities for the attainment of the quality requirements established by APED.

Detailed designs of NED-supplied nuclear systems and components, whether fabricated by the NED or by outside manufacturers, must meet the specified nuclear system requirements. A continuity of engineering control was maintained from the conceptual design phase through material procurement, manufacturing, field installation, preoperational testing, and plant startup. To ensure that the nuclear system requirements were met, and to ensure compliance with the nuclear system design and design requirements, APED Design Engineering reviewed and approved the appropriate detailed design documents, including selected Iowa Electric and Bechtel documents. APED Design Engineering had design change responsibility and authority for NED-supplied systems and components except when detailed design was provided for fuel and for nuclear instrumentation and control systems by NFD or NPGCD Engineering components. When detailed design was provided by NFD or NPGCD Engineering, these engineering components had detailed design change responsibility and authority. However, APED Design Engineering approval was required if deviation in the system design or the design of other components was involved.

APED Development Engineering contributed to the overall quality system by providing basic technical information and advanced inspection techniques resulting from development programs conducted.

The quality control activities related to NED-manufactured products were under the direction of managers of quality control subsections who reported directly to the managers of manufacturing sections. The quality program for APED-purchased (engineered) equipment was under the direction of the Manager, Quality Control - Engineered Equipment, and the quality program for NFGCD-procured instrumentation was under the direction of the Manager, Quality Control, NPGCD. Field installation of NED-supplied equipment and site quality control audits of field installation quality-related activities were under the direction of the Manager, Quality Control - Engineered Equipment. Audits are defined as overall quality system effectiveness reviews of items, records, or activities to verify that materials and products meet applicable drawings and specifications and/or to verify that the materials and products were produced in compliance with planned processes and quality-related procedures and practices. Quality Control Managers' responsibilities were divorced from those related to production scheduling and to the meeting of production schedules.

Technical direction for field installation of NED-supplied systems and components, in accordance with supplied installation instructions, was provided by the APED Site Resident Manager and staff. Technical direction is defined as technical

guidance, advice, and counsel given to Iowa Electric's staff based on current engineering and installation practices. Preoperational testing and startup engineering specialists assigned to the site resident manager were responsible for planning and providing technical direction for the preoperational testing and startup activities.

17.1.1.1.4 Chicago Shop and Chicago Construction District

The Chicago Shop and the Chicago Construction District had a quality assurance organization, separate from production, which evaluated and accepted materials, operations, examinations, and processes in accordance with approved acceptance criteria and also provided recommended solutions for problems related to quality. Supplementing these two organizations were two corporate quality assurance groups responsible for the following:

1 Established quality policy and programs.

2. Reviewed and approved procedures affecting quality.

3. Reviewed engineering drawings and procurement documentation for items affecting the control and assurance of quality review.

4. Approved vendors for the supply of nuclear materials and parts.

5. Audited the effectiveness of all quality assurance programs and quality assurance efforts.

6. Provided technical assistance and guidance.

7. Interpreted all quality assurance program requirements.

17.1.1.2 Delegation of Responsibilities

The responsibilities for implementing the DAEC Quality Assurance Program were delegated to the principal contractors (Bechtel, GE, and CB&I). Table 17.1-2 indicates the manner in which the responsibilities for implementing the program were assumed by contractor and component. To verify the implementation, Iowa Electric performed audits on these contractors and participated in audits with them.

Between May 1969 and January 1972, the following audits were performed or participated in by Iowa Electric's quality assurance staff augmented with technical personnel:

Bechtel, San Francisco	7
Bechtel vendors	31
Chicago Bridge and Iron (containment) (engineering and fabrication)	8

General Electric Engineering	7
General Electric vendors	4
Bechtel Field Operations	4

Contact was maintained with the Bechtel field quality assurance/quality control organization by Iowa Electric quality assurance staff through regular meetings. Continuous site activity surveillance and spot audits were conducted by Iowa Electric's site quality assurance personnel.

17.1.2 QUALITY ASSURANCE PROGRAM

17.1.2.1 Compliance with Requirements

The DAEC Quality Assurance Program required that GE, Bechtel, and their suppliers and subcontractors maintain quality assurance programs that complied with 10 CFR 50, Appendix B, including the requirements pertaining to fabrication, acceptance testing, shipping, field storage, installation, and checkout. General Electric and Bechtel complied with the quality assurance requirements through their respective quality assurance programs, which were outlined by the DAEC Quality Assurance Program. Suppliers and subcontractors complied with the quality assurance requirements through the enforcement of contractual agreements defined in procurement specifications. The following writeup describes the quality assurance provisions for instrumentation and control equipment in the reactor protection system, engineered safety features system, and the emergency electric power system circuits.

1. Fabrication and Acceptance Testing

   Inspections in accordance with approved written procedures that had been reviewed for compliance with the applicable codes were conducted throughout the fabrication and acceptance test phases. Inspection results were collected and a quality history file was established for each shippable unit (i.e., panel or assembly). Inspection was performed by quality control personnel and audited by quality assurance engineers. Tools, gauges, and instruments used in the inspections were calibrated to standards that were traceable to the National Bureau of Standards or another recognized authority.

   Records for the identification, documentation, segregation, and disposition of nonconforming material, parts, or components were compiled and maintained by the fabricating facility. This function was audited by the quality assurance groups of the principal contractors and Iowa Electric.

2. Shipment

   Final inspection signoff was required to ensure that all significant quality-related work elements were completed before release for shipment. Specific handling,

packaging, and shipping instructions were called out in the procurement specifications.

3. Field Storage

   Field handling and storage of all materials and equipment was the responsibility of the Bechtel project field organization. Procedures for handling and storage were contained in the Bechtel Field Inspection Manual supplemented as necessary by instructions prepared by field engineering, approved by the Project Superintendent and the Project Engineering Team. When project specifications required special procedures for handling, storage, or preservation, these were defined by the equipment supplier and approved by the Project Engineering Team. The Bechtel project field organization used procedures defined in the Field Inspection Manual for marking, tagging, or otherwise indicating inspection and acceptance status of items and/or systems. The Bechtel quality assurance program provided measures that controlled materials, parts, or components not conforming to prescribed requirements to prevent their inadvertent use or installation. Nonconforming items that could be made usable through rework, repair, or modification of requirements were reported to the Project Engineering Team for resolution. These items were prepared and incorporated in quality assurance files. This function was audited by the Iowa Electric Quality Assurance Group.

4. Installation and Checkout

   The Bechtel project field organization had the responsibility for developing and implementing approved procedures and instructions to ensure that all field construction, erection, and installation was in conformance with approved specifications, drawings, codes, and other specified requirements. They developed the tags, check-lists, quality documents, etc., necessary to comply and to demonstrate compliance with specified requirements. For GE NED-supplied equipment, the GE field engineers reviewed the detailed installation procedures to ensure that the quality requirements were consistent with the installation specifications supplied by NED.

   Each system, on installation, underwent a comprehensive preoperational test that tested all functions of the system and became a part of the quality assurance history when it was completed. All preoperational and startup testing was conducted using an approved written procedure. Each written test procedure delineated the prerequisites that must be satisfied before the test could be conducted, the equipment required for conducting the test and its calibration and cleanliness status, a step- by-step sequence for conducting the test, the criteria for determining the acceptability of the test results, and the means for documenting and retaining the results of the tests that became a part of the permanent record of the DAEC project.

5. Quality Assurance Records

   Iowa Electric's Quality Assurance Group maintains documents that demonstrate that all requirements of the Quality Assurance Program have been satisfied. This documentation shows that appropriate codes, standards, and regulatory requirements were observed; specified materials were used; correct procedures were used; qualified personnel were provided; and inspection and test data show that the finished components and systems meet the applicable specifications for safe and reliable operation. These records are available so that any desired item of information is retrievable for reference. The records will be maintained throughout the life of the operating license.

17.1.2.1.1 Iowa Electric

The Quality Assurance Program of Iowa Electric and its principal contractors was carried out in accordance with written policies, procedures, and instructions.

The intent of the Quality Assurance Program was to ensure sound engineering in all phases of design and construction through conformity to regulatory requirements and design bases described in the license application. In addition, the program ensured adherence to specified standards of workmanship and implementation of specifications in fabrication and construction. It also included the observance of proper preoperational and operational testing and maintenance procedures as well as the documentation of the foregoing by keeping appropriate records.

Iowa Electric required its principal contractors to have quality assurance programs responsive to and satisfying the intent of the quality-related requirements of 10 CFR 50, Appendix B.

The Quality Assurance Program described in this section applies to activities affecting safety-related functions of the structures, systems, and major components listed in Section 17.1.2.2. Since the relationships between the listed items and plant safety are not uniform, and since such relationships are not the same for all components within any structure or system, the design requirements and other information as to the implementation of the Quality Assurance Program can be found elsewhere in the FSAR and in the documents and records developed to carry out the Quality Assurance Program.

17.1.2.1.2 Engineer-Constructor

The Bechtel quality assurance program covered all phases of the project including engineering, procurement, and construction from initial design development through acceptance by Iowa Electric. Policies, procedures, and instructions for the quality assurance program were documented in the Bechtel NQAM and supplemented by the Field Inspection Manual, the Procurement Department Inspection Manual, and the Quality Control Manual for ASME Nuclear Components.

The scope of the Bechtel quality assurance program was defined by the Q-List, which was a list of essential items requiring quality assurance coverage. Because the Q-List was a working document and therefore was updated periodically to give more detail, a Q-List in sufficient detail to show the general scope of the Bechtel quality assurance program for the DAEC corresponds to the summary list of safety-related items in Section 17.1.2.2.

The following basic principles were applied in the accomplishment of the quality assurance program.

The Project Engineering Team had primary responsibilities for quality in the design phase.

Suppliers and subcontractors had primary responsibilities for the quality of materials, equipment, and services furnished by them and were required to provide a quality assurance program and organization, as appropriate.

The Bechtel project field organization supervised by the Project Superintendent had the primary responsibility for quality of construction performed directly by Bechtel.

One or more levels of inspection or checks were provided as required within the organization having primary quality responsibilities.

In addition, this quality assurance program provided for at least one level of monitoring and verification by individuals not under the direct control of the group having primary responsibility for quality (e.g., the Quality Assurance Engineer monitored construction, Bechtel Shop Inspectors, and vendors). Beyond this, quality assurance audits of engineering and field operations were carried out under the direction of the Quality Assurance Coordinator.

17.1.2.1.3 NSSS Supplier

A quality system was provided by the Nuclear Energy Division of GE to ensure that the required effort, equipment, procedures, and management were directed toward satisfying the intent of the AEC quality assurance criteria for nuclear power plants of 10 CFR 50, Appendix B, and the quality objectives of providing safe and reliable systems and components within the GE scope of supply.

This section describes, in summary, the quality system established by the Nuclear Energy Division for application to the DAEC for which GE supplied the nuclear system. The principal objectives of the quality system and the key functions and elements that it contained did not change over the duration of this nuclear system project. However, circumstances made advisable changes in the organization or emphasis in the quality system, and such changes were made in accordance with normal management practice. Iowa Electric was notified of significant changes in the quality system as set forth in this section. The term “Iowa Electric” is herein used to identify the applicant and/or its

designated representative. The quality system was designed to ensure that the quality-related work elements for systems and components supplied by the Nuclear Energy Division were identified, assigned, and controlled from conceptual design through plant startup.

Specific responsibilities were assigned for quality-related activities through the major steps of a power plant project encompassing the broad phases of

- Conceptual design.
- Systems and components specification.
- Systems and components design.
- Vendor selection.
- Material and component procurement.
- Fabrication of components.
- Material and component testing.
- Shipping, site receiving, and storage.
- Installation of systems and components.
- Preoperational testing.
- Startup testing.

The quality system fully recognized that systems and components supplied by the NED came from a number of sources. The Division manufactures such items as control rods, control rod drives, control rod drive system components, steam separators, reactor servicing equipment, nuclear fuel assemblies, and instrumentation and control systems and equipment. Equipment within the NED scope of supply purchased from outside the NED for installation at reactor sites includes such items as the reactor pressure vessel and internals, pumps, motors, piping, valves, and heat exchangers.

17.1.2.2 Safety-Related Items

Table 17.1-3 identifies specific safety-related major structures, systems, and components to which the total Quality Assurance Program applied.

17.1.2.2.1 APED-Purchased Equipment

Classification of Systems and Components

Classifications were made of those systems and components within the GE Atomic Power Equipment Department (APED) scope of supply that were considered essential from the standpoint of safety (Safety Essential) in that their proper functioning was required for the prevention of postulated accidents that could affect the public health and safety, or to the mitigation of their consequences.

These systems and components were required to be supplied to quality standards and receive commensurate quality assurance and control that reflect the classification and the importance of the safety-related function(s) to be performed.

Systems and components within the GE APED scope of supply not classified as Safety Essential (Nonsafety Essential) were required to be supplied to quality standards and receive commensurate quality assurance and control that reflect the importance of the overall function(s) to be performed.

APED-purchased equipment included such items as the reactor pressure vessels and internals, pumps, motors, piping, valves, and heat exchangers.

The quality system for engineered equipment was initiated with the review of purchase specifications and/or purchased part drawings and data or project sheets, and is implemented during vendor selection, and during phases of vendor design, fabrication, test, inspection, cleaning, and packing.

Quality system policies, procedures, or instructions were documented for the following:

1. Advance review of purchase specifications.
2. Quality control plans for engineered equipment.
3. Implementation of quality control plan on bid requests and purchase orders.
4. Vendor evaluation and selection.
5. Product quality control checklists.
6. Document change control.
7. Review and approval of special processes.
8. Nonconforming material control.

9. Quality information feedback.

10. Shipment release control.

Quality control plans for the DAEC were issued Quality Control - Engineered Equipment for all major components, were directly referenced in bid requests and purchase orders, and were designed to complement and ensure conformance with the purchase specifications and drawings. Design Engineering reviewed the quality control plans before issuance.

Quality control plans required that the vendor establish and maintain a quality system commensurate with the complexity and importance of the component. Major equipment suppliers were required to demonstrate adequate control in areas such as the following:

1. Document change control.

2. Preproduction quality planning.

3. Purchased material quality control.

4. Material identification.

5. Control of processes such as welding, heat treating, cleaning, and nondestructive examination.

6. Qualification of equipment, procedures, and operators.

7. Project quality records.

8. Deviating material.

9. Calibration of measurement equipment.

10. Handling, storage, preservation, packing, and shipping.

Responsibility for quality planning and implementation for purchased equipment was assigned to Quality Control - Engineered Equipment. Quality control engineers and quality control field representatives within Quality Control - Engineered Equipment were typically assigned responsibilities as listed below:

1. Quality control engineers

    a. Conduct preprocurement reviews with Design Engineering and Procurement to ensure clear understanding of quality requirements.

    b. Provide quality-related review of design specifications, drawings, manufacturing procedures, and quality control procedures.

    c. Establish quality control plans and checklists that define quality audit requirements to vendors and the quality control representative.

    d. Conduct or direct preproduction reviews with vendor personnel to ensure clear and mutual understanding of quality requirements.

    e. Provide technical guidance to the quality control field representatives.

    f. Audit the vendor quality control program before and during fabrication.

    g. Review quality problems encountered during fabrication and during or after the installation of equipment and initiate corrective action.

2. Quality control field representatives

    a. Review purchase specifications and drawings.

    b. Conduct preproduction reviews with vendor personnel to ensure mutual understanding of quality requirements.

    c. Review vendors' detail drawings and manufacturing and quality control procedures.

    d. Review vendors' detailed fabrication process sheets to ensure proper sequencing and adequate in-process inspection, testing, and control.

    e. Witness and audit the various qualifications, tests, and inspections.

    f. Audit cleaning, preserving, packing, and shipping activities.

    g. Audit vendor conformance with established procedures such as the following:

        (1) Product and process quality planning.
        (2) Document change control.
        (3) Deviating material control.
        (4) Material identification and traceability.
        (5) Calibration of measuring equipment.

h. Complete product quality checklists before the release of assigned equipment.

17.1.2.2.2 NED-Manufactured Products

NED-manufactured products included such items as control rod drives, control rods, steam separators, reactor servicing equipment nuclear fuel, and instrumentation and control systems.

A quality system encompassing the effort, equipment, procedures, policies, and management required to manufacture and deliver quality products was formally documented and implemented within the manufacturing components of the NED. Prime elements of the manufacturing quality system include the following:

1. Preproduction quality evaluation.
2. Quality planning.
3. Purchased material control.
4. Product and process control.
5. Inspection and test.
6. Discrepant material control.
7. Training, qualification, and certification of personnel.
8. Quality information equipment control.
9. Quality information feedback and corrective action.
10. Work instructions, procedures, and drawings.
11. Identification, status, and control of material, parts, and components.
12. Special processes control.
13. Shipment release control.
14. Handling, storage, preservation, packing, and shipping control.
15. Related activities.

