APPENDIX B

MANAGEMENT ANALYSIS: U.S. NUCLEAR REGULATORY COMMISSION PROGRAMS FOR ASSURANCE OF QUALITY IN DESIGN AND CONSTRUCTION OF NUCLEAR POWER PLANTS

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December 1983

Prepared for
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and Inspection Programs
Office of Inspection and Enforcement
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EXECUTIVE SUMMARY

A series of problems in the quality of construction at commercial nuclear power plants has resulted in Congress requiring the NRC to conduct a study of existing and alternative programs for improving quality assurance and quality control during design and construction. Included in NRC initiatives to assure quality in design and construction was a review of NRC quality assurance activities.

This management analysis was performed in conjunction with other NRC activities related to the Congressional legislation and NRC initiatives and included a review of implementation of management practices, past and present programs for assurance of quality in design and construction, organizational relationships between the Office of Inspection and Enforcement and Regional Offices, and a determination of root causes of the NRC's inability to prevent problems and slowness to identify and act on problems at the Diablo Canyon, Marble Hill, Midland, South Texas, and Zimmer nuclear power plants. The analysis was performed by reviewing literature provided by the Quality Assurance Branch of the Office of Inspection and Enforcement and by limited interviews with NRC personnel at the Office of Inspection and Enforcement and Regions II, III, IV and V. Time did not permit a visit to Region I.

The AEC/NRC have made the commercial nuclear power plant industry responsible for assuring the safety of its operations and have monitored the industry on a limited sampling basis. The construction of nuclear power plants has been a learning process for the AEC/NRC and the nuclear industry. NRC programs for assurance of quality during design and construction have evolved along with the nuclear industry and in response to adverse industry events. Although 10 CFR 50 became a regulation in 1954, it was not until 1967 that Appendix A of 10 CFR 50, containing the first mention of a Quality Assurance Program requirement, was published for comment and 1970 that Appendix B of 10 CFR 50, defining criteria of Quality Assurance Programs, was issued. From 1970 to about 1975, guidance documents for establishing and implementing quality assurance programs and AEC/NRC programs for assurance of quality were developed and implemented. Over the years, experience and adverse industry events, such as the Browns Ferry fire and the accident at Three Mile Island, have resulted in efforts to increase the safety of plants under construction and in operation. Instability in the regulatory process, caused by imposition of additional regulations and guidance, has contributed to longer construction times and increased opportunities for errors. Better preventive action and planning of programs would minimize the instability.

Regulations pertaining to quality assurance have not been sufficiently prescriptive or definitive to assure their clear understanding. As a result, many guidance documents have been developed. However, guidance documents have been neither mandatory nor sufficiently prescriptive or definitive to assure their understanding. The original intent of Appendix B of 10 CFR 50 applying to all aspects of a reactor without separate classes of applicability for safety-related items and items important to safety has not been fulfilled and regulations have not adequately defined safety-related items, items important to safety, and applicability of quality program requirements. Regulations should be more prescriptive and definitive in elements of control. Better regulations would eliminate the need for many guidance documents.

Licensing programs have been deficient in reviews of quality assurance programs prior to issuance of authorizations and Construction Permits and in evaluation of licensee and contractor experience, attitude, and management capability. Quality assurance programs have not been a condition of authorizations and Construction Permits and there was no requirement for submittal of program changes for NRC approval until 1983.

AEC/NRC monitoring of design and construction activities on too limited of a basis has caused inability to prevent problems and slowness to identify and act on problems. Little inspection was performed during construction prior to 1968. The direct inspection effort of the regionally based inspection program used until 1980 was about 16 days a year at each plant. Inspection orientation was towards documentation and records review until about 1979 when it changed towards hardware and results. A mindset existed that there was no immediate threat to the health and safety of the public until a nuclear power plant became operational and that plants would not be licensed until ready for operation as determined by pre-operational and startup tests. A Resident Inspector was assigned to each construction site starting in 1980. For multiple plant sites, one Resident Inspector covers all of the plants. An average of 1.5 man-years/unit is devoted to inspection during design and construction.

Budget and manpower restraints have precluded implementation of programs. Approximately 1.0% of NRC personnel are Resident Inspectors assigned to construction sites and 0.6% conduct the Licensee Contractor and Vendor Inspection Program. About 12% of the NRC budget is allocated to Inspection and Enforcement, of which inspection of design and construction is but a small part. The current inspection program is being rewritten with a goal of reducing it by 40% in recognition of budget and manpower restraints. Team inspections (PAT, CAT and IDI) are limited to a small number of plants because of budget and manpower constraints. Inspection programs appear to be designed around available resources. Inspection programs need to be designed around what must be done and the necessary resources to implement the programs need to be provided. The use of licensee inspection plans and establishment of hold points should be included.

Inspection procedures and modules have been intended as guidance and reliance has been placed on the engineering judgment of the inspector and Regional Office management for proper implementation. The degree of inspection program implementation has varied across the Regions dependent upon management's approach to regulations and the capability of personnel. Inspector experience has decreased over the years and it appears that training in quality assurance and performing inspections has been insufficient. Salaries have not been competitive with the industry, which has resulted in the loss of trained and experienced personnel to the industry and difficulty in attracting and keeping personnel. Inspection modules need to identify mandatory requirements and inspectors should receive additional training in quality assurance and in performing inspections. Less reliance on individual engineering judgment results in greater uniformity of implementation.

The NRC assumed part of licensee responsibility for evaluation of vendors through implementation of the Licensee Contractor and Vendor Inspection Program. The legal base for direct NRC inspection of vendors and any resultant enforcement action is not clearly addressed in regulations. The LCVIP does

not include material manufacturers or material suppliers, sources of many material related problems during construction. The NRC has been slow to respond to findings and recommendations of previous studies of the LCVIP. Regulations should be changed to permit industry organizations to evaluate vendors with NRC overview or to establish licensing or certification programs for vendors, including material manufacturers and suppliers.

Enforcement programs have not been aggressively implemented and have not encouraged conformance to commitments. Early enforcement action consisted of "jawboning" sessions and issuance of routine enforcement letters. A mindset existed that there was no immediate threat to the health and safety of the public until a plant became operational. Programs have tended to result in categorization of nonconformances to the lowest action levels. The action point system, categorizing of nonconformances to lower action levels, and limited monitoring of design and construction activities resulted in inability to raise problems to thresholds of stronger enforcement action. The AEC/NRC have placed insufficient importance on procedural matters and have had a tendency to accept a fix to a specific problem without requiring determination of the magnitude of the problem and correction of the root cause. They have had difficulty in recognizing the significance, magnitude, and complexity of problems and did not consistently require expeditious handling of corrective action. Management has been hesitant to take strong enforcement action.