Preproduction quality evaluations were conducted by engineering, manufacturing, and quality control components on new and revised product designs before release for full production. Evaluations were conducted to ensure the following:

1. Design quality requirements were clearly defined.

2. The required manufacturing equipment and processes were documented or were developed to a capability consistent with product quality requirements.

3. The quality system by which required product quality characteristics were attained, maintained, and measured, was planned, documented, and implemented.

4. The required personnel, facilities, equipment, and materials were made ready for production and qualified where necessary.

Product and process quality planning was provided by the NED quality control organizations for all major items manufactured or procured by manufacturing components to ensure conformance with applicable drawings, specifications, acceptance criteria, and special instructions. Formally documented product and process quality planning was oriented toward ensuring product operational dependability and compliance with applicable codes and standards. The planning emphasized the prevention of discrepancies; the control of materials, products, processes, and procedures; corrective action; the appraisal of product quality characteristics; and the control of discrepant material.

The following typical planning documents were generated:

1. Master product quality control plans.
2. Process quality plans.
3. Product quality control plans.
4. Receiving inspection plans for standard raw material.
5. Receiving inspection plans for specific parts.
6. Purchased material quality control plans.
7. Quality control inspection instructions.
8. Quality control test instructions.
9. Quality inspection standards.
10. Audit plans.
11. Quality standing instructions.
12. Operating instructions.
13. Manufacturing administrative and operative procedure

17.1.2.2.3 NED Installation Control

It was the responsibility of NED to deliver systems and components to a predesignated location. It was the responsibility of Iowa Electric to receive and install the supplied equipment. NED provided technical direction as required by the contract. The following paragraphs identify those contributions to installation quality control made by the Division.

Component Receiving, Inspection, Handling, and Storage Control

Instructions for site receiving, inspection, handling, and storage control were provided by NED for the equipment and components that it supplied.

Installation Instructions

Separate installation instructions or installation instructions included in operation and maintenance manuals were supplied for assemblies and equipment within the NED scope of supply. NED-supplied installation instructions for the reactor recirculation piping, the primary steam piping, and the reactor vessel and internals. These installation instructions, which were reviewed by Quality Control and reviewed and approved by the responsible Design Engineering component, define the requirements that must be met for the installation, examination, and testing of the system and interconnecting weld joints of piping or components.

NED-supplied cleaning instructions for systems and equipment within the NED scope of supply.

NED technical specialists provide technical direction for the field installation and cleaning of systems and equipment within the NED scope of supply. An audit of the field installation and cleaning was provided by NED to ensure that the requirements of the installation instructions, cleaning instructions, and operation and maintenance manuals were met.

Technical Direction

The site resident manager and staff provided technical direction of the installation of NED-supplied equipment and components in accordance with the contract and applicable NED installation instructions. Technical direction was technical guidance, advice, and counsel, based on current engineering and installation practices, given to Iowa Electric's staff. The objective of the technical direction was to ensure that supplied nuclear systems and equipment were properly installed by Iowa Electric or its agents.

Quality Planning and Implementation

Quality planning was provided by Iowa Electric to meet the quality criteria objectives of the installation specifications and instructions provided by NED.

Responsibility for the NED contribution to installation quality control, which was to provide quality requirements and audit of Iowa Electric's quality activity, was assigned to Quality Control - Engineered Equipment. This organization provided quality control engineers who were assigned responsibility for planning and directing the installation-related quality activity. Quality control site representatives were provided and were responsible for ensuring proper understanding of, and conformance with, the requirements of the Division. Although the quality control site representatives were members of Quality Control - Engineered Equipment, they worked closely with the resident manager and received their project-oriented administrative guidance from him. Typical activities assigned to the quality control engineer and the quality control site representative are described below:

1. Conducted preinstallation reviews with the responsible Design Engineering component, installation technical specialists, and quality control management to ensure clear delineation and understanding of NED quality requirements.

2. Provided quality-related review of detailed drawings, specifications, installation instructions, and procedures.

3. Reviewed adequacy of Iowa Electric's installation quality control plan with respect to NED-supplied equipment.

4. Developed plans for APED audit of installation quality activities.

5. Provided guidance to the quality control site representative.

6. Audited Iowa Electric/Bechtel's site quality control program.

Quality Control Site Representative Activity

1. Conducted quality-related review of NED-approved drawings, specifications, instructions, procedures, and manuals for NED-supplied equipment.

2. Conducted preinstallation reviews with APED site resident manager, technical specialists, and Iowa Electric's quality control representative to ensure mutual understanding of quality requirements.

3. Reviewed NED installation instructions and Iowa Electric/Bechtel's procedures to ensure proper sequence and adequate in-process inspection and control.

4. Audited conformance with Iowa Electric/Bechtel's installation procedures and in-process controls.

5. Reviewed quality control records.

6. Witnessed and audited the various installation tests, qualifications, and inspections.

7. Ensured orderly processing and formal disposition of quality-related discrepancies and deviations.

17.1.3 DESIGN CONTROL

17.1.3.1 Iowa Electric

Responsibility for design control was delegated to the principal contractors (GE, nuclear steam supply system; Bechtel, balance-of-plant). Iowa Electric audited the quality assurance performance of the contractors.

Although there was mutual concern by affected contractors for all points of interface, responsibility for design control at such points was assigned to Bechtel with audit by Iowa Electric.

Design drawings for safety-related systems prepared by Bechtel were reviewed by Iowa Electric quality assurance personnel as a part of the review cycle in the DAEC Project Group.

The scope of Iowa Electric's quality assurance/quality control review of drawings included review for evidence that the drawing had received proper and/or adequate technical review by Bechtel and Iowa Electric engineering personnel. Evaluation of design characteristics were the responsibility of engineering personnel.

Design drawings for safety-related systems were not reviewed by Bechtel quality assurance/quality control personnel as part of the design phase. These drawings were reviewed by technically competent engineers familiar with the systems or equipment involved. It was the responsibility of the engineer to evaluate all aspects of design characteristics.

Design drawings for GE-supplied, safety-related equipment and components were reviewed by GE quality assurance/quality control personnel during the review phase of original issue. The scope included reviewing for quality requirements and inspection requirements. Changes to these drawings were reviewed if quality was affected.

17.1.3.2 Engineer-Constructor

Several levels of design review and approval were applied to significant design aspects of all Bechtel work. These standard practices are described below:

1. Checking and review by design- and engineering-level personnel within the Project Engineering Team having technical qualifications comparable to those of the engineer or designer who originated the work.

2. Review and approval by the originating engineer's Design Supervisor.

3. Review and approval by the Project Engineer.

4. Review and approval by the appropriate Chief Engineer of key design drawings, specifications, and documents.

For structures, systems, and components on the Q-List for which Bechtel had design responsibility, additional design control measures were implemented. A Design Control Check List was prepared that identified drawings, specifications, and other data reviewed by Chief Engineers or technical specialists under the Chief Engineer's direction. The Design Control Check List was developed and agreed on by the Project Engineer and the cognizant Chief Engineer soon after the initiation of the project and an appropriate program for monitoring design development was instituted. When an item identified in the Design Control Check List had been completed, the cognizant Chief Engineer performed a final review and executed a design control approval signifying that the necessary reviews and monitoring work had been completed and that the item was satisfactory from the standpoint of quality assurance requirements.

Interfaces with GE and Iowa Electric were controlled by means of project procedures that called for appropriate distribution and approvals of various documents. In general, specifications, design and interface information and systems criteria developed by GE were submitted to Bechtel for review. Drawings, specifications, and procurement packages were also routinely submitted to Iowa Electric for appropriate review. Interfaces with other vendors were controlled by the Bechtel Project Engineering Team through appropriate specification review and appropriate vendor-developed design procedures.

The Project Engineering Team employed several documents to establish requirements for the project. These documents included or incorporated applicable NRC regulatory requirements and design bases as proposed by the license application and accepted by the NRC, basic client-furnished data defining plant requirements, basic engineering data amplifying the basic client-directed project data, NSSS supplier-furnished criteria and data, project criteria and Bechtel design guides, standard specifications, and data sheets.

17.1.3.3 NSSS Supplier

Design review, approval, release, and change control systems were documented and were in current use in the engineering components contributing to the BWR business. System and component designs were controlled from conception through the startup of the DAEC to ensure consideration for performance, safety, and reliability.

Each GE BWR is identified as a particular member or variation of the BWR "product line." Each member or variation of the BWR product line is reviewed for safety and conformance to the applicable NRC regulations before its being committed to sale. Quality control organizations review new and revised product designs for quality requirements before their use for procurement or production. The product design for the DAEC was reviewed for safety and conformance to the applicable AEC regulation before being used in the proposal for the DAEC.

17.1.3.3.1 System Design

Nuclear system data sheets for the DAEC contract were issued by Systems Engineering of APED Design Engineering to the responsible system design organizational components in Plant and Equipment Engineering in the early months following the receipt of the order. The system design controlling documents that were prepared by the responsible system design engineers typically included the system design specification, piping and instrument diagrams, process flow diagrams, function control diagrams, and the instrument and electric diagrams. These documents were issued to Iowa Electric and Bechtel over a period of approximately 6 to 12 months after the receipt of the order.

The nuclear system data sheets and the system design controlling documents incorporated the design and safety requirements for the DAEC. It was the responsibility of the Manager, Design Engineering, to conduct safety analyses and to audit the plant design to ascertain conformance with established design criteria and design safety requirements. The nuclear system data sheets and the system design controlling documents were subject to a technical review and release approval by Requisition Engineering before being issued as a basis for component design.

Design Engineering issued a series of general standard design specifications that established standard requirements for designing components that satisfied the system requirements. These standard design specifications identified the industry codes and supplemental requirements that were used to ensure compliance with the safety criteria, quality levels, and specific requirements that APED imposed to meet acceptable reliability goals. Changes to this group of design specifications received the approval of all affected subsection managers within APED Design Engineering. The original issue and any changes were subject to review and release approval by Requisition Engineering.

17.1.3.3.2 Overall Design Review

An overall design review was made of the engineering work after the design documents had been issued and Iowa Electric had an opportunity to review them for adherence to the NSSS contract. The overall design review was made by a task force that was directed by the requisition engineer who was responsible for total project coordination in Design Engineering, but who was not directly responsible for the generation of the systems controlling documents or the design specifications. Licensing and safety representatives participated to make a comparison with the PSAR and any applicable amendments. The responsible design engineers participated in the review to provide necessary design information and to initiate and to follow through on any required changes.

Following the implementation of any changes required as a result of the review, the design was frozen. After the overall design review, further changes to the system documentation were made only for the following reasons:

1. Requests by Iowa Electric for changes from the original plant sold.

2. Feedback from earlier plant startups.

3. Other information indicating that the systems might not perform as originally designed.

Documents covered by the overall design review were the nuclear system data sheets, system design specifications, piping and instrumentation diagrams, process flow diagrams, functional control diagrams, and instrument and electrical diagrams.

Before and after the overall design review, a change control procedure established within Design Engineering was followed. The control procedure required documentation and approval by the requisition engineer and appropriate levels of management before a change of any system controlling document could be implemented. The responsible systems design engineer was charged with the responsibility for defining all documents affected by any such change, for coordinating with other design engineers whose documents were affected, and for obtaining the necessary approvals. Distribution was made to those responsible engineers who signed the change control document, to the requisition engineer, and to personnel in other subsections who had need to know. Changes at interfaces between Iowa Electric and APED-supplied equipment were reviewed between the two parties as appropriate.

17.1.3.3.3 Component Design

The design of components was initiated in accordance with plant schedule requirements using the system data sheets, system design controlling documents, and the general design specification.

17.1.3.3.3.1 Design of APED-Purchased Equipment.

The design documentation for the GE APED-purchased items normally consisted of equipment procurement specifications that specified the general requirements, purchased part drawings that showed the outline and interface requirements, and specific data or project sheets that defined the project-unique requirements of the equipment. The responsible design engineer approved the specifications, drawings, data or project sheets after they had been generated, and a review was made by the requisition engineer to determine that the design documents met unique project requirements, the plant data sheets, system design documents, and the general design specifications. Equipment purchase specifications and/or purchase part drawings and data or project sheets were reviewed by Quality Control - Engineered Equipment before supplier bidding.

The specification outlined the engineering documents such as drawings, procedures, and calculations that were submitted by the supplier for review and approval by Design Engineering. Any subsequent changes to the approved vendor documents were formally reviewed and required approval by Design Engineering.

17.1.3.3.3.2 Design of Mechanical Components Manufactured by Reactor Equipment Manufacturing (R&FMO)

The design documentation for equipment manufactured by R&FMO normally consisted of specific detailed product drawings augmented by design procedure specifications necessary to fabricate, inspect, and test the finished product. Design Engineering identified the relative importance of the various design requirements defined in the controlling documents as a guide for the quality control organization in Reactor Equipment Manufacturing in establishing the quality plan. The design engineer was responsible for having the design document reviewed for conformance to the system design control documents and the general design specifications referenced previously before releasing them to manufacturing. This review was performed by design engineers in other components with which there is an interface plus Material Engineering (APED), Manufacturing Engineering (Reactor Equipment Manufacturing) and Quality Control (Reactor Equipment Manufacturing). The rigid change control system described in Section 17.1.3.4 applied to any changes required in component design.

17.1.3.3.3.3 Design of Fuel

Nuclear system requirements for fuel were specified by APED Design Engineering and transmitted to RF&RD Engineering. These requirements were reviewed and accepted by the Fuel Engineering component of RF&RD. Detailed fuel drawings and specifications were produced by RF&RD Engineering and, before release for manufacture, were reviewed by APED Design Engineering to ensure conformance with mechanical design requirements. Reviews were also conducted by NFD Engineering with Manufacturing Engineering (Nuclear Fuels Manufacturing) and Quality Control (Nuclear Fuels Manufacturing) to ensure compatibility with manufacturing and quality control technology and capability.

Product requirements were transmitted from RF&RD Engineering to Nuclear Fuels Manufacturing through the issuance of engineering instructions that specified applicable drawings and specifications. Changes to drawings were made through the use of engineering change notices (ECN) that were reviewed for consistency within RF&RD Engineering and R&FMO components. Before release for manufacturing, a review was held with APED Design Engineering for consistency where required.

Design review, release, and change control systems were developed and implemented and were documented in formal document systems.

17.1.3.3.3.4 Design of Instrumentation and Controls

The system design controlling documentation for items supplied by Nuclear Power Generation Controls Department (NPGCD) consisted of design specifications, instrument engineering diagrams, function control diagrams, piping and instrument diagrams, specification control drawings, instrument data sheets, and general requirements incorporated in an instrumentation and control purchase specification prepared by APED Design Engineering. The instrument data sheets defined the characteristics of the measured parameter, the instrument environment, ranges, accuracies, setpoints, and locations of instruments required by the system design. The responsible APED engineer was required to obtain review and approval of the drawings and documents he had initiated. Reviewers normally included the requisition engineer and all APED engineers responsible for equipment with which there exists an interface.

The controlling documents were measured against the requirements of the nuclear system data sheets. After the overall system design review, the final review and approval of the completed documents was by the responsible APED engineer who reviewed to determine that the approved changes had been accurately and properly made. The distribution of the approved documents was to the responsible APED engineer, to the unit manager of the APED units responsible for them, to the APED requisition engineer, and to NPGCD through APED Purchasing.

On receipt of the APED design controlling documentation from APED Purchasing, NPGCD Marketing reviewed the documentation package for completeness and technical content and transmitted copies to NPGCD Quality Control and to NPGCD Requisition Engineering. NPGCD Requisition Engineering performed the detail design that encompassed the generation of manufacturing drawings, drawings for Iowa Electric use, purchased part drawings, and instruction manuals. The detail design made use of NPGCD standard products and purchased components. The NPGCD standard products were designed to a NPGCD approved functional specification, qualified for performance and design adequacy by a separate testing group, and reviewed for critical applications (if appropriate) by a safe-guards specialist. The purchased components were bought by NPGCD Manufacturing to purchased part drawings prepared by NPGCD Engineering and controlled by quality control procedures similar to those discussed above for APED-purchased (engineered) equipment.

Certain NPGCD documents required review and approval by APED Design Engineering before the start of manufacture. On receipt of this approval, NPGCD Requisition Engineering transmitted the production drawings along with any special assembly and testing instructions to NPGCD Manufacturing. NPGCD Manufacturing ordered the necessary materials and planned the shop operations. NPGCD Quality Control planned the shop operations and the inspection, testing, and other quality control requirements. During the following production, NPGCD Quality Control monitored the products to ensure conformance with the drawings and specifications.

The design change control system for changes generated within NPGCD (and that did not affect APED-approved documents) was initiated with the generation of an engineering change notice by the responsible NPGCD engineer. The engineering change notice was reviewed and approved by NPGCD Engineering Release Control and by the cognizant NPGCD design engineer. NPGCD Manufacturing, on receipt of the engineering change notice, acknowledged receipt and implemented the change. Those changes that affected APED-approved documents were transmitted to APED by NPGCD Marketing. APED-approved documents could not be changed without the approval of APED Design Engineering.

17.1.3.3.3.5 Field Change Control

Field changes fall into two general classes: (1) those generated by design changes originally in the home office and (2) those initiated in the field as a result of unique field conditions. Design changes originating in the home office were generally the result of changes in licensing requirements, changes in Iowa Electric requirements, or information feedback from other plants or components being constructed, tested, started up, or in operation. In this case, the responsible design engineer generated a field disposition instruction, which defined in detail the component(s) affected, the changes to be made, the parts that had to be replaced, and the disposition of parts replaced. The responsible design engineer was also responsible for providing instructions for the manufacture or procurement of the replacement parts and for ensuring that instructions were issued for other projects requiring such changes. Review and approval of the field disposition instruction was by the responsible design engineer, the requisition engineer, and project management.

Field changes initiated by field organizations were generally the result of deviations from the expected construction conditions. The field organization generated a field deviation disposition request for compliance with the established criteria and the performance and functional design requirements. When a proposed method for correction did not comply with these criteria and requirements, it was the responsibility of Design Engineering to disapprove the field deviation disposition request and propose an alternative, acceptable solution to the problem. Final approval of the field deviation disposition request for a given project was by the responsible design engineer, the requisition engineer, and project management.

When a field deviation disposition request indicated an inherent design problem that affected more than one project, the responsible design engineer issued appropriate field disposition instructions to effect changes in other projects where the work had already been completed and initiated and instituted ECN changes to the basic design of plants where construction had not reached the same stage of completion.

17.1.3.4 Chicago Bridge & Iron Company (Containment)

Design calculations and drawings were made and checked by CB&I's Memphis Engineering. All drawings were reviewed both by Memphis Engineering and by CB&I's Oak Brook Engineering Special Structures Design Group (Corporate) for compliance with design and specification requirements and also by CB&I's applicable Corporate, Shop, and Construction quality assurance groups for compliance with quality control and assurance requirements. The approval of drawings was by the Corporate Engineering, and fabrication could not proceed before the receipt of drawings indicating that such approval had been given.

17.1.4 PROCUREMENT DOCUMENT CONTROL

17.1.4.1 Engineer-Constructor

Technical aspects of procurement documents were prepared by the Project Engineering Team in accordance with the procedures described in Section 17.1.3.2. Appropriate vendor quality assurance program requirements were incorporated in the procurement documents. Provisions were made for periodic and final inspection in vendor shops as appropriate. All procurement, whether carried out by home office procurement department or the field procurement organization, employed specifications and quality assurance requirements established by the Project Engineering Team.

17.1.4.2 NED-Manufactured Products

A product quality checklist system was used by quality control components to ensure that significant quality-related work elements had been completed before product shipment release. A responsible engineer reviewed and verified by signature that items on the checklist were accomplished and that the product was suitable for shipment.

17.1.4.3 Containment

The procurement of materials was controlled through the use of specially prepared material procurement specifications and by purchasing only from qualified vendors. These procurement specifications were prepared by Memphis Engineering and were subsequently reviewed and approved similar to that for drawings. Material selections and descriptions were shown on the drawings and on the bills of material that were prepared by Memphis Engineering for use by Purchasing in ordering materials. Purchasing was required to include applicable referenced approved material procurement specifications in their purchase orders and to place orders only with vendors who had

been surveyed and qualified by CB&I's Corporate quality assurance group. Vendor in-plant inspection by Plant Quality Assurance and auditing of vendors by Corporate Quality Assurance were scheduled at regular intervals by Corporate Nuclear Quality Assurance.

17.1.4.4 Iowa Electric

Iowa Electric retained ultimate responsibility for procurement document control by review of purchase specifications to ensure the inclusion of the required Quality Assurance Program. Periodic audits of prime contractor's procurement activities further ensured proper implementation of the program.

Procurement documents for material or equipment for plant maintenance, modification, repair, and replacement were routed through the Engineering Support Group for approval before purchase. The Quality Assurance staff reviewed the documents for the inclusion of adequate Quality Assurance Program requirements, inspection and test requirements, and proper documentation requirements.

17.1.5 INSTRUCTIONS, PROCEDURES, AND DRAWINGS

17.1.5.1 Activities That Affect Quality

Iowa Electric

Activities affecting quality were prescribed by documented instructions, procedures, or drawings appropriate to the circumstances. Audits of the instructions, procedures, and drawings of subcontractors were performed by the prime contractor and summaries of such audits were available to Iowa Electric. Iowa Electric audited the prime contractors.

NED-Manufactured Products

The NED quality system provided for the documentation in formally controlled document systems of those work instructions, procedures, and drawings having an effect on product quality.

Related quality control activities such as special quality studies, postproduction quality service, record accumulation, and maintenance and management of the quality control functions were a part of the quality system and were documented in formally documented systems.

17.1.5.2 Quantitative and Qualitative Acceptance Criteria

Design drawings for safety-related systems prepared by Bechtel were reviewed by Iowa Electric quality assurance personnel as a part of the review cycle in the DAEC Project Group.

The scope of Iowa Electric's quality assurance/quality control review of drawings included review for evidence that the drawing had received proper and/or adequate technical review by Bechtel and Iowa Electric engineering personnel. The evaluation of design characteristics was the responsibility of engineering personnel.

Design drawings for safety-related systems were not reviewed by Bechtel quality assurance personnel as part of the design phase. These drawings were reviewed by technically competent engineers familiar with the systems or equipment involved. It was the responsibility of the engineer to evaluate all aspects of design characteristics.

Design drawings for GE-supplied safety-related equipment and components were reviewed by GE quality assurance personnel during the review phase of original issue. The scope included reviewing for quality requirements and inspection requirements. Changes to these drawings were reviewed if quality was affected.

Material and equipment specifications for safety-related items prepared by Bechtel were reviewed by Iowa Electric's quality assurance personnel as a part of the review cycle within the DAEC Project Group. The scope of this review included review for inclusion of adequate Quality Assurance Program requirements, proper definition of quality assurance documentation, and evidence of proper and/or adequate technical review by Bechtel and Iowa Electric personnel.

The review included evaluation if the inspection requirements were clearly stated. Technical personnel evaluated the requirements for their adequacy. The responsible engineer consulted quality assurance personnel on matters relating to individual specifications. The evaluation of the design characteristics was the responsibility of the technically competent engineers who prepared and reviewed the specification.

Material and equipment specifications for GE-purchased safety-related items were reviewed by GE quality assurance personnel during the preparation of the original issue of the document. The scope included review for quality requirements, inspection requirements, and documentation. Changes to these documents were reviewed by quality assurance personnel if the changes affected quality.

Field change requests were reviewed by the same groups that made the review of the original design. Bechtel field change requests, which were approved and became design change notices, were cycled through the Iowa Electric engineering group in the same cycle as the original.

Field deviation disposition requests from GE were reviewed by home office technical personnel familiar with the design or equipment and by GE quality assurance personnel when quality was affected. Scope is the same as for other GE documents.

General procedures for carrying out engineering, procurement, and construction were contained in the following manuals and documents:

1. Project Engineer's Manual containing general guidelines for carrying out engineering activities.

2. Nuclear Quality Assurance Manual defining responsibilities and outlining quality assurance activities and procedures.

3. Field Inspection Manual describing general guidelines and procedures for field inspection.

4. Procurement Department Inspection Manual containing shop inspection instructions, guidelines, and procedures.

5. Bechtel general and technical engineering standards that establish selective criteria, guidelines, and standards for station design.

6. Project Procedures Manual, describing the responsibilities and interrelationship of engineering, procurement, construction, Iowa Electric, and other organizations involved with the project.

7. Quality Control Manual - ASME nuclear components, establishing requirements for the control of the quality of work in accordance with the ASME Code, Section III, for nuclear power components.

These were supplemented by specific instructions and procedures that might be prepared by engineering; obtained from vendors; or prepared by vendor, subcontractor, or Bechtel construction personnel as required. When appropriate, such instructions and procedures were reviewed and approved by the Project Engineering Team and Bechtel specialists.

17.1.6 DOCUMENT CONTROL

17.1.6.1 Control of Issuance of Documents

Iowa Electric

Measures were established to control the issuance of documents, such as instructions, procedures, and drawings, and the changes thereto, that prescribed all activities affecting quality. Iowa Electric conducted periodic audits of documentation by prime contractors to ensure that a quality control review had been performed.

Suppliers were required to maintain document control systems to ensure that documents, including changes, were reviewed for adequacy and approved for release by authorized personnel and were distributed to and used at the location where the prescribed activity was performed.

Iowa Electric's audit also ensured proper distribution of the latest issue of documents to interested parties.

Engineer-Constructor

The review and approval of design documents is covered in Section 17.1.3. Approved drawings and specifications were promptly issued to individual organizations and individuals performing the work and to those responsible for inspection. Changes made by the Project Engineering Team or proposed by field engineering to approved drawings were reviewed and approved by the Project Engineering Team in accordance with procedures for review of the initial issue. Where significant changes were involved, review by cognizant Chief Engineers and/or technical specialists was performed.

17.1.6.2 Types of Documents To Be Controlled

The project field organization was responsible for the implementation of a field procedure that controlled the distribution of approved drawings, specifications, and documents and that ensured that obsolete material was voided or destroyed.

The Quality Assurance Engineer monitored field engineering activities to verify that field engineering changes were reviewed and approved by the Project Engineering Team. He also made spot checks to ensure that a drawing control log was being maintained and that only current design documents were in use.

17.1.6.3 Review and Approval of Changes to Documents

The Quality Assurance Manual contained procedures to control changes to documents that had been specified as control documents. The review and approval to such documents generally were the same as that required for the original issue of such documents. Possible changes could be initiated by plant supervisory personnel. The approval of plant management was required in addition to the approval of Plant Safety Committee and Quality Assurance, depending on the nature of the change.

17.1.7 CONTROL OF PURCHASED MATERIAL, EQUIPMENT, AND SERVICES

17.1.7.1 Conformance to Procurement Document Requirements

Iowa Electric

Audits performed by Iowa Electric on a selective basis ensured that material, equipment, and subcontractors conformed to the procurement documents of the prime contractor. Measures included provisions as appropriate for source evaluation and selection, objective evidence of quality furnished by the contractor or subcontractor, inspection at the contractor or subcontractor source, and examination of the product on delivery. The prime contractor audited the performance of his subcontractors and made summaries of these audits available to Iowa Electric for review.

Quality Assurance evaluated the potential vendor to ensure that he had the ability and system to produce a quality product and the necessary documentation. Source selection was a decision of the Plant Engineering and/or Purchasing Departments choosing from the list of qualified vendors as reviewed by Quality Assurance. The procurement documents were written such that the vendor was required to provide documentary evidence of performance to procurement requirements. The surveillance of the vendor was provided by Quality Assurance to ensure that the vendor was performing in accordance with the purchase requirements.

Source inspection was provided by Quality Assurance when it was deemed necessary. As part of the receiving function, there were instructions to ensure that some documentary evidence of conformance to procurement requirements was provided. This documentary evidence might have been in the form of a certificate by a quality assurance inspector, a certificate of conformance to ASME requirements from the vendor, etc., in addition to purchase documents. The documentary evidence of conformance to procurement requirements was retained at the site.

NED-Manufactured Products

Purchased material control was exercised for the purpose of ensuring that vendor-supplied materials, equipment, and services were provided at proper quality levels and conformed to the specifications of purchase.

Requests for production material were reviewed by quality control personnel before submittal for purchasing, and necessary quality requirements were added to the material request. These requirements included, where applicable, review of vendor planning, documentation required, objective evidence of quality to be supplied by the vendor, hold points for source inspection by NED quality control personnel, qualification and certification requirements, and receiving inspection coding.

Vendors selected were qualified by virtue of past performance, vendor survey, or a specific program in which the vendor was qualified by demonstrating the ability to perform. Vendors were required to maintain a quality system commensurate with design and quality assurance requirements. On certain designated items, Quality Control maintained the surveillance of fabrication and testing at vendors' plants and furnished reports of source inspections and tests.

Incoming vendor items were inspected and approved by NED quality control components in accordance with the quality requirements as specified in the purchase order, material specifications, standard practices, and receiving inspection plans.

Acceptable parts and materials were appropriately identified at receiving inspections and released for production control accumulation.

Engineer-Constructor

The Bechtel quality assurance program included a comprehensive system to ensure that purchased material, equipment, and services conformed to the procurement documents. The program provided for the evaluation of vendor's quality assurance program and preparation of procurement specifications incorporating quality assurance requirements. These quality assurance requirements included provision for an appropriate vendor quality assurance program and organization, purchaser surveillance as required, vendor preparation and maintenance of appropriate test and inspection records, certificates and other quality assurance documentation, and vendor submittal of quality control records considered necessary for purchaser retention to verify the quality of completed work.

Bechtel Shop Inspectors reviewed and verified vendor quality assurance records and prepared reports documenting vendor data not submitted to purchaser. Where Bechtel shop inspection was performed, a final inspection of the finished item was carried out in the vendor's shop before release for shipment.

Bechtel field procurement procedures provided for receipt inspection by the Material Supervisor on all materials and equipment delivered to the jobsite. For significant items or materials that form parts of Q-List Systems, Bechtel field engineers carried out an independent receipt inspection and documented results on appropriate receiving reports. Bechtel procurement procedures also provided for periodic audits of vendor quality assurance activities as appropriate.

17.1.7.2 Auditing the Effectiveness of Control

APED-Purchased (Engineered) Equipment

APED Design Engineering and Quality Control - Engineered Equipment reviewed and approved all vendor deviations from specified requirements. When it was inappropriate to revise the approved drawings, specifications, or procedures, a deviation

disposition request form or equivalent vendor form was used to formally document and control deviation approvals.

A project quality checklist system was used on engineered equipment as a means of ensuring systematic verification of vendor conformance during fabrication and before release for shipment. The checklists summarize the quality verification performed during and after fabrication, testing, and inspection of purchased equipment.

Examples of items to be verified on the checklist are the following:

1. Use of approved drawings and specifications.

2. Use of approved welding, heat treating, cleaning, and nondestructive examination procedures.

3. Procedure and operator qualification.

4. Material test results.

5. Dimensional measurements.

6. Radiographs and other examination results.

7. Performance testing.

8. Heat treatment.

9. Cleaning.

10. Deviation approvals.

11. Project quality records.

On selected equipment, the use of product quality checklists was extended to include the verification of materials such as castings, forgings, pipe fittings, and plate.

The APED quality control representative dated and initiated each checklist. All items on the checklist were required to be verified before APED release for shipment unless specific arrangements were made to complete fabrication and/or verification after shipment. Such arrangements required the advance approval of the Project Manager and the Manager, Quality Control - Engineered Equipment. A copy of each completed checklist was forwarded to the Project Manager and other NED personnel, as required.

Containment

Materials received at CB&I plants directly from the vendor first underwent a documented receiving inspection under the direction of Plant Quality Assurance in order to ascertain physical conformance to purchase order requirements. Purchasing then reviewed vendor test reports, certificates of compliance and other applicable documents, including CB&I's Receiving Inspection Report for completeness and compliance with purchase order requirements before forwarding all such documents and reports to Shop Quality Assurance, who subsequently verified compliance before accepting the material and releasing it to Shop Production for fabrication.

The control of material in CB&I's plant began at receipt when Purchasing initiated a Material Verification Summary Sheet for each item ordered and which recorded the results of certification review, receiving inspection, material application, and provided a cross check to the effect that the material had been properly applied. After verification of compliance and release, piece marks corresponding to the piece marks shown on applicable drawings were assigned and affixed to the material in the shop. These piece marks, along with vendor's material identification numbers, were then tabulated on a Daily Fabrication Report that provided traceability to material certification, and after this document was later compared with the Material Verification Summary Sheet, assurance was attained that the proper material had been used.