The deficiencies previously discussed were causes of NRC inability to prevent problems and slowness to identify and act on problems at the Diablo Canyon, Marble Hill, Midland, South Texas and Zimmer nuclear plants. In particular, the root cause at Diablo Canyon was insufficient attention in the area of design; the root causes at Marble Hill were inadequate review of experience and management capability, irregular NRC presence, and inability to recognize the significance and magnitude of problems; the root causes at Midland were irregular presence, reluctance to take enforcement action, and the mindset that the plant would not be licensed until ready for operation as determined by pre-operational and startup tests; the root causes at South Texas were inadequate review of experience and management capability, irregular presence, inability to recognize the significance and magnitude of problems, and the mindset that the plant would not be licensed until ready for operation as determined by pre-operational and startup tests; and the root causes at Zimmer were inadequate review of experience and management capability, failure to require licensee review of problems to determine their magnitude and correct their root cause, inability to recognize the significance and magnitude of problems, loss of inspection experience in the Region, and the mindset that the plant would not be licensed until ready for operation as determined by pre-operational and startup tests.

Commercial nuclear power plants under construction have been built during a period of learning and understanding the beneficial effects of an effective quality assurance program. Caution must be used in judging design and construction activities of the past against the standards of today. The next generation of nuclear plants will have the benefit of many man years of construction quality assurance experience. It is vital that the knowledge and understanding gained to date be properly incorporated in the NRC requirements for future nuclear installations.

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MANAGEMENT ANALYSIS
OF
U.S. NUCLEAR REGULATORY COMMISSION

1.0 INTRODUCTION

1.1 PURPOSE OF MANAGEMENT ANALYSIS

To determine shortcomings in the U.S. Nuclear Regulatory Commission (NRC) policies and programs for assurance of quality in the design and construction of commercial nuclear power plants and improvements that could be made.

1.2 SCOPE

The scope of this management analysis of NRC policies and programs for assurance of quality in the design and construction of commercial nuclear power plants was:

- to review and analyze implementation of management practices
- to review and analyze past and present programs for assurance of quality in design and construction
- to review and analyze organizational relationships between the Office of Inspection and Enforcement and Regional Offices
- to determine root causes of the NRC's inability to prevent problems and slowness to identify and act on problems at the Diablo Canyon, Marble Hill, Midland, South Texas and Zimmer nuclear plants.

1.3 BACKGROUND

During the past several years, there have been a series of well publicized problems in the quality of construction of commercial nuclear power plants.

At Midland, excessive settlement of the diesel generating building was observed in 1978. Investigation revealed that the settlement was a result of inadequate and poorly compacted soil and that other safety-related systems and structures were affected. Design and construction specifications for placement of soil fill materials had not been followed and there was insufficient control and supervision of soil placement activities by the utility and its contractors. In 1979, a civil penalty of $38,000 was issued for HVAC problems and in 1982, a civil penalty of $120,000 was issued for breakdown of the Quality Assurance Program.

At Marble Hill, all safety-related work was halted in 1979 because of concrete consolidation problems, improper repair of the imperfections, inadequate or nonexistent records traceable to the repairs, inadequate

training and supervision of personnel responsible for the repairs, and insufficient awareness of the problems and control by the licensee.

At South Texas, safety-related work was halted in 1980 because of problems with concrete placement, welding, procedural violations, records falsification, personnel qualification, harassment and intimidation of inspectors, and insufficient design work. NRC investigations revealed shortcomings in management and implementation of the QA/QC Program.

At Zimmer, construction was nearly completed when in 1981 allegations prompted investigation of quality problems. Following the investigations, the NRC issued a $200,000 fine for quality assurance breakdowns. In 1982, safety-related work was halted. The major problems were identified as QC documentation, procedure violations, inadequate nonconformance reporting system, deficiencies in drawings, specifications, instructions and procedures, material control, and licensee audits and corrective action. Additional investigations reported inadequate management controls and inadequacies in administration of the Quality Assurance Program.

At Diablo Canyon, the NRC issued an Operating License in September of 1981 and revoked it two months later following licensee identification of errors in the seismic design of some piping and equipment restraints. NRC investigations revealed that proper quality assurance controls were not implemented in technical and procurement communications with service-type contractors and document control was inadequate to assure ready access to the most recent information available.

This series of problems in the quality of construction resulted in Congress requiring the NRC to conduct a study of existing and alternative programs for improving quality assurance and quality control in the construction of commercial nuclear power plants (U.S. Congress 1983).

In recognition of the problems and in anticipation of the Congressional mandate, the NRC established a series of initiatives designed to assure quality in design and construction of nuclear power plants and the NRC's ability to monitor and evaluate it (NRC 1982). Included in the initiatives was a review of NRC quality assurance activities to determine shortcomings and improvements that could be made.

This management analysis of NRC programs for assurance of quality in design and construction of commercial nuclear power plants was performed in response to the Congressional legislation and the NRC initiative.

1.4 TECHNICAL APPROACH

This management analysis was performed by reviewing literature pertaining to past and present AEC/NRC programs for assurance of quality in design and construction of commercial nuclear power plants and previous studies of those programs, and by limited interviews with the staff of the Office of Inspection and Enforcement in Bethesda, Maryland, Region II offices in Atlanta, Georgia, Region III offices in Glen Ellyn, Illinois, Region IV offices in Arlington, Texas and Region V offices in Walnut Creek, California. Personnel interviewed at the Office of Inspection and Enforcement were:

- Deputy Director, Division of Quality Assurance, Safeguards, and Inspection Programs
- Chief, Construction Inspection Branch
- Chief, Operating Reactor Programs Section
- Chief, Construction, Vendor and Special Programs Section
- Chief, Licensing Section of Quality Assurance Branch

From 12 to 16 personnel were interviewed at the Regional Offices. Personnel interviewed had the following job titles:

- Regional Administrator

- Deputy Regional Administrator

- Director
  - Division of Project and Resident Programs
  - Division of Engineering
  - Division of Vendor and Technical Programs
  - Division of Resident, Reactor Project and Engineering Programs
  - Division of Reactor Safety and Reactor Projects
  - Enforcement

- Branch Chief
  - Engineering Programs
  - Reactor Projects
  - Construction
  - Vendor

- Section Chief
  - Management Programs
  - Plant Systems
  - Materials and Mechanical
  - Reactor Projects
  - Reactor Systems
  - Reactive and Components
  - Program Support
  - Project Operations

- Enforcement Officer

- Engineer
  - Nuclear (Reactor Licensing)
  - Reactor
  - Project

- Inspector
  - Reactor
  - Project
  - Electrical Construction

The analysis includes licensee, contractor, and NRC Resident Inspector perceptions of problems with the NRC and suggestions for improvement obtained during NRC Site Assessment Case Studies performed in response to the Congressional legislation (U.S. Congress 1973).

1.5 LIMITATIONS OF THE MANAGEMENT ANALYSIS

The management analysis has been limited to NRC programs for assurance of quality in design and construction of commercial nuclear power plants and does not include other NRC programs.

The analysis has been based solely upon literature reviewed and information obtained during interviews. N.C. Kist & Associates, Inc. has not performed activities to authenticate the information obtained and makes no representations to this effect.

The study of NRC programs has been performed in conjunction with and not independent from the NRC. The Quality Assurance Branch of the Division of Quality Assurance, Safeguards, and Inspection Programs of the NRC Office of Inspection and Enforcement provided the literature reviewed, scheduled trips and interviews, and participated in the trips and interviews. The NRC did not, however, participate in the analysis of the information obtained or in the preparation of this report.

Limited interviews of personnel were performed. Two days were spent at the Office of Inspection and Enforcement in Bethesda, Maryland and two days were spent at each of the Regional Offices visited.

N.C. Kist & Associates, Inc. expended approximately two man-months of effort in performing the analysis.

2.0 SUMMARY AND CONCLUSIONS

2.1 General

This analysis of implementation of basic management practices, past and present programs for assurance of quality in design and construction of commercial nuclear power plants, organizational relationships between the Office of Inspection and Enforcement and Regional Offices, and root causes of the NRC's inability to prevent problems and slowness to identify and act on problems has revealed the following shortcomings in NRC policies and programs.

2.2 Organization

- Allocated resources have been insufficient for effective implementation of programs.

- Several functions of the Quality Assurance Branch of the Office of Inspection and Enforcement appear to duplicate functions of the Reactor Programs Construction Branch.

  - developing inspection procedures

  - performing assessments of inspection program inplementation

  - coordinating with industry the development of overview programs.

- Organizationally, there is no single overview of Resident Inspector and Speciality Inspector activities below the level of Deputy. Administrator or Administrator in Regions I, II, and III, which may create a potential for inadequate consolidation of inspection information.

- Differences exist in Regional Office organizational structures and job titles for personnel assigned similar positions, which may lead to differences in job descriptions and understanding of responsibilities.

2.3 Management Practices

- The following basic management practices have not been effectively implemented:

  - clearly defining objectives to assure their understanding

  - providing clear and constant direction

  - establishing a firm and expeditious decision-making process

  - providing adequate resources

  - performing meaningful regular assessments of the adequacy and effectiveness of NRC activities

- taking prompt, forceful corrective action in response to problems and deficiencies.

2.4 Standards Program for Assurance of Quality

- The development and application of quality assurance standards have evolved with the growth of the nuclear industry and there has been insufficient preventive action and planning.

- The original intent of Appendix B of 10 CFR 50 being applicable to all aspects of a reactor, without separate classes of applicability for items important to safety and safety-related items, has not been fulfilled.

- Regulations have not adequately defined safety-related items, items important to safety, and the applicability of quality program requirements and have not been sufficiently prescriptive or definitive to assure their clear understanding.

- Guidance documents have been neither mandatory nor sufficiently prescriptive to assure their understanding.

- Instability in the regulatory process has resulted in longer construction times and more opportunities for error.

2.5 Licensing Program for Assurance of Quality

- Licensing Programs have been insufficient to help assure quality during design and construction.

  - prior to 1970, there was no documented guidance for review of Quality Assurance Programs before issuance of permits

  - from 1970 until 1975, guidance documents for review of Quality Assurance Program descriptions did not require a description of the complete program nor a detailed description of how the commitments were to be implemented

  - reviews of Quality Assurance Program descriptions have emphasized completeness in addressing requirements of Appendix B of 10 CFR 50 without detailed evaluation of how the program would be implemented

  - regional personnel responsible for reviewing QA Manuals were not trained in reviewing manuals

  - the Quality Assurance Program has not been a condition of authorizations and Construction Permits

  - until 1983, submittal of PSAR changes for NRC approval was not required

  - design work and procurement of major components has been permitted prior to submittal of Quality Assurance Program descriptions

- approval of Quality Assurance Program descriptions has been heavily based on reviewer judgment as opposed to clearly defined acceptance criteria

- there has been inadequate evaluation of licensee and contractor experience, attitude and management capability.

2.6 Inspection Program for Assurance of Quality

. There has been insufficient AEC/NRC inspection during design and construction

  - little inspection was performed prior to 1968

  - there was irregular and non-constant presence until 1980 (a minimum of six inspections a year were to be performed and inspections were performed by regional personnel of varying disciplines)

  - the annual direct inspection effort of the regionally based inspection program was about 16 days at each plant

  - until 1979, inspection orientation was towards documentation and records review

  - GAO concluded in 1978 that the NRC's inspection program cannot independently assure that nuclear power plants are constructed adequately

  - inadequate attention has been given to design activities

  - a national average of 1.5 man-years/unit is devoted to inspection during design and construction.

  - approximately 1% of all NRC personnel are Resident Inspectors assigned to construction and 0.6% are in the Licensee Contractor and Vendor Inspection Program

  - for multiple plant sites, one Resident Inspector covers all the plants during construction.

. Budget and manpower restraints have precluded complete implementation of inspection programs.

  - the regionally-based inspection program

  - the resident inspection program

  - Performance Appraisal Teams

  - Construction Assessment Teams

  - Independent Design Inspections

- the Licensee Contractor and Vendor Inspection Program

- the current inspection program is being rewritten with a goal of a 40% reduction in recognition of budget and manpower restraints

- diverting inspection personnel to investigate allegations and team inspection findings has resulted in missing inspection "windows of opportunity" and inability to complete inspection modules

. Pre-Construction Permit activities have been insufficient in their:

- attention to design activities

- review of Quality Assurance Programs and their implementation

- evaluation of licensee and contractor experience, attitude, and management capability.

. Inspection Programs appear to have been designed around available resources instead of determining what must be done and obtaining the resources to do it.

. Regional and resident inspection programs have been intended as guidance, not as mandatory requirements, and have been based upon the use of individual engineering judgment regarding the adequacy of activities performed.

. The degree of implementation of inspection programs has varied across the Regions dependent upon management's approach to regulations and the capability of personnel.

. Insufficient attention has been paid to personnel matters.

- Inspector experience has decreased over the years and it appears training in quality assurance and performing inspections has been inadequate

- NRC salaries have not remained competitive with the industry.

. Inspection Programs have not included hold points designating activities requiring NRC inspection.

2.7 Licensee Contractor and Vendor Inspection Program

. The Licensee Contractor and Vendor Inspection Program LCVIP evolved as a result of the learning process and of licensee inability to assure the quality of items and services supplied by their vendors.

- Prior to 1969, vendor qualification and monitoring was viewed as the licensee's responsibility.

- In 1970, regional inspectors evaluated licensee vendor inspection programs.

- In 1973, a trial vendor inspection program was initiated for fuel fabricators.

- In 1974, a trial LCVIP was initiated because 63% of construction and operation problems were traceable to vendor errors in design or fabrication.

- In 1974, a task force recommended expansion of the LCVIP as a result of increases in vendor-related problems.

- In 1977, electrical equipment was added to the program.

- In 1978, the effectiveness of vendor design programs began being evaluated.

- In 1979, inspections became reactionary as a result of Three Mile Island.

. The legal base for direct NRC inspections of vendors and resultant enforcement action is not clearly addressed in regulations.

. The NRC has been slow to respond to findings and recommendations of previous studies of the LCVIP.

. The NRC has assumed licensee responsibility for evaluation of vendors through the LCVIP and has not taken sufficient enforcement action with licensees to force them to fulfill their responsibilities.

. The LCVIP does not apply to material manufacturers and suppliers.

2.8 Enforcement Program for Assurance of Quality

. Enforcement Programs have not been aggressively implemented.