17.1.8 IDENTIFICATION AND CONTROL OF MATERIAL, PARTS, AND COMPONENTS

17.1.8.1 Material and Examination Requirements

General

Material and examination requirements for piping and valves are listed in the following Schedules I through IV.

These requirements are described in general. No attempt has been made to completely describe each and every detailed component requirement in these piping systems. Various minor deviations from the basic requirements, for example, materials substitution, were reviewed to ensure that such deviations met the applicable codes and standards.

SCHEDULE I

MATERIAL AND EXAMINATION REQUIREMENTS FOR GROUP A PIPING AND VALVES

A. Material Specifications

1. Carbon steel piping

   Pipe in all sizes is seamless, ASTM A-106, Grade B.

   Fittings, 2.5 in. and larger, are seamless butt welding, ASTM A-234, Grade WPB.

   Fittings, 2 in. and smaller, are socket welding, forged, ASTM A-105, Grade II.

2. Stainless steel piping

   Pipe, 10 in. and larger, is seam welded, ASTM A-358, Type 304.

   Pipe, 8 in. and smaller, is seamless, ASTM A-376, Type 304, or A-312, Type 304.

   Fittings, 2.5 in. and larger, are butt welding, ASTM A-403, Grade WP-304 or WP-304-W.

   Fittings, 2 in. and smaller, are socket welding, forged, ASTM A-182, Grade F-304.

3. Flanges

   Carbon steel flanges are ANSI Standard, forged, ASTM A-105, Grade II.

   Stainless steel flanges are ANSI Standard, forged, ASTM A-182, Grade F-316.

4. Carbon steel valve pressure parts

   Castings are ASTM A-216, Grade WCB.

   Forgings are ASTM A-105, Grade II.

5. Stainless steel valve pressure parts

   Castings are ASTM A-351, Grade CF 8 M.

   Forgings are ASTM A-182. Grade F-316.

SCHEDULE I

MATERIAL AND EXAMINATION REQUIREMENTS
FOR GROUP A PIPING AND VALVES (Continued)

B. Examination and Test

Piping and valves, including materials, are examined and tested in accordance with the requirements of the applicable code (see Table 3.2-2) and the following requirements:

1. Piping materials

   a. Seamless and welded without filler metal tubular products and fittings are 100% examined by the ultrasonic method after final heat treatment.

      Where ultrasonic examination on the final product form will not yield pertinent information (such as on a tee), it is performed before final forming and heat treatment. After final heat treatment, a magnetic particle examination or liquid-penetrant examination is performed on all accessible surfaces.

   b. Longitudinal and girth welds in-welded with filler metal tubular products and fittings are 100% radiographed and the accessible surface of the welds and heat-affected zones of the base metal are examined by magnetic particle method or liquid-penetrant method after the completion of major forming and final heat treatment.

      In addition, these components are 100% examined by the ultrasonic method. This examination is performed after final heat treatment or on the plate for these products before forming.

   c. Flanges in all sizes and forged fittings 2 in. and smaller are examined by the magnetic particle or liquid-penetrant method on all accessible surfaces after final heat treatment.

   d. Statically or centrifugally cast fittings used for pressure boundary components are examined by 100% radiography and, in addition, by either the magnetic particle or liquid-penetrant method.

SCHEDULE I

MATERIAL AND EXAMINATION REQUIREMENTS
FOR GROUP A PIPING AND VALVES (Continued)

e. All bolting is visually examined after final machining and heat treatment.

Bolting materials greater than 1 in. nominal bolt size are examined by either the magnetic particle method or the liquid-penetrant method after final heat treatment.

In addition, all bolts and studs greater than 2 in. nominal bolt size are ultrasonically examined before threading.

2. Piping welds

a. Completed girth and longitudinal butt welds are 100% examined by radiography, and in addition, the accessible surface of the weld and the heat-affected zone of the base metal adjacent to the weld are examined by either the magnetic particle or the liquid-penetrant method.

b. All accessible surfaces of completed fillet, socket and attachment welds, and the heat-affected zone of the base metal adjacent to the weld, are examined by the magnetic particle or liquid-penetrant method.

c. Completed welds of branch connections over 4 in. pipe size are 100% examined by radiography and, in addition, the accessible surface of the weld and heat-affected zone of the base metal adjacent to the weld are examined by the magnetic particle or liquid-penetrant method.

d. All accessible surfaces of completed welds, and the heat-affected zone of the base metal adjacent to the weld, of branch connections 4-in. pipe size and under, are examined by the magnetic particle or liquid-penetrant method.

3. Valves

a. Castings and forgings are 100% examined by radiography and additionally by magnetic particle method or liquid-penetrant method in the finished condition.

b. Weld overlays are examined by either the magnetic particle or liquid-penetrant method.

c. Weld-end preparations on forgings are examined by either the magnetic particle or liquid-penetrant method.

SCHEDULE I

MATERIAL AND EXAMINATION REQUIREMENTS
FOR GROUP A PIPING AND VALVES (Continued)

C. Special Requirements for Group A Systems

1. Impact testing of ferritic steel is required for the Group A systems listed below:

   HPCI discharge to feedwater line downstream of [redacted].

   Feedwater discharge from isolation stop check valve to reactor.

   Steam to HPCI turbine through penetration, from [redacted].

   Residual heat removal pump suction from reactor recirculation line to [redacted].

   Residual heat removal discharge from [redacted] through penetration to valve [redacted].

   Residual heat removal discharge from [redacted] through penetration to valve [redacted].

   Core spray discharge from [redacted] to reactor spray valve.

   Core spray discharge from [redacted] to reactor spray valve.

2. The following carbon steel materials are used where impact testing is required for Group A pipe and fittings.

   Pipe: 8 through 24 in.: Seamless ASTM A-333, Grade 6.

   Fittings: 8 in. and larger: Butt welding, ASTM A-420, Grade WPL special (ASTM A-33, Grade 6), (seamless).

SCHEDULE II

MATERIAL AND EXAMINATION REQUIREMENTS
FOR GROUP B PIPING AND VALVES

A. Material Specifications

1. Carbon steel piping

Pipe in all sizes is seamless ASTM A-106, Grade B.

Fittings, 2.5 in. and larger, are seamless butt welding, ASTM A-234, Grade WPB.

Fittings, 2 in. and smaller, are socket welding, forged, ASTM A-105, Grade II.

2. Stainless steel piping

Pipe, 10 in. and larger, seam welded, ASTM A-358, Type 304.

Pipe, 8 in. and smaller, is ASTM A-376, Type 304, or ASTM A-312, Type 304.

Fittings, 2.5 in. and larger, are butt welding, ASTM A-403, Grade WP-304 or WP-304-W.

Fittings, 2 in. and smaller, are socket welding, forged, ASTM A-182, Grade F-304.

3. Flanges

Carbon steel flanges are ANSI Standard, forged, ASTM A-105, Grade II.

Stainless steel flanges are ANSI Standard, forged, ASTM A-182, Grade F-316.

4. Carbon steel valve pressure parts

Castings are ASTM A-216, Grade WCB.

Forgings are ASTM A-105, Grade II.

5 Stainless steel valve pressure parts

Castings are ASTM A-351, Grade CF 8 M.

Forgings are ASTM A-182, Grade F-316.

SCHEDULE II

MATERIAL AND EXAMINATION REQUIREMENTS
FOR GROUP B PIPING AND VALVES (Continued)

B. Examination and Test

Piping and valves including materials are examined and tested in accordance with the applicable code (see Table 3.2-2) and the following requirements:

1. Piping materials

   a. Longitudinal and girth welds in-welded with filler metal tubular products and fittings are 100% radiographed.

   b. Cast fittings are examined by radiography and additionally by either the magnetic particle or liquid- penetrant method.

2. Piping welds

   Group B piping is examined in accordance with applicable portions of the Nuclear Piping Code, paragraph 2-727, which includes:

   a. Completed girth and longitudinal butt welds are 100% examined by radiography.

   b. All accessible surfaces of completed fillet, socket and attachment welds, and the heat-affected zone of the base metal adjacent to the weld, are examined by the magnetic particle or liquid-penetrant method.

   c. Completed welds of branch connections over 4-in. pipe size are 100% examined by radiography.

   d. All accessible surfaces of completed welds, and the heat-affected zone of the base metal adjacent to the weld, of branch connections 4-in. pipe size and under are examined by the magnetic particle or liquid-penetrant method.

3. Valves

   a. Castings are examined by radiography and, in addition, by the magnetic particle or liquid-penetrant method in the finished condition.

   b. Forgings including weld-end preparations are examined by either the magnetic particle or the liquid-penetrant method.

MATERIAL AND EXAMINATION REQUIREMENTS
FOR GROUP B PIPING AND VALVES (Continued)

c. Weld overlays are examined by either the magnetic particle or the liquid-penetrant method.

C. Special Requirements For Group B Systems

1. Impact testing of ferritic steel is required for the Group B systems listed below:

Core spray test line from [redacted].

Core spray test line from [redacted].

RHR pump discharge and test line to torus spray between [redacted].

RHR pump discharge to torus spray and test line between [redacted].

RHR pump discharge to containment coil from [redacted].

RHR pump discharge to containment coil from [redacted].

HPCI pump suction from torus to [redacted].

RCIC pump suction from torus to [redacted].

Core spray pump [redacted] suction from torus to [redacted].

Core spray pump [redacted] suction from torus to [redacted].

RCIC turbine exhaust to torus.

HPCI turbine exhaust to torus.

RHR pump suction from torus to isolation valves [redacted].

RHR pump suction from torus to isolation valves [redacted].

RCIC turbine drains to torus downstream of stop check valve.

SCHEDULE II

MATERIAL AND EXAMINATION REQUIREMENTS
FOR GROUP B PIPING AND VALVES (Continued)

HPCI turbine drains to torus downstream of stop check valve.

RHR pump discharge to torus spray from [redacted].

RHR pump discharge to torus spray from [redacted].

RHR test line to torus from [redacted].

RHR test line to torus from [redacted].

Core spray test line to RHR test line from [redacted].

Core spray test line to RHR test line from [redacted].

RHR pump discharge to containment coil from [redacted] through penetration.

RHR pump discharge to containment coil from [redacted] through penetration.

HPCI minimum flow line downstream of [redacted].

RCIC minimum flow line to HPCI minimum flow line downstream of [redacted].

Instrument air drywell penetration.

Service air drywell penetration.

Containment vent purge exhaust.

Torus vent purge exhaust.

Containment purge (supply).

Torus purge (supply).

Torus vacuum breaker line.

Reactor building cooling water penetration supply.

SCHEDULE II

MATERIAL AND EXAMINATION REQUIREMENTS
FOR GROUP B PIPING AND VALVES (Continued)

Reactor building cooling water penetration return.

Drywell floor drain sump pump discharge containment penetration.

Drywell equipment drain sump pump discharge containment penetration.

Drywell cooling water/well water supply penetrations.

Drywell cooling water/well water return penetrations.

Nitrogen purge and makeup to containment downstream of isolation valves.

2. The following carbon steel materials are used where impact testing is required for Group B materials:

   Pipe: 6 in. through 24 in.: Seamless, ASTM A-333, Grade I.

   Fittings: 6 in. through 24 in.: Butt welding, seamless, ASTM A-420, Grade WPL1.

SCHEDULE III

MATERIAL AND EXAMINATION REQUIREMENTS
FOR GROUP C PIPING AND VALVES

A. Material Specifications

1. Carbon steel piping

Pipe in all sizes is seamless, ASTM A-106, Grade B.

Fittings, 2.5 in. and larger, are seamless, butt welding, ASTM A-234, Grade WPB.

Fittings, 2 in. and smaller, are socket welding, forged, ASTM A-181, Grade 1.

2. Stainless steel piping

Pipe, 10 in. and larger, is seam welded, ASTM A-358, Type 304.

Pipe, 8 in. and smaller, is seamless, ASTM A-376, Type 304, or ASTM A-312, Type 304.

Fittings, 2.5 in. and larger, are butt welding, ASTM A-403, Grade WP-304 or WP-304-W.

Fittings, 2 in. and smaller, are socket welding, forged, ASTM A-182, Grade F-304.

3. Flanges

Carbon steel flanges are ANSI Standard, forged, ASTM A-181, Grade I.

Stainless steel flanges are ANSI Standard, forged, ASTM A-182, Grade F-304.

4. Carbon steel valve pressure parts

Castings are ASTM A-216, Grade WCB.

Forgings are ASTM A-105, Grade II.

SCHEDULE III

MATERIAL AND EXAMINATION REQUIREMENTS
FOR GROUP C PIPING AND VALVES (Continued)

5. Stainless steel valve pressure parts

   Castings are ASTM A-351, Grade CF 8 M.

   Forgings are ASTM A-182, Grade F-316.

B. Examination and Test

Piping and valves are examined in accordance with the applicable code (see Table 3.2-2) and the following requirements:

1. Piping materials are examined in accordance with the materials specification.

2. Girth and longitudinal butt welds in piping over 4-in. nominal pipe size are examined by random radiography.

SCHEDULE IV

MATERIAL AND EXAMINATION REQUIREMENTS FOR GROUP D PIPING AND VALVES

Critical Group D Piping and Valves

A. Material Specifications

1. Carbon steel piping

Pipe in all sizes is seamless ASTM A-106, Grade B.

Fittings, 2.5 in. and larger, are seamless butt welding, ASTM A-234, Grade WPB.

Fittings, 2 in. and smaller, are socket welding, forged, ASTM A-105, Grade II.

2. Stainless steel piping

Pipe, 10 in. and larger, is seam welded, ASTM A-358, Type 304.

Pipe, 8 in. and smaller, is ASTM A-376, Type 304, or ASTM A-312, Type 304.

Fittings, 2.5 in. and larger, are butt welding, ASTM A-403, Grade WP-304 or WP-304-W.

Fittings, 2 in. and smaller, are socket welding, forged, ASTM A-182, Grade F-304.

3. Flanges

Carbon steel flanges are ANSI Standard, forged, ASTM A-105, Grade II.

Stainless steel flanges are ANSI Standard, forged, ASTM A-182, Grade F-316.

4. Carbon steel valve pressure parts

Castings are ASTM A-216, Grade WCB.

Forgings are ASTM A-105, Grade II.

SCHEDULE IV

MATERIAL AND EXAMINATION REQUIREMENTS
FOR GROUP D PIPING AND VALVES (Continued)

Critical Group D Piping and Valves

5. Stainless steel valve pressure parts

   Castings are ASTM A-351, Grade CF 8 M.

   Forgings are ASTM A-182, Grade F-316.

B. Examination and Test

Piping and valves are examined in accordance with the applicable code and the following requirements:

1. Piping materials

   a. Longitudinal and girth welds in-welded with filler metal tubular products and fittings are radiographed.

   b. Cast fittings are examined by radiography and additionally by either the magnetic particle or liquid-penetrant method.

2. Piping welds

   a. Completed girth and longitudinal butt welds are 100% examined by radiography.

   b. All accessible surfaces of completed fillet, socket and attachment welds, and the heat-affected zone of the base metal adjacent to the weld, are examined by the magnetic particle or liquid-penetrant method.

3. Valves

   a. Castings are examined by radiography and, in addition by the magnetic particle or liquid-penetrant method on machined surfaces.

   b. Forgings including machined surfaces are examined by either the magnetic particle or the liquid-penetrant method.

   c. Weld overlays are examined by either the magnetic particle or liquid-penetrant method.

MATERIAL AND EXAMINATION REQUIREMENTS
FOR GROUP D PIPING AND VALVES (Continued)

Group D critical valves are examined in accordance with the Power Piping Code, Chapter VI, except that weld overlays are examined by either the magnetic particle or liquid-penetrant method.

Noncritical Group D Piping and Valves

A. Material Specifications

Materials are in accordance with the material specifications permitted by the applicable code (see Table 3.2-2).

B. Examination and Test

Examination and test is in accordance with the applicable code (see Table 3.2-2).

17.1.8.2 Role of Quality Assurance Staff

Iowa Electric

Iowa Electric performed periodic audits of the procedures of its prime contractors and other major suppliers regarding the identification and control of materials, parts, and components, including partially fabricated assemblies.

For minor suppliers and subcontractors, audits were conducted by prime contractors. Iowa Electric reviewed the summaries of such audits and made periodic audits of its own.

The program required each supplier to demonstrate his ability to properly identify material, parts, and components. Iowa Electric's Quality Assurance Program provided for a check of this item in review of documentation.

Engineer-Constructor

As it applied to vendors, the appropriate requirements for the identification and control of materials, parts, and components were established through procurement specifications supplemented by a review of the vendor's quality assurance program and procedures.