- early enforcement action consisted of "jawboning" sessions and routine enforcement letters

- mindset existed that there was no immediate threat to the health and safety of the public until a nuclear power plant became operational

- tendency of nonconformances in design and construction to be categorized to the lower action levels since the safety function or integrity could not be clearly shown to be impaired or lost

- the action point system, categorizing of nonconformances to the lower action levels, and periodic nature of inspections resulted in inability to raise problems to thresholds of stronger enforcement action

- failure to recognize the significance, magnitude and complexity of problems

- tendency to accept a fix to a specific problem without requiring a determination of the magnitude of the problem and correction of the root cause

- failure to force expeditious handling of corrective action

- AEC/NRC management hesitancy to take action.

. Enforcement Programs have not encouraged conformance to commitments.

- Failure to conform to commitments, such as PSAR, Regulatory Guides, etc., when lack of conformance did not constitute an item of noncompliance, was considered a deviation, the lowest level of categorization. Commitments are not regulatory requirements and have not been binding. NRC approval has not been required to cancel or change commitments.

. The AEC/NRC have had difficulty in recognizing Quality Assurance Program breakdowns because of:

- the periodic nature of inspections

- categorizing of noncompliances to lower action levels

- low level of attention afforded commitments

- insufficient significance attached to procedural matters.

2.9 NRC Inability to Prevent Problems and Slowness to Identify and Act on Problems

The root causes of NRC inability to prevent problems and slowness to identify and act on problems at Diablo Canyon, Marble Hill, Midland, South Texas and Zimmer nuclear plants follows.

. Diablo Canyon

- insufficient attention in the area of design.

. Marble Hill

- inadequate review of licensee and contractor experience and capability to manage construction of a nuclear power plant

- irregular, non-constant presence
- inability to recognize the significance and magnitude of problems

. Midland

- irregular, non-constant presence

- reluctance to take enforcement action

- loss of inspection experience in the Region

- mindset that it was the licensee's responsibility to properly construct the plant and it would not be licensed until ready for operation as determined by pre-operational and startup tests.

. South Texas

- inadequate review of licensee and contractor experience and capability to manage construction of a nuclear power plant

- irregular, non-constant presence

- inability to recognize the significance and magnitude of the problems

- mindset that it was the licensee's responsibility to properly construct the plant and it would not be licensed until ready for operation as determined by pre-operational and startup tests.

. Zimmer

- inadequate review of licensee and contractor experience and ability to manage construction of a nuclear power plant

- failure to require licensee reviews of problems to determine their extent and to take corrective action regarding the cause of the problem

- inability to recognize the significance and magnitude of the problems

- loss of inspection experience in the Region

- mindset that it was the licensee's responsibility to properly construct the plant and it would not be licensed until ready for operation as determined by pre-operational and startup tests.

The following improvements could be made in NRC policies and programs for assurance of quality during design and construction of commercial nuclear power plants.

. Stabilize the regulatory process through more preventive action and planning.

. Streamline regulations and guidance documents and make them more prescriptive and definitive in terms of required elements of control without specifying how the elements of control must be implemented. Regulations that can stand on their own would eliminate the need for many guidance documents. Clearly define the applicability of

quality program requirements, safety-related items and items important to safety.

- Make the Quality Assurance Program and licensee commitments a condition of authorizations and permits.

- Replace Licensing review of the Quality Assurance Program description as presented in the Preliminary Safety Analysis Report with a Licensing or Office of Inspection and Enforcement review of the licensee Quality Assurance Manual and require the Manual to detail how the Quality Assurance Program shall be implemented. Require Licensing or Office of Inspection and Enforcement approval of Quality Assurance Manual changes. Establish definitive acceptance criteria for Manual reviews specifying required elements of control but not methods of accomplishing them. Do not permit work to be performed until approval of the Quality Assurance Manual.

- Evaluate licensee and contractor experience, attitude and management capability prior to issuance of authorizations and permits. Establish parameters and acceptance criteria.

- Require demonstration of capability to implement the Quality Assurance Program prior to issuance of authorizations or permits.

- Devote greater attention to design activities.

- Develop programs based upon what must be done and then obtain the necessary resources to implement the programs.

- Establish mandatory requirements in inspection programs and reduce dependency upon individual engineering judgement.

- Require an Inspection Plan of licensees and contractors and establish NRC hold points.

- Reevaluate personnel practices, including salaries.

- Change regulations to permit industry organizations to evaluate vendors instead of individual licensees and monitor their activities or establish licensing or certification programs for vendors. Extend the program to include material manufacturers and material suppliers.

- Take stronger enforcement action. Require expeditious handling of corrective action, including determination of the magnitude of problems and correction of their root causes.

- Perform detailed annual audits of licensee Quality Assurance Program implementation

- Review functions to be performed by the Quality Assurance Branch and Construction Programs Branches of the Office of Inspection and Enforcement to assure efforts are not duplicated.

- Eliminate differences in basic Regional Office structures and job titles to assure uniformity of functional responsibilities.

- Increase the training of inspectors in the areas of quality assurance, auditing, and implementation of inspection modules. Broaden the capabilities of inspectors to encompass all disciplines or provide additional support.

- Establish an audit program of NRC activities utilizing qualified personnel not having responsibility in the areas audited.

- Establish a Quality Assurance Program within the NRC.

3.0 MAIN DISCUSSION

3.1 ENABLING LEGISLATION

3.1.1 Description

3.1.1.1 Atomic Energy Act of 1946

The Atomic Energy Act of 1946 created the Atomic Energy Commission (AEC), empowered it to control all aspects of atomic energy, and forbade private ownership of nuclear materials. The AEC's primary activities related to the control of nuclear weapons.

3.1.1.2 Atomic Energy Act of 1954

The Atomic Energy Act of 1954 empowered and directed the AEC to promote nuclear energy and to regulate the nuclear industry. Among the provisions of the Act were to issue licenses to private companies to build and operate commercial nuclear power stations and to adopt whatever regulations it deemed necessary to protect the health and safety of the public.

3.1.1.3 Energy Reorganization Act of 1974

The Energy Reorganization Act of 1974 abolished the AEC and eliminated the conflict of interest of promoting and regulating nuclear energy by creating the Energy Research and Development Administration (ERDA) and the Nuclear Regulatory Commission (NRC).

ERDA was responsible to bring together and direct Federal activities relating to research and development of various sources of energy, to increase the efficiency and reliability in the use of energy, and to carry out the performance of other functions, including but not limited to AEC's military and production activities and its general basic research activities (U.S. Congress 1974).

NRC was responsible for all the licensing and related regulatory functions of the AEC and the functions of the Atomic Safety and Licensing Board Panel and the Atomic Safety and Licensing Appeal Board (U.S. Congress 1974).

NRC's licensing and related regulatory authority (U.S. Congress 1974) extend to:

- Demonstration Liquid Metal Fast Breeder reactors when operated as part of the power generation facilities of an electric utility system or when operated to demonstrate the suitability for commercial application of such a reactor.

- Other demonstration nuclear reactors except those in existence before the effective date of the Energy Reorganization Act of 1974 when operated as stated above.

- Facilities used primarily for the receipt and storage of high-level radioactive wastes resulting from activities licensed.

- Retrievable Surface Storage facilities and other facilities authorized for the express purpose of subsequent long-term storage of high-level radioactive waste generated by the Administration, which are not used for, or part of, research and development activities.

The Energy Reorganization Act of 1974 (U.S. Congress 1974) established the organization of the Commission and Offices of Nuclear Reactor Regulation, Nuclear Material Safety and Safeguards, and Nuclear Regulatory Rsearch.

The Commission is composed of five members appointed by the President, by and with advice and consent of the Senate. Appointments must be made in such a manner that not more than 3 members are of the same political party. Each member serves a 5-year term with terms expiring in consecutive years. The President designates one member as chairman to serve during the pleasure of the President and any member may be removed by the President for inefficiency, neglect of duty or malfeasance in office. Each member has equal responsibility and authority in all decisions and actions, has full access to all information relating to his duties or responsibilities, and has 1 vote. Action of the NRC is determined by a majority vote of members present.

The Office of Nuclear Reactor Regulation is responsible for such functions as the NRC delegates (U.S. Congress 1974) including:

- principal licensing and regulation of all facilities and materials licensed under the Atomic Energy Act of 1954, as amended

- review of the safety and safeguards of all such facilities, materials and activities, including but not limited to monitoring, testing and recommending upgrading of systems designed to prevent substantial health or safety hazards and evaluating methods of transporting nuclear materials and transporting and storing high level radioactive wastes

- recommending research necessary for the discharge of the functions of the NRC.

The Office of Nuclear Material Safety and Safeguards is responsible for such functions as the NRC delegates (U.S. Congress 1974) including:

- principal licensing and regulation involving all facilities and materials, licensed under the Atomic Energy Act of 1954, as amended, associated with the processing, transport, and handling of nuclear materials, including the provision and maintenance of safeguards against threats, thefts, and sabotage of such licensed facilities, and materials

- review of safety and safeguards of all such facilities and materials, including, but not limited to monitoring, testing, and recommending upgrading of internal accounting systems for special nuclear and other nuclear materials and developing contingency plans for dealing with threats, thefts, and sabotage relating to special

nuclear materials, high-level radioactive wastes and nuclear facilities

- recommending research to enable the NRC to more effectively perform its functions.

The Office of Nuclear Regulatory Research is responsible for such functions as the NRC delegates (U.S. Congress 1974) including:

- developing recommendations for research deemed necessary for performance by the Commission of its licensing and related regulatory functions

- engaging in or contracting for research which the Commission deems necessary for the performance of its licensing and related regulatory functions.

The Energy Reorganization Act of 1974 also included a survey to locate and identify possible nuclear energy center sites, quarterly submittal by the Commission to Congress of a report listing abnormal occurrences at or associated with any facility licensed or regulated and dissemination of such information to the public within fifteen days of Commission receipt of such information, development of a plan for the specification and analysis of unresolved safety issues, employee protection against discharge and discrimination because the employee commenced or participated in a proceeding under the Act or the Atomic Energy Act of 1954, including investigation of such charges by the Secretary of Labor, annual authorization of appropriations to the Commission which reflect the need for effective licensing and other regulation of the nuclear power industry in relation to the growth of such industry, and Comptroller General of the United States audit, review and evaluation of implementation of the provisions of the Act pertaining to the Nuclear Regulatory Commission not later than 60 days after the effective date of the Act.

3.1.1.4 Additional Enabling Legislation

Congress provides additional enabling legislation as part of its annual authorization of appropriations.

3.1.2 Analysis

Until the Energy Reorganization Act of 1974, the AEC was empowered and directed to promote nuclear energy and to regulate the nuclear industry. This dual responsibility created an inherent conflict of interest which resulted in widespread criticism of the AEC emphasizing their promoting role at the expense of their regulating role.

The Energy Reorganization Act of 1974 eliminated the inherent conflict of interest by making the NRC responsible for all licensing and related regulatory functions and ERDA responsible for directing Federal activities related to research and development of various sources of energy.

Enabling legislation has provided the AEC/NRC adequate authority for fulfilling its responsibilities. This study has not identified a need for changes to enabling legislation.

3.2 ORGANIZATION

3.2.1 Description

3.2.1.1 General

The Energy Reorganization Act of 1974 (U.S. Congress 1974) transferred to NRC the Chairman and members of the AEC, the General Counsel, and other officers and components of the Commission except functions, officers, components, and personnel transferred to ERDA.

The Commission is responsible for licensing and regulating nuclear facilities and materials and for conducting research in support of the licensing and regulatory process, including protecting public health and safety, protecting the environment, protecting and safeguarding materials and plants in the interest of national security, and assuring conformity with antitrust laws (NRC 1983). To fulfill its responsibilities, the Commission has used; standards setting and rule making; technical reviews and studies; conduct of public hearings; issuance of authorizations, permits and licenses; inspection, investigation, and enforcement; evaluation of operating experience; and confirmatory research. The Commissioners are described under Enabling Legislation in this section of the report. Reporting to the Commissioners are the:

- Office of Public Affairs
- Office of Congressional Affairs
- Atomic Safety and Licensing Board Panel
- Atomic Safety and Licensing Appeal Panel
- Advisory Committee on Reactor Safeguards
- Office of Investigations
- Office of Inspector and Auditor
- Office of Policy Evaluation
- Office of the General Counsel
- Office of the Secretary
- Executive Director for Operations.

The Executive Director of Operations (EDO) performs functions as the Chairman or Commission directs and is governed by policies and decisions of the Commission (NRC 1983). Reporting to the Executive Director for Operations are the:

- Office of Administration
- Office of the Executive Legal Director
- Office of Resource Management
- Office of Small and Disadvantaged Business Utilization and Civil Rights
- Office for Analysis and Evaluation of Operational Data
- Office of International Programs
- Office of State Programs
- Regional Offices
- Office of Nuclear Material Safety and Safeguards

- Office of Nuclear Reactor Regulation
- Office of Nuclear Regulatory Research
- Office of Inspection and Enforcement.

The NRC has operated with a budget ranging from 333 million dollars to 513 million dollars over the past five years. The annual Congressional authorization specifies the amounts that will be used for specific activities. The following summary shows the average allocation of funding to each specified area of activity during the last five year period (U.S. Congress 1983 et al).

Area of Activity	Average % of Total Appropriation
Nuclear Regulatory Research	49.7
Nuclear Reactor Regulation	15.4
Inspection and Enforcement	12.0
Nuclear Material Safety and Safeguards	8.4
Program Direction and Administration	8.3
Technical Support	4.2
*Standards	4.1

*1979 and 1980 only. Not listed as a separate category after 1980.

The elements of the organization primarily involved in NRC programs for assurance of quality during the design and construction of nuclear power plants are the Office of Nuclear Reactor Regulation, the Office of Nuclear Regulatory Research, the Office of Inspection and Enforcement and the Regional Offices.

The Office of Nuclear Reactor Regulation develops and administers regulations, policies and procedures. The Division of Licensing directs and administers the licensing process for all utilization facilities including safety and environmental evaluations of reactors required to be licensed for operation. It directs and supervises the processing of applications and petitions for license amendments and issues, denies, and amends all limited work authorizations, permits and licenses for reactors, administers the Standardization Program, and serves as NRR coordinator with the Office of Inspection and Enforcement (NRC 1983).

The Office of Nuclear Regulatory Research plans, recommends and implements the programs of Nuclear regulatory research necessary for performance of licensing and related regulatory functions. The Division of Engineering Technology plans, develops, and directs research programs and develops standards for the design, qualification, construction, inspection, testing, operations and decommissioning of nuclear power plants (NRC 1983).