As it applied to construction activities, Bechtel field procedures and practices incorporated measures for material control, including the segregation of nonconforming items, and for marking and identification as required. Traceability was accomplished where required by code, standard, or specification. In other cases, measures such as physical separation or appropriate marking procedures were used to identify and control materials or components of specific type, specification, class, etc. Positive control of nonconforming items was maintained by suitable markings and/or segregation (see Section 17.1.15).

NED-Manufactured Products

Product and process control activity was oriented toward ensuring that quality planning was properly understood and followed; equipment and processes met design and quality requirements; materials, parts, and components were identified and controlled; and only finished goods meeting design and quality requirements, including those of applicable codes and standards, were released for shipment. Audits were conducted to ensure that quality planning was properly implemented and that products met applicable quality requirements.

17.1.9 CONTROL OF SPECIAL PROCESSES

Iowa Electric

Iowa Electric considered "special processes" those requiring the use of specific procedures, qualified personnel, and equipment where specified by code, standard, or contract. Design control procedures included the identification of areas requiring such special processes. Iowa Electric's Quality Assurance Manual provided for a followup to ensure proper performance and adequate documentation.

Engineer-Constructor

The use of qualified procedures and application thereof as required by established codes and standards was rigidly enforced on all Bechtel vendors, subcontractors, and Bechtel personnel. For other special processes identified by equipment suppliers or Bechtel, procedures were prepared by equipment suppliers, Project Engineering, or Bechtel and approved by appropriate personnel in the organization that identified the process. Personnel performing such operations were trained and carefully supervised by personnel familiar with the specific process.

NED-Manufactured Products

Special processes such as welding, heat treating, cleaning, and nondestructive testing were controlled by formalized procedures and practices. The quality system provided for the performance of such special processes by qualified personnel using qualified procedures in accordance with applicable codes, standards, regulatory criteria, and other special instructions.

Containment

Welders and welding procedures were qualified in accordance with Section III of the ASME Code. Nondestructive examination personnel were qualified in accordance with the requirements of SNT-TC-1A for the examinations they performed. Cold and hot forming of material where such workmanship falls under the ASME Code, Section III, Subsection B, were performed in accordance with qualified procedures. Personnel conducting heat treating, cold forming, and other special processes were experienced suitably. Welders identification and the location of their welds were recorded on as-built drawings and/or sketches for the welds in the pressure boundary material, the welds of the penetrations, and the welds of the locks. A system was in use to verify operator qualifications before task assignments.

All procedures such as welding, heat treating, nondestructive examinations, testing, handling, storage, and shipping were prepared by experienced personnel and, after a local review by the using organization (Shop or Field), were given a Iowa Electric review and approval before release by Iowa Electric Nuclear, Quality Assurance. Control of procedures was through a contract quality assurance manual for this project.

The contents of this manual were under a controlled distribution system including a copy for the customer and/or the final owner/user. In addition to procedures, these manuals included customer specifications, CB&I material procurement specifications, and vendor procedures. All contents were controlled by an index sheet describing the document and the applicable revision number. Revised index sheets accompanied each insertion or revision to the contents of that manual. Only procedures approved by CB&I were released for issuance to the contract quality assurance manual.

17.1.9.1 Fabrication, Assembly, and Erection of Piping and Equipment Pressure Parts

Piping and equipment pressure parts were assembled and erected by welding; however, where permitted by applicable Code, flanged and screwed joints could be used, where necessary, to provide essential takedown capability for maintenance, testing, flushing, or refueling operation.

17.1.9.1.1 Welding Procedures and Processes

General

All welding procedures, welders, and welding machine operators were qualified in accordance with the requirements of Section IX of the ASME Code for the materials to be welded. Qualification records, including the results of procedure and performance qualification tests and identification symbols assigned to each welder, were maintained.

Procedures and Processes

Welding procedures and processes were employed that produced welds of complete penetration, of complete fusion, and free of unacceptable defects. The finished surfaces of the weld merged smoothly into the adjacent component surfaces with a maximum of 1/32-in. undercut permitted. Pressure-containing and attachment welds were made by the following processes:

1. Gas tungsten-arc welding with filler metal added.

2. Shielded metal arc welding with low hydrogen coated electrodes.

3. Submerged arc welding.

4. Gas metal arc welding within the limitations in the project specifications.

17.1.9.1.1.1 Dissimilar Metal Welds.

Transition pieces were used wherever possible when carbon steel valves are welded to stainless steel piping. For piping systems with nominal wall thicknesses of 0.75 in. and greater, the carbon steel transition piece mating to stainless steel was clad, a minimum of 3/16 in. after machining, with stainless steel weld metal (Type 308 or 309).

17.1.9.1.1.2 Branch Connections.

Piping branch connections were made as shown in the following table:

Piping Group	Branch Nominal Pipe Size (B)	Type of Construction
A, B	B> 4 in.	Standard welding tees or integrally reinforced contour insert fittings
	2 in. < B ⇔ 4 in.	Integrally reinforced welding outlet fittings
	2 in. and smaller	Standard socket welding half-couplings
C, D	2.5 in. and larger	Standard welding tees, contour insert fittings, welding outlet fittings, or suitably reinforced stub-ins
	2 in. and smaller	Socket welding or screwed half-couplings

17.1.9.1.2 Bending and Forming

Bending and forming was in accordance with the applicable code and the following requirements:

1. Sections of pipe were selected so that thinning did not reduce the wall thickness below the minimum specified.

2. Hot bending of carbon steel piping was done between 1650 to 2000°F and postbending heat treatment was not required.

3. Postbending heat treatment of austenitic stainless steel piping, 2.5 in. and larger, was required. The material was heated to a temperature between 1900° and 2050°F and then held for 1 hr/in. of thickness, but not less than 1 hr, followed by a rapid cooling to below 800°F in less than 5 min. After heat treatment, all accessible surfaces along the bend were examined by the liquid-penetrant method.

17.1.9.1.3 Heat Treatment of Welds

Heat treatment of welds including preweld and postweld heat treatment was in accordance with the applicable Code for the Nuclear Piping Class.

17.1.9.1.4 Defect Repair

17.1.9.1.4.1 General

The repair of base metal or weld metal defects was in accordance with the applicable code and the following requirements:

1. Surface defects such as laps, scabs, slivers, seams, or tears, which did not encroach on minimum wall thickness, were removed by machining or grinding and were blended into the adjacent metal surfaces.

2. When the defects or defect removal encroached on minimum wall thickness, repairs were made by welding.

17.1.9.1.4.2 Repair Welding

Repair welding was performed employing welding procedures and welders qualified in accordance with Section IX of the ASME Code.

17.1.9.1.4.3 Examination of Repair Welds

The examination of base material and weld repairs was in accordance with the applicable code and Schedules I through IV shown in Section 17.1.8.

17.1.9.1.4.4 Heat Treatment After Repair by Welding

Base material repair welds were heat treated as required by the applicable code.

17.1.9.2 Cleaning

To minimize the requirement for cleaning after erection and to prevent damage during shipment, storage, or handling, piping and equipment pressure parts were cleaned and capped by the pipe fabricator before shipment.

17.1.9.2.1 Stainless Steel Piping

All austenitic stainless steel piping assemblies were furnished with both interior and exterior clean and free of mill scale, rust, grease oil, dirt, flux, weld splatter, and other contaminants. The final cleaning operation consisted of cleaning with process-controlled water with chemical additive, followed by rinsing with deionized or demineralized water. Immediately after cleaning and inspection, all openings in the pipe assemblies were covered with suitable protective covers or caps.

17.1.9.2.2 Carbon Steel

Groups A and B carbon steel piping was shot or grit blasted internally to white metal. Residual shot or grit was completely removed by blowing with clean, oil-free air.

Group C and noncritical Group D carbon steel piping was mechanically cleaned in accordance with approved standards.

17.1.10 INSPECTION

17.1.10.1 General

Iowa Electric

Periodic audits were conducted of the inspection program and documentation of the principal contractors or major suppliers. Audits of subcontractors and minor suppliers were the responsibility of the principal contractor involved. Iowa Electric reviewed audit reports and conducted audits of its own.

Inspection during the construction stage was performed by Bechtel and audited by Bechtel quality assurance personnel. Such activities were periodically audited by Iowa Electric's quality assurance personnel.

Engineer-Constructor

Bechtel performed periodic and final inspections of vendor work as described in Section 17.1.7. This was normally performed by Shop Inspectors; however, in special cases engineering personnel participated. Inspection practices normally included the witnessing of tests, as appropriate, and requirements for vendors to accept mandatory hold-points where, in the opinion of Bechtel, work should not proceed without prior examination by the Bechtel Inspector.

For field operations, in-process and final inspections of activities affecting quality were carried out by Bechtel Field engineers with a knowledge of the discipline involved, project requirements, and the inspection process. Field inspection was carried out in accordance with guidelines and procedures contained in the Bechtel Field Inspection Manual and ASME Quality Control Manual supplemented by approved procedures for special processes and specific project requirements. Field inspection operations were coordinated by the Quality Control Engineer and monitored by the Quality Assurance Engineer. Reports or records of inspection operations were prepared by the field engineers and approved and distributed by the Quality Control Engineer.

NED-Manufactured Products

Receiving, in-process, and final inspections and testing were performed in compliance with planned, documented inspection and test instructions and standards to

ensure conformance with applicable drawings, specifications, and special instructions. As required by quality planning, inspection and test results were documented to provide objective evidence that quality requirements had been satisfied.

Containment

Examinations, tests, and inspections were listed on Quality Assurance Checklists. For the shop, they were prepared by the shop quality assurance organization. For the field, they were prepared by Memphis Engineering and subsequently reviewed and released for use by Memphis CNQA and Memphis General Welding. These lists provided space for the identification of the operator and for signoffs to signify satisfactory completion and acceptance of the test or examination. Before the examination or test, these lists were made available to the Authorized Inspector, and to the customer, for them to establish witness or hold-points in the spaces provided thereon. There was also space for identifying repairs by reference to a List of Repairs, and after the repair was satisfactorily completed, a space for a signoff. Spaces were provided for procedure identification and revision number for each examination or test procedure on the Quality Assurance Checklist, the Repair Procedure, the Welding Procedure, the Inspection Procedure, and the welder who makes the repair on the List of Repairs, and the welder and welding procedure on the Shop Quality Assurance Check List. Quality Assurance Check List, as-built drawings or sketches, and marking on the vessel and assemblies were used to indicate the status of examination. In the field, the Quality Assurance Check List was augmented by as-built drawings that covered radiography so as to provide a means for establishing the status of X-ray examination. Satisfactory completion of each X-ray, as-built drawing was verified on a line of the Field Examination Check List.

17.1.10.2 Examination Procedures

The procedures and acceptance for nondestructive examinations were in accordance with the applicable code (see Table 3.2-2) and the following.

17.1.10.2.1 Radiography

1. Radiography was performed generally with lead film filters to reduce scatter.

2. The acceptable film density range through weld metal was generally limited to 2.0 to 3.4 for single viewing. Only the single-viewing, double-film radiographic technique was usually permitted.

17.1.10.2.2 Liquid-Penetrant Examination

Penetrant testing materials used for the examination of austenitic stainless steel piping was of the low sulfur and Halogen type.

17.1.10.2.3 Hydrostatic Testing

Piping was hydrotested after installation, and valves were hydrotested before installation in accordance with the applicable code.

17.1.11 TEST CONTROL

Iowa Electric

Iowa Electric's Quality Assurance Program required principal contractors to include the designation of appropriate tests to be performed at specific stages of fabrication or construction. Tests were conducted by the supplier or constructor as required and were audited by the principal contractor.

Engineer-Constructor

Supplier and subcontractor test operations, including procedures as appropriate, were reviewed in accordance with the specified procurement requirements. In the field, certain test operations were carried out by the construction organization in the course of plant construction. Construction tests were normally performed in accordance with standard construction practice or via specific test procedures as specified by the Project Engineering Team. Results of required tests were documented.

Containment

Tests were conducted in accordance with Iowa Electric-approved written procedures. Instruments and measuring devices were used during these tests and also for all activities affecting or judging quality, and were calibrated and checked or adjusted as applicable at established periods. Calibration, where necessary, was made against certified measurement standards that had known valid relationships to national standards.

17.1.12 CONTROL OF MEASURING AND TEST EQUIPMENT

Iowa Electric's Quality Assurance Program required that records be maintained to ensure the use of tools, gauges, and instruments calibrated to standards traceable to the National Bureau of Standards or other recognized authority. These were available during fabrication or test.

Vendor procedures for the control of measurement and test equipment were reviewed as appropriate in evaluating the vendor quality assurance program. In the field,

a standard written procedure was followed to provide control and periodic calibration of special tools and measuring and test equipment.

NED-Manufactured Products

A system was developed, documented, and implemented to ensure that gauges, instruments, and measuring devices necessary to control and measure product quality were calibrated, adjusted, repaired, or replaced in a systematic and timely manner. The system provided for the calibration of such equipment against measurement standards that were traceable to national standards.

17.1.13 HANDLING, STORAGE, AND SHIPPING

Iowa Electric

The review of procedures for the handling, storage, shipping, and preservation of materials and equipment to prevent damage or deterioration rested with the principal contractors with audit by Iowa Electric. Receiving inspection reports by the engineer-constructor determined what further action was required in the field. Periodic audits were conducted by Iowa Electric both in the supplier's shop and in storage at the site.

During construction, Bechtel personnel received material and equipment using material receiving instructions for the particular item. General Electric personnel participated in the receiving inspection of GE-supplied items. Iowa Electric personnel reviewed receiving documents.

For operation, Iowa Electric quality assurance personnel will audit the activities of the plant storekeeper.

NED-Manufactured Products

The quality system for NED-manufactured products provided for the control of the handling, storage, preservation, packing, and shipping of NED-supplied systems and equipment to prevent their inadvertent damage or deterioration before delivery to Iowa Electric.

Engineer-Constructor

Special handling, storage, shipping, and preservation requirements were identified in procurement specifications for vendors' work.

In the field, materials and equipment were stored in accordance with standard procedures as well as specific requirements and any special procedures issued by the Project Engineering Team or furnished by vendors. Procedures for handling and storage were contained in the Field Inspection Manual supplemented as necessary by instructions prepared by field engineering, approved by the Project Superintendent and the Project

Engineering Team. When project specifications required special procedures for handling, storage, or preservation, these were approved by the Project Engineering Team.

Containment

All materials and assemblies shipped from the shop were formally released for shipment on a "Shop Release for Shipment Check List" that was signed off for each shipping piece as final inspections were completed. The entire sheet was signed off by the CB&I Shop Inspector after loading was completed. Spaces were provided on that form for the Authorized Inspector and for the Customer Inspector to indicate their concurrence. This checklist was sent to the field where field quality assurance used it for a receiving inspection checklist. The field checked for establishing identity and for shipping damages. Damaged material was not released for processing in the field until after an approved repair procedure was established and the defective item was entered on the List of Repairs for control. A Material Heat Number List was prepared by shop quality assurance and sent to the field with each shipment. This list correlated supplier's heat numbers with CB&I piece identification numbers and was used by the Field Authorized Inspector to identify material that was reviewed and certified to be in the shop by the Authorized Inspector at that location. These two documents provided the necessary evidence that material and equipment listed and shipped to the field conformed to the procurement requirements. They were kept at the jobsite so that Mill Test Reports and other fabrication documentation were not required for each material shipment to the jobsite.

17.1.14 INSPECTION, TESTING, AND OPERATING STATUS

The quality control program for the field-fabricated DAEC Unit 1 reactor vessel was a continuing program involving the surveillance of GE, Iowa Electric, and CB&I. The design and fabrication of the reactor vessel was of the highest quality practicable with current technology at the time of fabrication. The reactor vessel was designed, analyzed, independently checked, fabricated, and inspected in accordance with the ASME Code, Section III, Class A for nuclear vessels. Refer also to Section 5.3.

Design and fabrication of the DAEC reactor primary system was of the highest quality practicable with current technology at the time of fabrication. The design basis for primary systems components other than the reactor vessel incorporated a quality level that produces equal serviceability to that of the reactor vessel. This was accomplished by specifying these components to meet applicable codes (See Section 3.2) and imposing additional special requirements, as applicable.

Chapter 5 provides additional information on the quality level of the reactor primary system. An inservice inspection program for the DAEC reactor primary system has been developed and is discussed in Section 5.2.4.

Initial responsibility for documenting inspection and testing status rested with the supplier during fabrication. Proper performance of this function was audited by principal

contractors to ensure that measures were established to indicate, by the use of markings (stamps, tags, labels, or route cards) or by the use of other suitable means, that the status of inspection and tests performed on individual items were properly functioning. Periodic audits were conducted by Iowa Electric and audited reports are available for review.