3.2.1.2 Office of Inspection and Enforcement

The Office of Inspection and Enforcement was formed by the Commission during the Energy Reorganization Act of 1974. Its function (NRC 1983) is to develop policies and programs for enforcement and inspection of licensees, applicants, and their contractors and suppliers to:

- ascertain whether they are complying with NRC regulations, rules, orders, and license conditions
- identify conditions that may adversely affect public health and safety, the environment, or the safeguarding of nuclear materials and facilities
- provide a basis for recommending issuance or denial of an authorization, permit or license
- determine whether quality assurance programs meet NRC criteria
- recommend or take appropriate action regarding incidents or accidents
- develop policies and implement a program of enforcement action
- direct emergency preparedness activities
- provide guidance to Regional Offices on program matters
- appraise program performance in terms of effectiveness and uniformity.

In January 1983, several organizational and functional changes were made in the Office of Inspection and Enforcement because of their expanded role in quality assurance.

1) The Division of Reactor Programs was redesignated the Division of Quality Assurance, Safeguards, and Inspection Programs. Primary emphasis continues to be placed on quality assurance while integrating quality assurance concerns and principles into the reactor construction and operating reactor inspection programs.

2) The Division of Engineering and Quality Assurance was redesignated the Division of Emergency Preparedness and Engineering Response.

3) The Reactor Training Center became the Technical Training Center.

Quality assurance functions of Nuclear Reactor Regulation and Nuclear Reactor Research were transferred to the Quality Assurance Branch of the Office of Inspection and Enforcement. Within the Division of Quality Assurance, Safeguards, and Inspection Programs, the Quality Assurance Branch consists of 12 personnel and performs the following functions (De Young 1982):

- Develops a comprehensive NRC program for Quality Assurance of licensee facilities to be applied to design, fabrication, construction, testing and operation. This encompasses licensees, vendors, architect-engineers, constructors, and other licensee agents.
- Develops requirements and standards based upon regulatory experience and industry coordination.
- Reviews existing requirements and standards to clarify and optimize the effectiveness of QA requirements and standards.

- Reviews existing office programs to optimize the effectiveness of QA activities.

- Responsible for developing QA-related inspection procedures and for performing assessments of QA inspection program implementation by the regional offices.

- Develops and coordinates with the regional and other headquarters offices, NRC initiatives to confirm the management effectiveness of licensees in assuring the quality of licensee and contractor activities during design, fabrication, construction, testing and operation.

- Develops and coordinates with the regional and other headquarters offices, NRC initiatives to independently verify the quality of construction at selected utilities.

- Coordinates with industry the development of overview programs for improving the effectiveness of QA programs and their implementation.

The Reactor Construction Programs Branch consists of 21 personnel and performs the following functions (De Young 1982):

- Develops the NRC inspection policies and programs for reactor projects from the time of an application for a construction authorization or permit to the time the operating license is issued. Includes inspection programs for associated nuclear steam suppliers, architect-engineers, constructors and component vendors. Excluded from the branch responsibilities are the preoperational preparations that do not pertain to the actual construction of the plant. The policies, strategies, and programs will be revised principally to improve staff resource effectiveness by integrating applicable licensing procedures and experiences with those from the office inspection activities.

- Based on the results of assessments of program implementation and on recommendations from regional offices, NRR, and NMSS, revises established programs, as necessary, to increase their effectiveness to better coordinate inspection activity with licensing policy and objectives, and to tailor the programs to anticipated resources.

- Develops estimates of resources that are needed to perform the various elements of the programs which have been established, or which are under consideration.

- Represents NRC to outside agencies and technical organizations such as INPO, ASME, and IEEE, in order to further the development of integrated construction inspection programs and to make best use of available resources of NRC, licensees, and associated organizations.

- Develops and maintains the Construction Appraisal Team (CAT) programs for reactors under construction including assessment of regional office implementation. Conducts CAT team inspections at licensee facilities.

- Assesses regional office implementation of established inspection programs to determine to what degree program requirements are being met. Assesses the effectiveness of each established program and determines whether the regions are implementing the programs in a technically adequate and consistent manner. This process will include field observations and examinations at licensee sites and at licensee and regional offices. Provides guidance to the regions regarding areas of program implementation which need improved performance and areas where the program can be cut back to better fit available resources.

3.2.1.3 Regional Offices

The Regional Offices execute established NRC policies and assigned programs relating to inspection, enforcement, licensing, state agreements, state liaison, and emergency response within Regional boundaries. Regional Office activities include project and resident inspection programs, engineering, radiological safety, emergency preparedness, and materials safety programs. Region IV is responsible for implementation of the Licensee Contractor and Vendor Inspection Program. In 1980, the NRC began to expand the scope of functions of Regional Offices to create an agencywide regional operation which includes licensing as well as inspection and enforcement functions.

Regional Administrators have managerial and supervisory responsibility for all functions and personnel assigned to their Region. Regional organizations include an Administrator; Deputy Administrator; Enforcement Director, Coordinator, or Specialist; Counsel or Attorney; Public Affairs Officer; Division Directors; Branch Chiefs, Section Chiefs; Resident Inspectors; Specialty Inspectors and support personnel.

The two Regional Office groups of major interest to this study are the Division of Project and Resident Inspector Programs, which administers assigned project and resident inspectors, and the Division of Engineering, which provides technical or speciality inspectors to perform work such as quality assurance reviews or nondestructive examinations.

In Regions IV and V, inspection responsibilities of these two divisions is consolidated in the Division of Resident Reactor Project and Engineering Programs.

Each division is comprised of two branches supervised by Branch Chiefs who are responsible for providing management of the division's functions for assigned facilities within the Region. Each branch is comprised of sections supervised by Section Chiefs who are responsible for providing management of functions at from three to five nuclear power plant sites. Within sections are Project Inspectors who are responsible for overseeing implementation of the inspection program at one or more sites and helping to coordinate regional activity at the sites. Also within sections are Resident Inspectors who are responsible for implementation of the inspection program at their assigned site.

Of the 3300 employees working for the NRC, 890 are located at the Regional Offices and of these, 460 are classified as inspectors. Of the 460

inspectors, 32 are Resident Inspectors for construction and 22 are involved in the Licensee Contractor & Vendor Inspection Program.

A more detailed breakdown of inspector personnel by Region follows: (Blaha 1983):

	Total Personnel		Total Inspectors		Resident Inspectors-Construction	
Region	Actual	Budgeted	Actual	Budgeted	Actual	Budgeted
I	211	218	118	124.5	6	7
II	213	222	118	125	5	7
III	222.3	216	116	118	14	10
IV	151	139	64	67.5	4	4
V	93	92	44	47.5	3	4
TOTALS	890.3	887	460	482.5	32	32

3.2.2 Analysis

3.2.2.1 General

The scope of this study limited organizational analysis to relationships between the Office of Inspection and Enforcement and Regional Offices. Additional study of other NRC offices involved in the assurance of quality during design and construction of nuclear power plants is warranted.