In the field, test and operating status were indicated by procedures provided for in Bechtel's quality program. Periodic audits were conducted by Iowa Electric to ensure that procedures were implemented to indicate the status of plant operating equipment and that provisions were provided for tagging equipment, such as valves and switches, when necessary to prevent inadvertent operation.

17.1.15 NONCONFORMING MATERIALS, PARTS, OR COMPONENTS

Iowa Electric

Initial responsibility for the identification, documentation, segregation, and disposition of nonconforming materials, parts, or components rested with the fabrication facility or plant site, as appropriate. Audit responsibility rested with the principal contractor. Audit reports were available for review by Iowa Electric, who also conducted periodic audits of vendor facilities and the construction site.

Containment

Defects, deviations, and nonconformities disclosed during receiving inspection and examination or during manufacturing and/or construction were reported to the responsible quality assurance supervisor or manager for resolution. Records were kept of nonconforming items that were disposed. Repair procedures were reviewed by the Authorized Inspector and were followed for the repairing or reworking of materials or parts. Special repair procedures were prepared for repairs that could not be corrected within the scope of the existing standard repair procedures. Repetitive nonconformities in areas of major deficiencies were reported to Iowa Electric for corrective action.

Engineer-Constructor

The Bechtel quality assurance program provided measures to control materials, parts, or components not conforming to prescribed requirements to prevent their inadvertent use or installation. Materials were physically controlled in accordance with procedures described in Section 17.1.8. For nonconforming items that could be made usable through rework, repair, or modification of requirements, reports were prepared and submitted to the Project Engineering Team for resolution, unless rework could have been accomplished by prior approved procedures. Records of resolution for these cases were prepared and incorporated in quality assurance files.

NED-Manufactured Products

Quality control personnel documented, maintained, and implemented systems for the handling and control of discrepant material. These systems provided for the physical identification, segregation, documentation, and timely disposition of nonconforming materials and products. Whenever a process was performed in such a manner as to cast doubt on the acceptability of a product or whenever a material or product was found by inspection or test not to meet applicable drawings or specifications, the affected items were rejected and processed in accordance with the discrepant materials control system.

Quality information feedback systems made provision for timely reporting to management and others having quality system responsibility the overall status of product quality and quality-related plans and programs. Quality information feedback provided input for the initiation of corrective actions deemed necessary to correct or improve quality system performance.

17.1.16 CORRECTIVE ACTION

Iowa Electric

Initial responsibility for performing corrective action rested with the supplier for fabricated work and with the constructor at the erection stage. Audits were performed by principal contractors and audit reports were made available to Iowa Electric for review to ensure that corrective action was effective.

Engineer-Constructor

The Bechtel quality assurance program incorporated procedures for identifying and reporting situations that were deemed adverse to quality. These included reports of significant failures, malfunctions, deficiencies, deviations, defective material, etc., that required management attention and could necessitate changes in program, procedures, or practices. Routine occurrences of rework and repair generally expected for the activity involved were not normally included in the corrective action program.

For work in vendor shops, Bechtel Shop Inspector reports identified situations that could require corrective action. Inspectors' reports were reviewed by the Project Engineering Team and Bechtel Procurement; where necessary, corrective action was taken through the Bechtel Procurement Department.

For Bechtel field work, "Significant Deficiency Reports" were used for the purpose of initiating corrective action. The report was initiated through the Quality Assurance Engineer and reviewed by the Project Engineering Team, Chief Engineers, and/or Engineering Specialists. Copies were sent to the Quality Assurance Coordinator and Manager, Quality Assurance. The Significant Deficiency Report Form included space to note the resolution of the problem. When the resolution had been duly recorded, the report was filed at the jobsite.

NSSS Supplier

See Section 17.1.3.3 for corrective action measures of the NSSS Supplier.

Containment

See Section 17.1.13 for corrective action measures of CB&I.

17.1.17 QUALITY ASSURANCE RECORDS

Iowa Electric

Documents were maintained for features listed in Section 17.1.2 that demonstrated that all the requirements of this program had been satisfied. This documentation showed that appropriate codes, standards, and regulatory requirements were observed; specified materials were used; correct procedures were used; qualified personnel were provided; and inspections and tests showed that the finished parts and components met the applicable specifications for safe and reliable operation. These records were available so that any desired items of information were retrievable for reference. These records were maintained during the life of the operating licenses.

Those quality-related records generated at the construction site were accumulated and maintained by the constructor's quality control group throughout the course of construction activity. These records were available and were reviewed and audited by Iowa Electric.

Sufficient records were prepared as work was performed to furnish documentary evidence of the quality of the items and of activities affecting quality. Records were consistent with applicable codes, standards, specifications, and contracts. The quality assurance records were compiled and maintained to allow for access and retrievability and protected against damage by fire. In general, records that correctly identify the as-built conditions of items in the plant will be maintained for the life of the plant. These records include material certification and test data for traceability and quality verification; reports of inspections, examinations, and test results for conformance verification; specification, drawings, and procedures for use in the control of configuration; and records of nonconformance and their resolution.

Engineer-Constructor

Copies of all documentation pertaining to the quality assurance program, prepared by Bechtel or obtained from vendors and subcontractors, were collected in project quality assurance files. These files were available for audit by management and Iowa Electric during the design and construction period and were turned over to Iowa Electric at the completion of the Bechtel contract.

NSSS Supplier

For essential items of equipment under the NED scope of supply for which there were no code requirements for record retention or transmittal, designated quality records such as as-built outline drawings, purchase specifications, material specifications, inspection and test data were provided to, or provisions made for maintenance for Iowa Electric, in accordance with the contractual agreement with Iowa Electric.

For items of equipment under the NED scope of supply for which there were code requirements for record retention or transmittal, the requirements of the codes in effect at the time of placement of the order for the equipment component were followed. Furthermore, Iowa Electric was advised of any record requirements in codes that were issued before the component order placement, but which were not yet mandatory, and was given the option of obtaining such records.

The NED quality system provided for appropriate identification and control of materials, parts, and components from receiving inspection through fabrication steps to ensure that only finished goods that met quality requirements were released for shipment. The system was designed to ensure that incorrect or defective items were not incorporated in the product and that the inspection and test status of raw, in-process, and finished goods was known at all times.

Containment

Records required by the ASME Code and the customer's specifications were maintained at Memphis Engineering, the Chicago plant, the Greenville plant, and the jobsite during the engineering, fabrication, and construction phases, respectively, of the contract. On the completion of each phase, pertinent records were classified in accordance with CB&I's Nuclear Records Procedure and shipped to their Nuclear Records Center at Memphis. When all records for the contract were complete and in Memphis, the paper documents were microfilmed on a 16mm roll film. One set of these films was available for transfer to the customer for the final owner/user. The stress report and other pressure vessel records were retained in the paper form for the life of the vessel. Radiographic film was preserved in its original form until transfer to the final owner/user.

17.1.18 AUDITS

Iowa Electric

Iowa Electric's Quality Assurance Program provided for audits to ensure the effective implementation of the program and to correct deficiencies. Iowa Electric was responsible for auditing the programs of GE, Bechtel, CB&I, and other major contractors and equipment suppliers.

They, in turn, had the responsibility for the audit of the quality assurance programs of their suppliers or subcontractors. Audit reports or summaries were available for review by Iowa Electric.

Nuclear Audit and Testing Company (NATCO) and Iowa Electric representatives conducted a quality assurance audit at GE's nuclear fuel fabrication facility at Wilmington, North Carolina, on May 30 and 31, 1973. This was the tenth audit performed by Iowa Electric/NATCO at the GE facility during the fabrication of nuclear fuel for the DAEC.

The primary purpose of this visit was to attempt to resolve the open items and the discussion items that had been previously reviewed with the GE personnel. In addition, the Iowa Electric/ NATCO audit team reviewed the remaining schedule requirements and inspected and audited the bundle assembly, packaging, and storage area.

A NATCO representative conducted a quality assurance audit at GE's nuclear fuel fabrication facility at Wilmington, North Carolina, on September 6 and 7, 1973.

The purpose of this visit was to audit the operations involved in the replacement of lower tie plates on DAEC fuel bundles and to audit the channel fabrication operations with particular respect to the translation of drawing requirements to quality plans and their implementation in the shop. Of particular interest were the channel drawing requirements and the corresponding requirements as specified on the quality plans. Release procedures and inspection travelers applicable to channel fabrication were also audited.

Continued audits during the operational phase are discussed in Quality Assurance program for the DAEC (Section 17.2).

Engineer-Constructor

The quality assurance program included the following three specific formal audit activities:

1. Audits of project engineering activities and records by, or under the direction of, the Quality Assurance Coordinator.

2. Audits of vendor's quality assurance program and records by Bechtel Shop Inspectors.

3. Audits of field quality assurance and inspection activities under the direction of the Quality Assurance Coordinator.

All of the above were carried out, on a sampling basis, periodically during the design and construction period. At the completion of construction for systems and structures subject to the Bechtel quality assurance program, a final inspection was performed on the work and associated quality assurance records to ensure that necessary inspections and records had been prepared and were on file.

Containment

The Iowa Electric Nuclear Quality Assurance Organization conducted periodic audits of the shop and of the field work to verify compliance with the Quality Assurance Program, and to determine the effectiveness of that program. All apparent discrepancies noted during such audits were reported to the responsible Quality Assurance Manager for resolution. Audited items that were not resolved by local review were brought to the attention of the Director of Iowa Electric Nuclear Quality Assurance.

ASME Data Reports were certified to by plant and jobsite management personnel after audit release was given by the assigned Iowa Electric Nuclear Quality Assurance Auditor.

Table 17.1-1

QUALITY CONTROL FUNCTIONS REQUIRED

Type of Equipment or Component	Overall Quality Requirements	Design Requirements	Procurement Requirements	Manufacture Requirements	Quality Control Compliance Requirements
		Responsible Manager			
APED-engineered equipment (procured)	APED Design Engineering	APED Design Engineering	APED Procurement	Vendor procedures approved by APED Design Engineering	Quality Control-Engineered Equipment
Fuel	APED Design Engineering	NFD Engineering	- -	R&FMO	Nuclear Fuels Manufacturing Quality Control
Reactor equipment	APED Design Engineering	APED Design Engineering	- -	R&FMO	Reactor Equipment Quality Control
NPGCD-manufactured instrumentation	APED Design Engineering	NPGCD Engineering	- -	NPGCD Manufacturing	NPGCD Quality Control
NPGCD-procured instrumentation	APED Design Engineering	NPGCD Engineering	NPGCD Procurement	Vendor	NPGCD Quality Control

Table 17.1-2 Page 1 of 13

QUALITY ASSURANCE FUNCTION RESPONSIBILITY REFERENCE[a]

Structures, Systems and Components	(1) Design & Specification	(2) Review of Design & Specifications	(3) Procurement	(4) Fabrication	(5) Receiving, Handling, & Storage	(6) Installation & Construction	(7) Site Monitoring
I. Civil-Structural							
Reactor building	B	B	B	B	B	B	B
Containment	C	B	C	C	C	C	A
Auxiliary structure housing engineered safeguard systems	B	B	B	B	B	B	B
Emergency diesel-generators, control room, and portions of structures- housing for class components	B	B	B	B	B	B	B
Diesel fuel storage facilities	B	B	B	B	B	B	B
Supports for class 1 system components	B	B	B	B	B	B	B
Emergency cooling water supply structures	B	B	B	B	B	B	B

[a] See notes at end of table.

Table 17.1-2 Page 2 of 13

QUALITY ASSURANCE FUNCTION RESPONSIBILITY REFERENCE[a]

Structures, Systems and Components	(1) Design & Specification	(2) Review of Design & Specifications	(3) Procurement	(4) Fabrication	(5) Receiving, Handling, & Storage	(6) Installation & Construction	(7) Site Monitoring
I. Civil-Structural (Continued)							
Spent-fuel pool	B	B	B	B	B	B	B
Offgas stack	B	B	B	B	B	B	B
II. Mechanical Reactor Assembly							
Reactor vessel	C	G	C	C	C	C	G
Shroud	G	G	G	G	B	B	B
Core support	G	G	G	G	B	B	B
Top guide	G	G	G	G	B	B	B
Feedwater spargers	G	G	G	G	B	B	B
CRD housing	G	G	G	G	B	B	B
Control rod guide tube	G	G	G	G	B	B	B
Control rod	G	G	G	G	B	B	B

[a] See notes at end of table.

Table 17.1-2 Page 3 of 13

QUALITY ASSURANCE FUNCTION RESPONSIBILITY REFERENCE[a]

Structures, Systems and Components	(1) Design & Specification	(2) Review of Design & Specifications	(3) Procurement	(4) Fabrication	(5) Receiving, Handling, & Storage	(6) Installation & Construction	(7) Site Monitoring
II. Mechanical Reactor Assembly (Continued)							
Control rod drive	G	G	G	G	B	B	B
Power range detector	G	G	G	G	B	B	B
Jet pumps	G	G	G	G	B	B	B
Reactor vessel support	G	G	G	G	B	B	B
Reactor vessel stabilizer	G	G	G	G	B	B	B
CRD housing support	G	G	G	G	B	B	B
Nuclear Boiler System							
Main steam isolation valves	G	G	G	G	B	B	B
Steam-line drain valves	B	B	B	B	B	B	B
Pressure vessel relief valves	G	G	G	G	B	B	B
Pressure vessel safety valves	G	G	G	G	B	B	B

[a] See notes at end of table.

Table 17.1-2 Page 4 of 13

QUALITY ASSURANCE FUNCTION RESPONSIBILITY REFERENCE[a]

Structures, Systems and Components	(1) Design & Specification	(2) Review of Design & Specifications	(3) Procurement	(4) Fabrication	(5) Receiving, Handling, & Storage	(6) Installation & Construction	(7) Site Monitoring
Steam-line flow restrictor	G	G	G	G	B	B	B
Main steam lines to and including second isolation valves	G	G	G	G	B	B	B
Balance of main steam lines	B	B	B	B	B	B	B
Steam pipe suspension	B	B	B	B	B	B	B
PPB pipe and isolation valves (other than steam lines)	B	B	B	B	B	B	B
Reactor Circulation Systems							
Recirculation pump	G	G	G	G	B	B	B
Recirculation valves	G	G	G	G	B	B	B
Bypass valves	G	G	G	G	B	B	B
Recirculation piping	G	G	G	G	B	B	B
Recirculatin loop suspension	G	G	G	G	B	B	B

[a] See notes at end of table.

Table 17.1-2 Page 5 of 13

QUALITY ASSURANCE FUNCTION RESPONSIBILITY REFERENCE[a]

Structures, Systems and Components	(1) Design & Specification	(2) Review of Design & Specifications	(3) Procurement	(4) Fabrication	(5) Receiving, Handling, & Storage	(6) Installation & Construction	(7) Site Monitoring
Recirculation loop restraint	G	G	G	G	B	B	B
Residual Heat Removal System							
Heat exchangers	G	G	G	G	B	B	B
RHR pumps	G	G	G	G	B	B	B
PPB pipe and isolation valves	B	B	B	B	B	B	B
Automatic control valves	B	B	B	B	B	B	B
Residual Service Water System							
RHR service water pumps	B	B	B	B	B	B	B
RHR service water piping and valves	B	B	B	B	B	B	B
Accident detection and system initiation instrumentation	B	B	B	B	B	B	B

[a] See notes at end of table.

Table 17.1-2 Page 6 of 13

QUALITY ASSURANCE FUNCTION RESPONSIBILITY REFERENCE[a]

Structures, Systems and Components	(1) Design & Specification	(2) Review of Design & Specifications	(3) Procurement	(4) Fabrication	(5) Receiving, Handling, & Storage	(6) Installation & Construction	(7) Site Monitoring
Power supply and electrical control systems	B	B	B	B	B	B	B
Core Spray System							
Core spray pumps	G	G	G	G	B	B	B
PPB and isolation valves	B	B	B	B	B	B	B
Automatic control valves	B	B	B	B	B	B	B
Motor-operated control valves (manual)	B	B	B	B	B	B	B
Core spray piping	B	B	B	B	B	B	B
High-Pressure Coolant Injection System							
HPCI pump and turbine	G	G	G	G	B	B	B
PPB pipe and isolation valves (steam and water)	B	B	B	B	B	B	B

[a] See notes at end of table.

Table 17.1-2 Page 7 of 13

QUALITY ASSURANCE FUNCTION RESPONSIBILITY REFERENCE[a]

Structures, Systems and Components	(1) Design & Specification	(2) Review of Design & Specifications	(3) Procurement	(4) Fabrication	(5) Receiving, Handling, & Storage	(6) Installation & Construction	(7) Site Monitoring
Automatic control valves	B	B	B	B	B	B	B
Motor-operated valves (manual)	B	B	B	B	B	B	B
HPCI piping (water)	B	B	B	B	B	B	B
HPCI piping (steam)	B	B	B	B	B	B	B
Reactor Core Isolation Cooling System							
RCIC pump and turbine	G	G	G	G	B	B	B
PPB pipe and isolation valves (steam and water)	B	B	B	B	B	B	B
Automatic control valves	B	B	B	B	B	B	B
Motor-operated valves (manual)	B	B	B	B	B	B	B
RCIC piping (water)	B	B	B	B	B	B	B
RCIC piping (steam)	B	B	B	B	B	B	B

[a] See notes at end of table.

Table 17.1-2 Page 8 of 13

QUALITY ASSURANCE FUNCTION RESPONSIBILITY REFERENCE[a]

Structures, Systems and Components	(1) Design & Specification	(2) Review of Design & Specifications	(3) Procurement	(4) Fabrication	(5) Receiving, Handling, & Storage	(6) Installation & Construction	(7) Site Monitoring
Control and Instrumentation (Safety Related)							
System initiation instruments	G	G	G	G	B	B	B
Electrical power and control system	B	B	B	B	B	B	B
Radwaste System							
Drywell drain isolation values	B	B	B	B	B	B	B
Reactor Water Cleanup System							
PPB and isolation valves	B	B	B	B	B	B	B
Plant Service and Cooling Water Systems							
Serving ES equipment	B	B	B	B	B	B	B
Offgas Systems	B	B	B	B	B	B	B

[a] See notes at end of table.

Table 17.1-2 Page 9 of 13

QUALITY ASSURANCE FUNCTION RESPONSIBILITY REFERENCE[a]

Structures, Systems and Components	(1) Design & Specification	(2) Review of Design & Specifications	(3) Procurement	(4) Fabrication	(5) Receiving, Handling, & Storage	(6) Installation & Construction	(7) Site Monitoring
Standby Gas Treatment System							
Fans and filters	B	B	B	B	B	B	B
Ductwork and pipe	B	B	B	B	B	B	B
Valves and dampers	B	B	B	B	B	B	B
Control Rod Drive Hydraulic System							
Hydraulic control modules	G	G	G	G	B	B	B
Insert and withdraw lines	B	B	B	B	B	B	B
Scram discharge piping	B	B	B	B	B	B	B
Water return to RPV and isolation valves	B	B	B	B	B	B	B

[a] See notes at end of table.

Table 17.1-2 Page 10 of 13

QUALITY ASSURANCE FUNCTION RESPONSIBILITY REFERENCE[a]

Structures, Systems and Components	(1) Design & Specification	(2) Review of Design & Specifications	(3) Procurement	(4) Fabrication	(5) Receiving, Handling, & Storage	(6) Installation & Construction	(7) Site Monitoring
The CRD is only essential for its scram function and the isolation of the system from the reactor vessel and the extensions of primary pressure boundary							
Standby Liquid Control System							
Main system and components	G	G	G	G	B	B	B
PPB pipe and isolation valves	B	B	B	B	B	B	B
Neutron Monitoring System							
Intermediate range monitor	G	G	G	G	B	B	B
Average power range monitor	G	G	G	G	B	B	B
Rod block monitor	G	G	G	G	B	B	B
Local power range monitor	G	G	G	G	B	B	B
Reactor Protection System	G	G	G	G	B	B	B

[a] See notes at end of table.

Table 17.1-2 Page 11 of 13

QUALITY ASSURANCE FUNCTION RESPONSIBILITY REFERENCE[a]

Structures, Systems and Components	(1) Design & Specification	(2) Review of Design & Specifications	(3) Procurement	(4) Fabrication	(5) Receiving, Handling, & Storage	(6) Installation & Construction	(7) Site Monitoring
Reactor Radiation Monitoring System							
Main steam-line monitors	G	G	G	G	B	B	B
SJAE monitor	G	G	G	G	B	B	B
Reactor building vent monitor	G	G	G	G	B	B	B
Cooling System for							
HPCI room	B	B	B	B	B	B	B
RCIC room	B	B	B	B	B	B	B
RHR/core spray	B	B	B	B	B	B	B
Primary Containment Atmosphere Control System Through Isolation Valve	B	B	B	B	B	B	B
Reactor Building Crane	B	B	B	B	B	B	B

[a] See notes at end of table.

Table 17.1-2 Page 12 of 13

QUALITY ASSURANCE FUNCTION RESPONSIBILITY REFERENCE[a]

Structures, Systems and Components	(1) Design & Specification	(2) Review of Design & Specifications	(3) Procurement	(4) Fabrication	(5) Receiving, Handling, & Storage	(6) Installation & Construction	(7) Site Monitoring
III. Electrical							
Standby Diesel Generation							
Including fuel supply	B	B	B	B	B	B	B
Electrical Power System Associated with Safety-Related System	B	B	B	B	B	B	B
Control Room Panels (Safety related)							
NSSS	G	G	G	G	B	B	B
Balance of plant	B	B	B	B	B	B	B
Local Panels and Racks (Safety related)							
NSSS	G	G	G	G	B	B	B
Balance of plant	B	B	B	B	B	B	B

[a] See notes at end of table.

Table 17.1-2 lists quality assurance activities for the structures, systems, and components to which the Quality Assurance Program applies. For each entry the responsibility for the activity is designated by letter, as follows:

A Applicant (Iowa Electric Light and Power Company)
B Bechtel Corporation
C Chicago Bridge and Iron
G General Electric Company

The following paragraphs define the activities included in each column.

QUALITY ASSURANCE COLUMN DEFINITION

Column 1 Design and Specification.
Indicates responsibility for designing quality into structures, systems, and components by translating quality requirements into drawing, procedures, instructions, and specifications.

Column 2 Review of Design and Specifications.
Indicates responsibility for review of design and assurance that design generated is as described in license application.

Column 3 Procurement.
Indicates responsibility for providing and/or assuring quality assurance for procured items.

Column 4 Fabrication.
Indicates responsibility for surveillance of the QC program performance during fabrication (including inspection and testing) of the specified item.

Column 5 Receiving, Handling, and Storage.
Indicates responsibility to assure maintenance of as-received quality of material and equipment at the plant site prior to installation.

Column 6 Installation and Construction.
Responsibility for performance of QA program during construction of structures or installation of systems or components.

Column 7 Site Monitoring.
Responsibility for assuring that required QC program is being performed in the field regarding installation, construction, and inspection.

SAFETY-RELATED ITEMS

The basic purpose of this table is to identify specific major structures, systems, and components to which the total Quality Assurance Program applied.

Civil Structural

- Reactor building
- Containment structures
- Auxiliary structures housing engineered safeguard systems
- Emergency diesel-generators, housing and supports
- Supports for engineered safeguard system components
- Spent-fuel pool
- Pump house
- Intake structure
- Control building

Mechanical

Reactor assembly

- Reactor vessel
- Shroud
- Core support
- Top guide
- Feedwater spargers
- Control rod drive (CRD) housing
- Control rod guide tube
- Control rod drive
- Control rod
- Power range detectors
- Jet pumps
- Reactor vessel support
- Reactor vessel stabilizer
- CRD housing supports and seismic supports
- Fuel assemblies
- Incore flux monitoring guide tubes

SAFETY-RELATED ITEMS

Nuclear boiler system

- Main steam isolation valves
- Steam line drain valves
- Pressure vessel relief valves
- Pressure vessel safety valves
- Steam line flow restrictor
- Main steam lines up to and including isolation valves
- Steam pipe suspension
- Primary pressure boundary (PPB) pipe and isolation valves (other than steam lines)

Reactor recirculation systems

- Recirculation pumps
- Recirculation valves
- Recirculation piping
- Recirculation loop suspension
- Recirculation loop restraint

CRD hydraulic control system

- Hydraulic control modules
- Insert and withdraw lines and components
- Scram discharge piping and components
- Water return line to reactor pressure vessel and associated isolation valves (the CRD system is essential only for its scram function and as an extension of the primary pressure boundary)

Standby liquid control system

- Main system and components
- PPB pipe and isolation valves

Neutron monitoring system

- Intermediate range monitor
- Average power range monitor
- Rod block monitor
- Local power range monitor

SAFETY-RELATED ITEMS

Reactor protection system

Nuclear steam supply shutoff system

Reactor radiation monitoring system

- Main steam line monitors
- Reactor building ventilation monitors
- Refueling floor exhaust ventilation monitors

Residual heat removal (RHR) system

- Heat exchangers
- RHR pumps
- PPB pipe and isolation valves
- Automatic control valves

RHR service water systems

- RHR service water pumps
- RHR service water piping and valves

Core spray system

- Core spray pumps
- PPB pipe and isolation valves
- Automatic control valves
- Motor-operated control valves (manual)
- Core spray piping

High-pressure coolant injection (HPCI) system

- HPCI pumps and turbine
- PPB pipe and isolation valves (steam and water)
- Automatic control valves
- Motor-operated control valves (manual)
- HPCI piping (water)
- HPCI piping (steam)

SAFETY-RELATED ITEMS

Reactor core isolation cooling (RCIC) system

- RCIC pump and turbine
- PPB pipe and isolation valves (steam and water)
- Automatic control valves
- Motor-operated valves(manual)
- RCIC piping (water)
- RCIC piping (steam)

Control and instrumentation (safety related)

- System initiation instrumentation
- Electric power and control system

Radwaste system

- Drywell sumps isolation valves

Reactor water cleanup system

- PPB pipe and isolation valves

Emergency service water system

- Emergency service water pumps
- Emergency service water piping and valves

River water supply system

- River water supply pumps
- River water supply piping and valves

Standby gas treatment system

- Fans and filters
- Ductwork
- Valves
- Offgas stack dilution fans

SAFETY-RELATED ITEMS

Ventilation system for

- HPCI room
- RHR core spray room
- RCIC room
- Control room
- Emergency diesel-generator room
- Intake structure
- Pump house - RHR and emergency service water pump rooms
- Battery rooms
- Essential switchgear rooms

Reactor building secondary containment isolation dampers
Reactor building crane

Primary containment atmosphere control system through isolation valves

Electrical

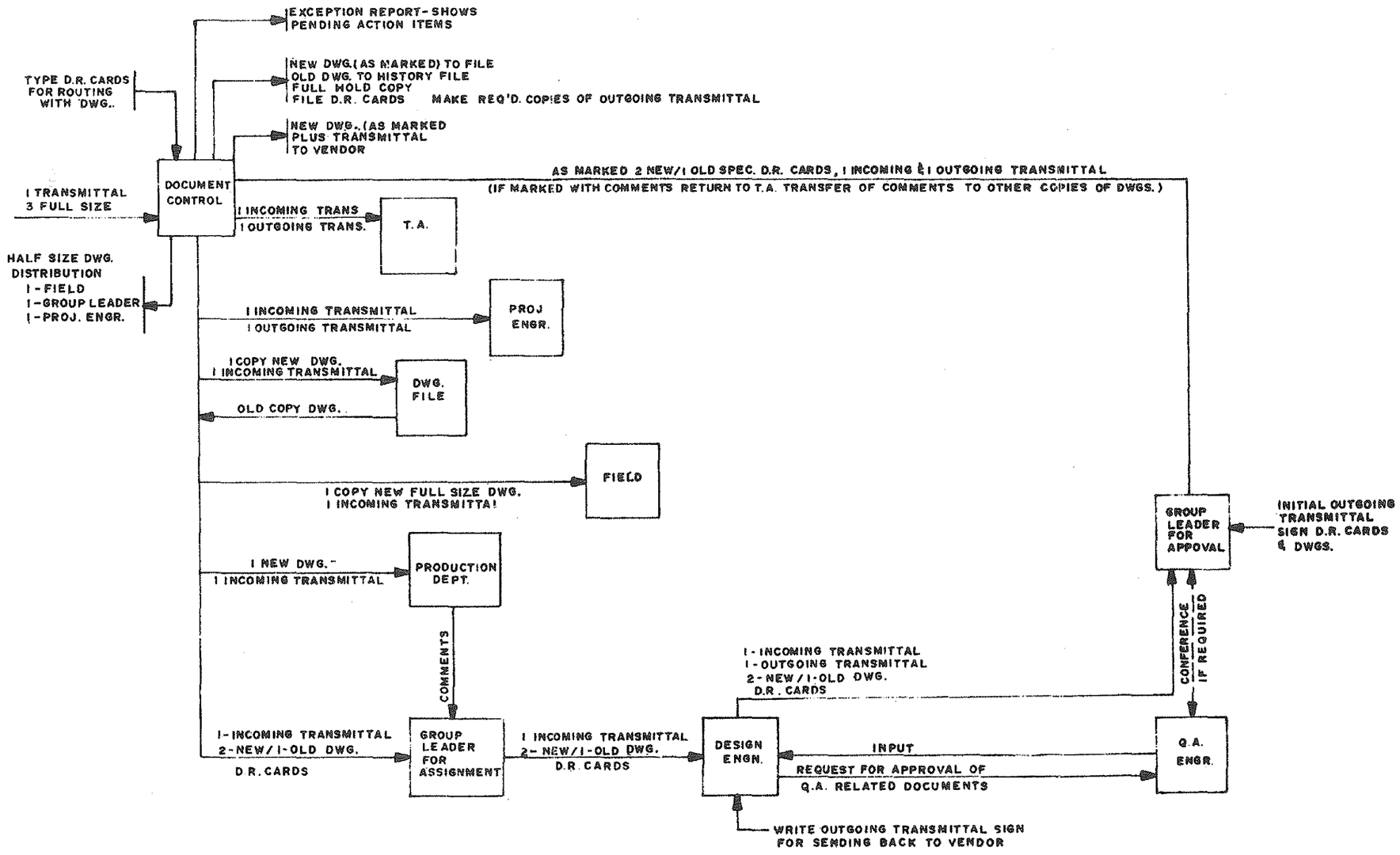
Standby diesel generation

- Diesel fuel supply systems
- Diesel air-start system

Controls and electric power systems associated with safety-related systems

Control room panels (safety-related)

Local panels and racks (safety related)



DUANE ARNOLD ENERGY CENTER
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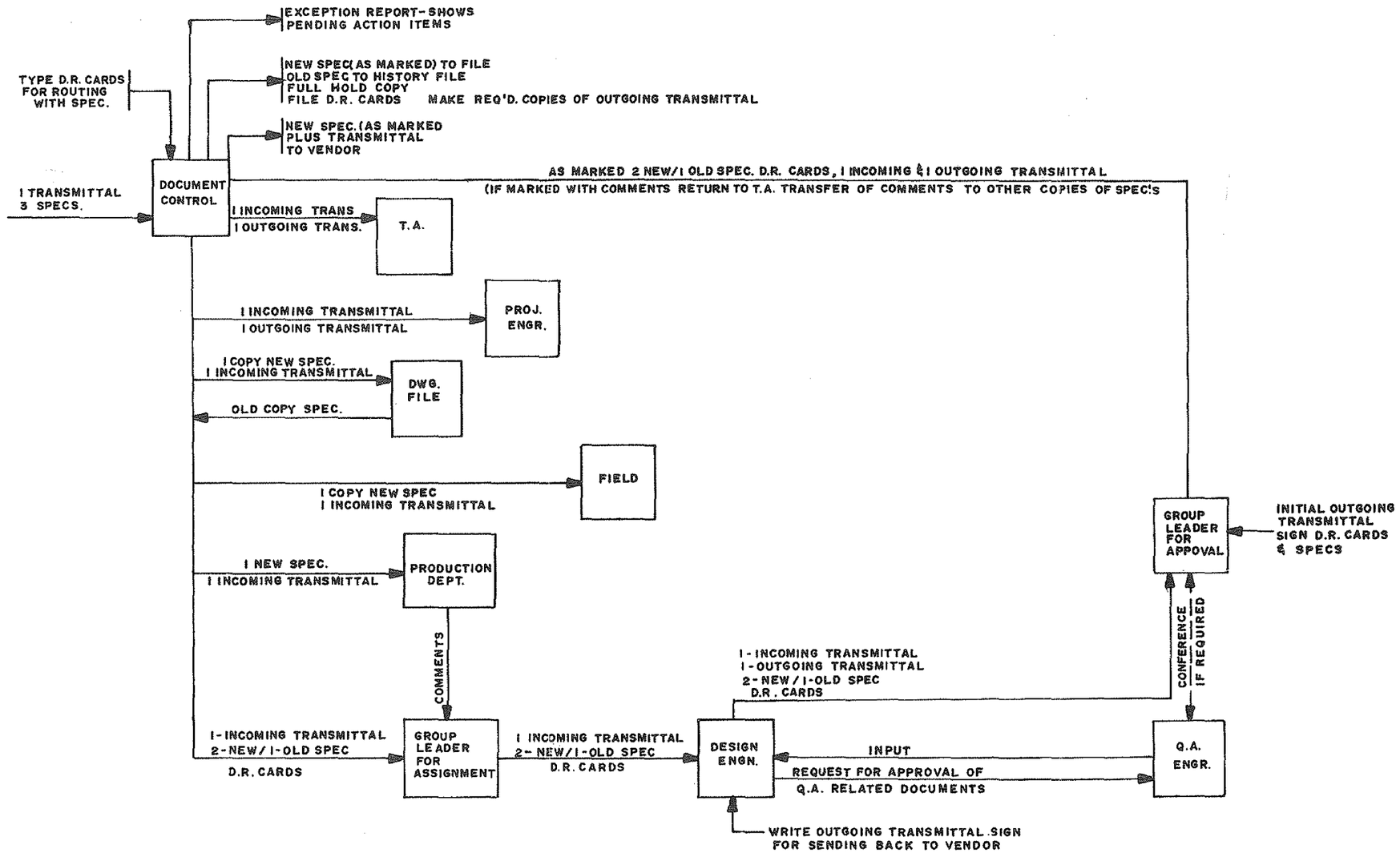
UPDATED FINAL SAFETY ANALYSIS REPORT