Communications between NRC headquarters and Regional Offices appear to be adequate, although more personal unscheduled meetings in handling problems and suggestions should be encouraged. Complaints were heard that by the time a suggestion travels from a Resident Inspector upwards through the Regional Office and then downward in the I and E chain to the QA Division, much of its effectiveness is lost. Regular meetings of individuals involved with standards and inspection modules would be beneficial.

Over the past five years, an average of 12 percent of the NRC budget has been allocated to all inspection and enforcement activities. The portion of the 12 percent assigned to inspection of design and construction activities was not readily obtainable, but would be small. Allocated resources have been insufficient for effective implementation of programs and is discussed under the programs in this report. In order to assure quality during design and construction, additional budget allocations to inspection activities appears necessary.

3.2.2.2 Office of Inspection and Enforcement

Recent changes in the Bethesda, MD headquarters organization have shifted the quality assurance functions from other offices to the Office of Inspection and Enforcement Division of Quality Assurance, Safeguards, and Inspection Programs. The consolidation of these functions within a central group should provide more effective management of the functions. The functions to be performed by the Quality Assurance Branch and Construction Programs Branch appear adequate to assure quality in design and construction of commercial

nuclear power plants. However, the effectiveness of the NRC will be dependent upon the implementation of the functions. Additional guidance, describing in more detail the implementation of each function, appears to be necessary.

Some of the functions appear to duplicate efforts. The Quality Assurance Branch is responsible for developing QA-related inspection procedures and for performing assessments of QA inspection program implementation by the Regional Offices. The Reactor Programs Construction Branch is responsible to develop the NRC inspection policies and programs and to assess Regional Office implementation of established inspection programs. The Quality Assurance Branch is to coordinate with industry the development of overview programs for improving the effectiveness of QA programs and their implementation. The Reactor Construction Programs Branch is to represent the NRC to outside agencies and technical organizations such as INPO, ASME, and IEEE, in order to further the development of integrated construction inspection programs and to make best use of available resources of NRC, licensees, and associated organizations. These functions should be reviewed to assure efforts are not being duplicated.

3.2.2.3 Regional Offices

Each Region does not have the same organizational structure and job titles for personnel assigned similar positions. For example, Regions I, II and III, have two separate divisions for Project and Resident Programs and Engineering while these activities are combined into one division in Regions IV and V. The responsibility of implementing enforcement policies and procedures is held by an Enforcement Specialist in Region I, a Director of Enforcement in Regions II and IV, an Enforcement Coordinator in Region III, and an Enforcement Officer in Region V. Differences in organization and job titles may lead to differences in job descriptions and misunderstandings of responsibilities. Regional Office organizational structures should be standardized for identical functions.

In Regions I, II, and III, project and resident inspectors are part of the Division of Project and Resident Programs and specialty inspectors are part of the Division of Engineering. Organizationally, there is no single overview of all inspector activities below the level of Deputy Administrator or Administrator. Functionally, interaction between the inspection personnel, Section Chiefs, Branch Chiefs, and Division Directors may provide overview of all inspector activities, but the organization would indicate a potential for inadequate consolidation of inspection information. Consideration should be given to providing a single overview of all inspector activities below the level of Deputy Administrator or Administrator.

The organizational structure of Regions results in four levels of supervision between an inspector and the Regional Administrator, which could result in attenuation of information. Regional personnel indicated there was little attenuation of information between the inspectors and the Administrator on anything of significance. A formal NRC policy was placed into effect following Three Mile Island to permit submittal of differing professional opinions to the Commission over Regional management.

Personnel allocation to inspection activities during design and construction of Nuclear power plants has been insufficient. Of the total number of NRC personnel, approximately 1.0 percent are Resident Inspectors

assigned to construction sites and approximately 0.6 percent are involved in the Licensee Contractor and Vendor Inspection Program. Current NRC headquarters personnel estimates of manpower performing inspections during design and construction is 1.5 man-years/unit. At the time of pre-operational activities, inspection effort increases to about five to seven man-years.

The EDO stated in SECY-82-352:

> "Although a resident inspector is now assigned to every site at which construction is more than 15 percent complete, the NRC is limited in its ability to assure compliance with all NRC requirements because of the limited inspection resources."

Inability to fully implement past and present programs as a result of budget and manpower restraints has been a contributing factor to the AEC/NRC inability to prevent problems and slowness to identify and act on problems. Additional discussion of resource allocation pertaining to past and present programs may be found in other sections of this report. In order to assure quality during design and construction, additional allocation of personnel to inspection activities is necessary.

3.3 MANAGEMENT PRACTICES

3.3.1 General

To effectively regulate and control the commercial nuclear power plant industry in the United States, it is necessary for the NRC to implement basic management practices, such as:

- clearly defining objectives and philosophy
- assuring clear understanding of objectives and philosophy
- defining organizational structure, functional responsibilities, authorities, and interfaces
- defining a detailed approach towards accomplishing objectives in instructions, procedures and other documents which may be easily understood
- providing clear and constant direction
- establishing a firm and expeditious decision-making process
- assuring good communications
- providing adequate resources
- performing meaningful, regular assessments of the adequacy and effectiveness of the organization's activities
- taking prompt, forceful corrective action in response to problems or deficiencies.

The results of this study provides the following information regarding implementation of basic management practices.

3.3.2 Objectives and Philosophy

The objectives and philosophy of the AEC and NRC have been clearly stated and well understood by the industry and AEC/NRC. Objectives have included:

- to protect the public health and safety
- to protect the environment
- to protect and safeguard materials and plants in the interest of national security
- to assure conformity with antitrust laws.

The basic philosophy has been to make the nuclear power plant industry responsible for assuring the safety of its operations and to monitor the industry on a limited sampling basis to verify its fulfilling of this responsibility.

Although the objectives have been clearly stated, the subjective terminology used and vagueness in defining their meaning has resulted in different perceptions by Congress, the public, the nuclear power plant industry, and the AEC/NRC of what has been expected in meeting the objectives.

3.3.3 Organization

The organizational structure, functional responsibilities, authorities and interfaces have been clearly defined and documented in organization charts and procedures.

3.3.4 Approach

The approach towards accomplishing objectives has been clearly defined in procedures and other documents which may be easily understood.

3.3.5 Direction

Clear and constant direction has not always been provided to regulatory personnel and the industry. The AEC and NRC have learned along with the industry during years of construction and operation of nuclear power plants. Programs for assurance of quality during design and construction evolved as a result of the learning process and in reaction to adverse industry events. There has been insufficient preventive action and planning of programs.

Regulations pertaining to quality assurance and guidance documents for their implementation have not been sufficiently prescriptive or definitive to assure their clear understanding by the industry, the AEC and the NRC. Regulations have not adequately defined the applicability of quality program requirements. Additional discussion of regulations and guidance documents is included under the Standards Program for Assurance of Quality in this section of the report.

Licensing activities have not assured that licensees have developed and implemented adequate quality assurance programs before performing activities affecting quality. Licensee commitments at the Preliminary Safety Analysis Report stage have not been made a condition of the Construction Permit. Additional discussion of licensing is included under the Licensing Program for Assurance of Quality in this section of the report.