Drawing Flow Chart

Figure 17.1-1



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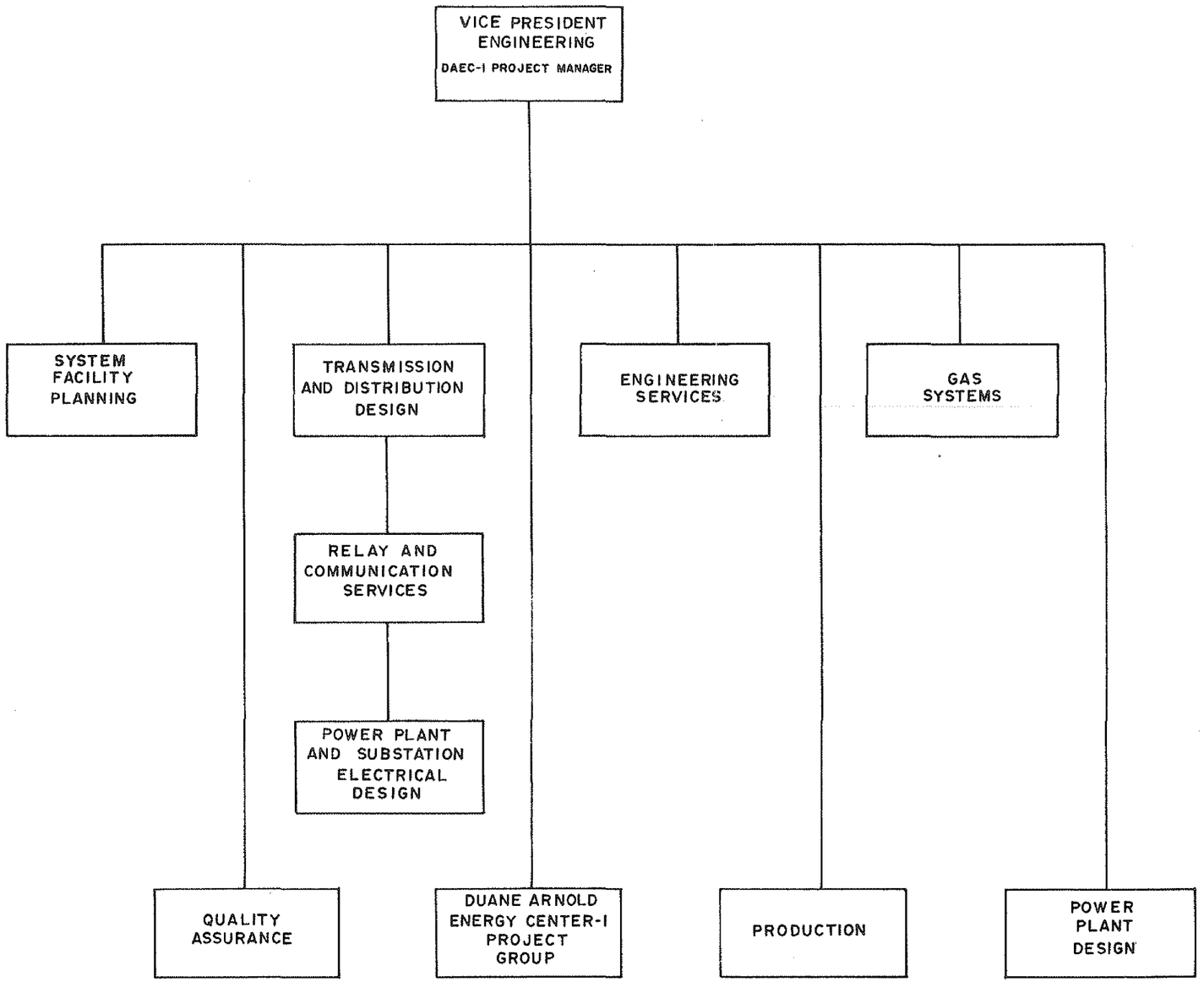
Specification Flow Chart

Figure 17.1-2

IOWA ELECTRIC LIGHT AND POWER COMPANY

ENGINEERING DEPARTMENT



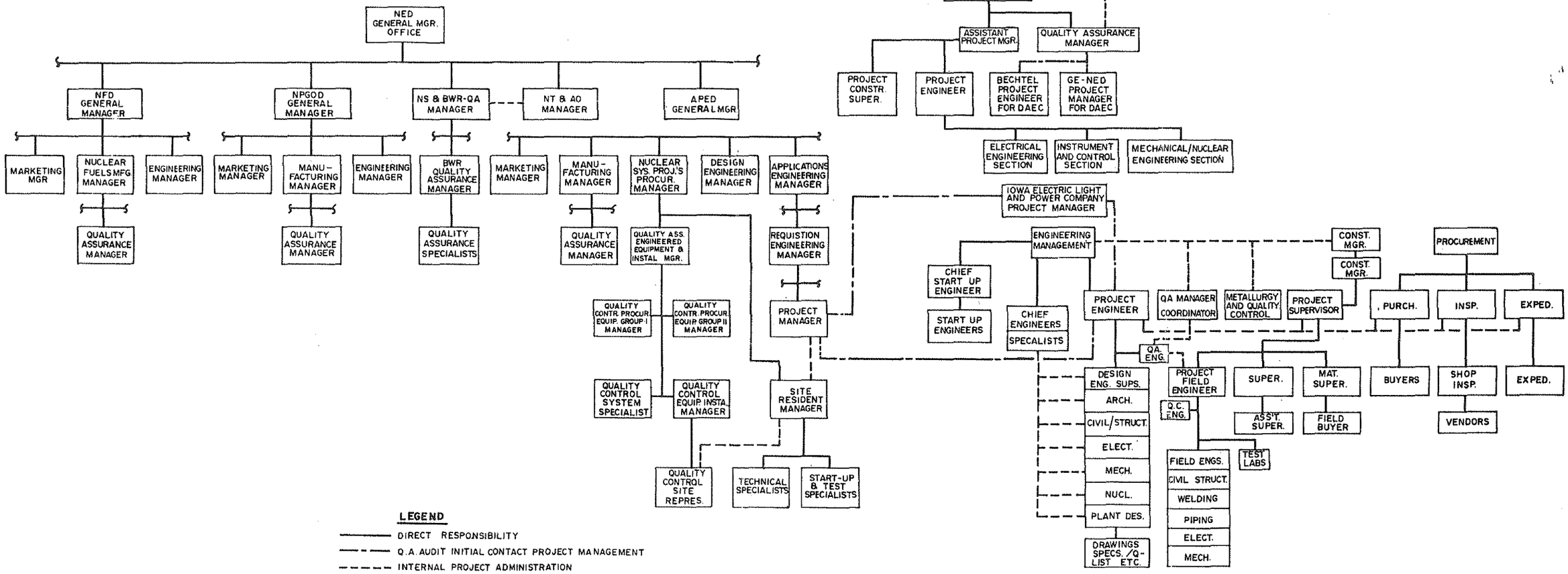
DUANE ARNOLD ENERGY CENTER
IOWA ELECTRIC LIGHT & POWER COMPANY
UPDATED FINAL SAFETY ANALYSIS REPORT

Iowa Electric Engineering Department Organization

Figure 17.1-3

IOWA ELECTRIC LIGHT AND POWER COMPANY

DUANE ARNOLD ENERGY CENTER



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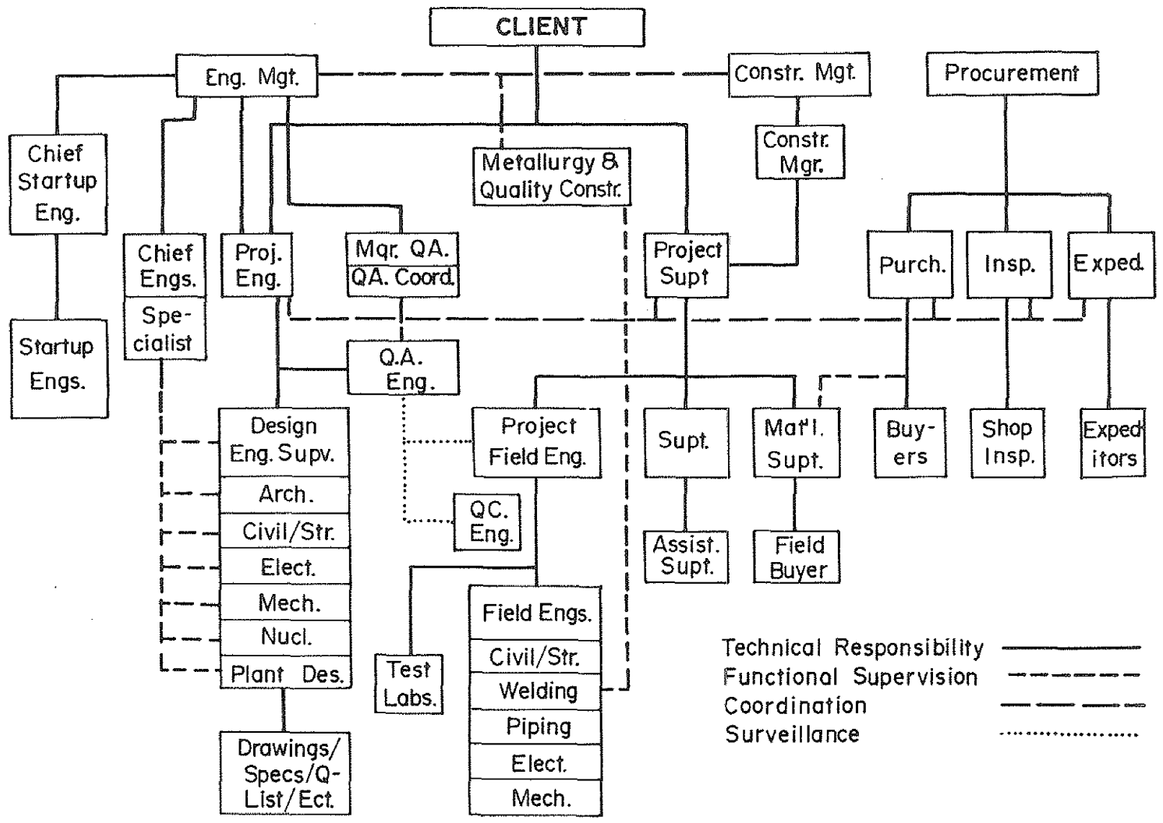
DAEC Quality Assurance Interrelation

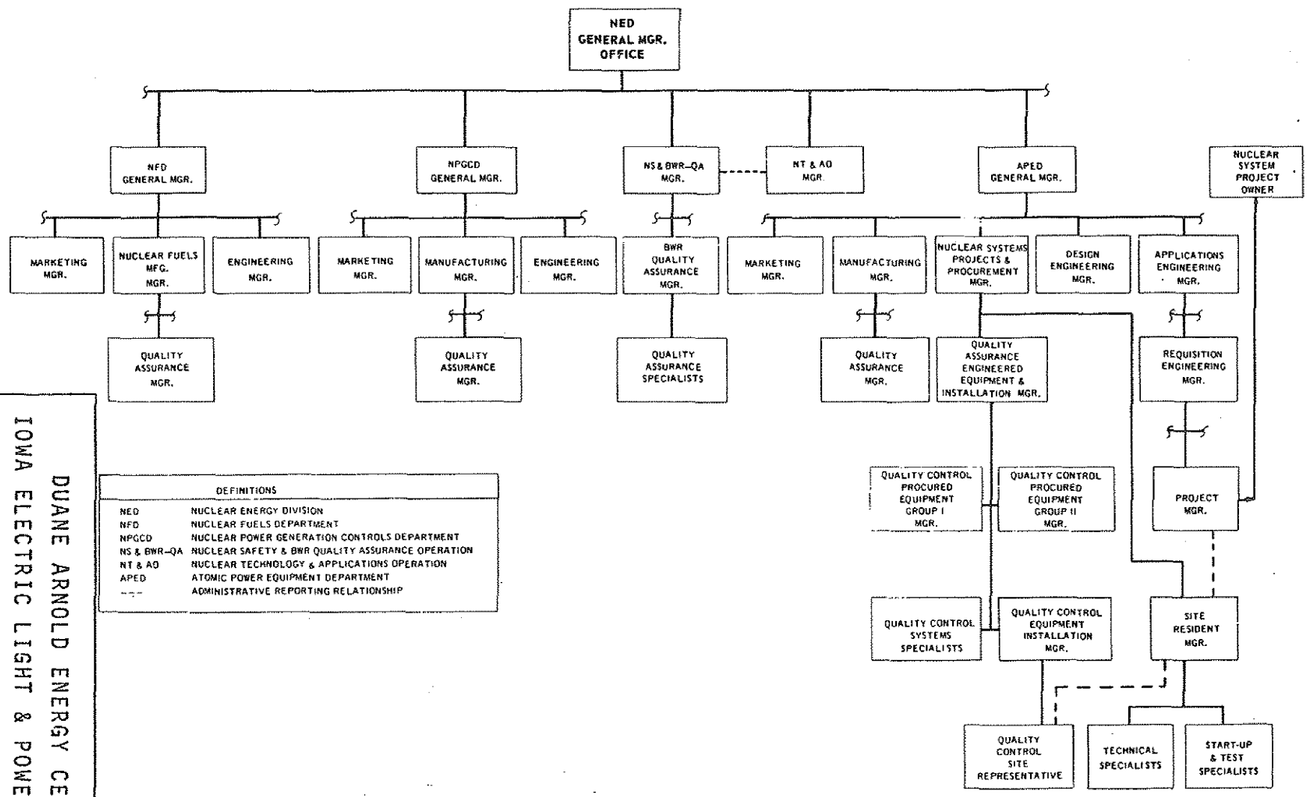
Figure 17.1-4



QUALITY ASSURANCE ORGANIZATION CHART

Bechtel Quality Assurance Organization

Figure 17.1-5



DUANE ARNOLD ENERGY CENTER
IOWA ELECTRIC LIGHT & POWER COMPANY
UPDATED FINAL SAFETY ANALYSIS REPORT

General Electric
Nuclear Energy Division Organization
Figure 17.1-6

Chapter 17

QUALITY ASSURANCE

17.2 QUALITY ASSURANCE DURING THE OPERATIONS PHASE

DAEC nuclear plant operational and support activities are conducted in accordance with the FPL Quality Assurance Topical Report, FPL-1. FPL-1 is the top-level policy document that establishes the manner in which quality is to be achieved and presents the overall philosophy regarding achievement and assurance of quality. FPL-1 responds to and satisfies the requirements of Appendix B of 10 CFR Part 50. FPL-1, Revision 0 was submitted for NRC review on March 31, 2006 and received NRC approval via Safety Evaluation Report dated December 29, 2006. FPL-1 is periodically revised to meet changing requirements. Revisions are reviewed and approved in accordance with 10 CFR 50.54(a).

2012-005

The FPL Quality Assurance Program has been expanded to include non-safety-related structures and components subject to an aging management review for license renewal.