Inspection programs have been intended to serve as guidance to the inspectors and implementation of the programs has been dependent upon the engineering judgment of regional management and each individual inspector. The degree of implementation of inspection programs has varied across the Regions dependent upon management's approach to regulations and programs and the capability of personnel.

3.3.6 Decision Making

The decision making process has not always been firm and expeditious. Licensee and contractor personnel indicated during the NRC Case Studies that:

- the industry needed decisions from the NRC and was guessing for years what to do following Three Mile Island
- the NRC took too long to resolve problems and questions and took one to two years in some instances
- appeal boards resulted in long hearings with few design changes
- anyone can second guess the NRC and hold up utility programs for years
- the NRC needs to accept the technical views of experts and not hold up work due to unqualified intervenors.

Regional personnel indicated that headquarters was often more of an obstacle than a help. Upon identifying problems, regional personnel would get little assistance from headquarters. Some regulations were viewed as encouraging slow decisions. It was indicated that it may take a year to resolve a 50.55 (e) finding after it is reported. A need for more accountability within the NRC was also expressed.

3.3.7 Communications

Generally, there appears to be good communication within and between NRC headquarters and Regions. Regional personnel did indicate, however, that feedback to Regions on suggestions made by regional personnel was poor, resulting in a reduction of incentive to make suggestions for improvements.

3.3.8 Resources

Adequate resources have not been provided to assure quality in design and construction of nuclear power plants. Budget and manpower restraints have precluded adequate development and implementation of AEC and NRC programs. Programs have tended to be prepared on the basis of available resources instead of defining what must be done to assure quality in design and construction and then obtaining the necessary resources to assure the required activities are uniformly implemented at each facility. Diverting manpower from the inspection program to perform reactionary inspections, investigate allegations and follow-up on special inspection findings, has resulted in missing inspection "windows of opportunity", periods of construction during which an inspection must be performed because it cannot be performed later. Licensee and contractor personnel indicated during the NRC Case Studies that:

- the NRC needs more resident inspectors or roving teams to support all disciplines
- there should be a resident for each discipline
- they questioned the capability of the NRC staff to do adequate technical reviews
- the NRC staff has to be equal or competitive with the utility's and architect engineer's

Regional personnel indicated a need to assure the NRC staff is qualified to perform their jobs and that many auditors from the NRC didn't know enough about the subject being audited to perform meaningful audits. They also indicated that:

- if Regions are to perform all activities for which now responsible, increased resources will be required
- the level of inspector experience has decreased over the years
- the NRC has not remained competitive with the industry regarding salaries
- the NRC needs to hire people with actual experience
- additional training is needed for inspectors, headquarters, and regional personnel.

3.3.9 Assessment of Activities

Although there have been numerous studies of the AEC and NRC, there have not been meaningful, regular internal assessments of the adequacy and effectiveness of AEC/NRC programs for assurance of quality in design and construction of nuclear power plants. No NRC organization has been responsible for auditing all of the activities of the NRC. Review functions of the Quality Assurance Branch and Reactor Construction Branches of the Office of Inspection and Enforcement do not include audits of implementation of NRC programs and the Office of Inspector and Auditor has not fulfilled this function. Findings regarding the accident at Three Mile Island (NRC 1980) included:

- There appears to be no internal technical audit function in NRC. The I&E in Washington, D.C. does review the activities of its inspectors, but there does not appear to be any organization responsible for reviewing and auditing the overall utility overview process. The Office of Inspector and Audit appears to be a legal and administrative audit only, not involved in technical reviews.
- There is no assignment within the NRC organization for overview of critical functions such as problems reporting, failure analysis, and corrective action; systems engineering; and the role of the operator and human factors in plant safety.
- No NRC organization is identified as being responsible for auditing the project management, engineering, and inspection functions of the NRC.

The NRC needs to correct this situation by establishing an audit program that utilizes qualified personnel not having responsibility in the areas audited.

3.3.10 Corrective Action

Forceful action has been taken in response to many problems and deficiencies. However, the promptness of action has been slowed by the organizational structure and procedures of the AEC/NRC and the action taken has tended to be additional requirements resulting from specific events and has not sufficiently included corrective actions regarding the causes of the problems and deficiencies.

3.4 STANDARDS PROGRAM FOR ASSURANCE OF QUALITY

3.4.1 Description

In 1955 and 1956, the AEC issued a set of basic regulations for the civilian nuclear industry. Chairman Strauss emphasized that the regulations were not intended to restrain the industry but to "open the way to all who are interested in engaging in research and development of commercial activities in the atomic energy field" (Langstaff 1982). Providing facilities which did not endanger the health and safety of the employees and the public was to be the industry's responsibility.

In 1967, the AEC published for comment 70 General Design Criteria for Nuclear Power Plant Construction Permits (Appendix A of 10 CFR 50). Criterion 1 specified the quality expected to be incorporated in all aspects of nuclear facilities and required a QA Program "be established and implemented in order to provide adequate assurance that these structures, systems and components will satisfactorily perform their safety functions." Specific criteria for a QA Program were not included.

The need for more definitive QA regulatory criteria was strongly emphasized at the Atomic Safety Licensing Appeal Board hearing on Zion Nuclear Station in 1968.

The following year, the AEC published Appendix B of 10 CFR 50 for comment, which specifically defined the requirements of the licensee's Quality Assurance program.

Interviews with NRC headquarters personnel revealed that when Appendix B of 10 CFR 50 was published for comment, the criteria were meant to elaborate on the Quality Assurance Program requirements of Appendix A with no intention of separate classes of applicability for items important to safety and safety-related items. Appendix B was to complement Appendix A and apply to all aspects of a reactor, not just seismic category 1. Appendix B was published as an effective rule in 1970 and Appendix A was published as an effective rule in 1971. Since Appendix B was published while Appendix A was still in draft form, references to Appendix A were dropped, including language that indicated Appendix B was to apply to the general design criteria. When Appendix A was published, there was no attempt to revise Appendix B to clarify the intent of applicability. Appendix B was interpreted by AEC staff performing Safety Analysis Reviews to apply to seismic category 1, and was not applicable to any broader class of equipment, systems, or components.

As the AEC reviewed individual nuclear plants, the resolution of issues were negotiated with owners. AEC staff positions gradually emerged in the form of Safety Guides. In 1970, the AEC began to publish Regulatory Guides which clarified the AEC's position and replaced the Safety Guides. A primary purpose of Regulatory Guides (AEC 1972) was to describe and make available to the public methods acceptable to the AEC Regulatory Staff of implementing specific parts of regulations and to provide guidance to applicants concerning information needed by the staff in review of applications for permits and licenses. The Guides were not intended as substitutes for regulations and compliance was not required. Different methods and solutions were acceptable

if they provided a basis for findings requisite to the issuance of a permit or license. The AEC delegated the work of devising needed rules to industry committees who would prepare a standard governing a certain aspect of plant design. The AEC would then write a Regulatory Guide that adopted the standard in whole or in part. There are currently 153 Regulatory Guides.

In a report regarding the status and application of ANSI N45.2 Standards (Bernsen and Hellman 1973), the following observations regarding the philosophy of the ANSI Standards were made with assistance from the N45.2 Subcommittee membership:

> "Each of the standards issued by the N 45.2 Subcommittee has been subject to an extremely intensive preparation and review process and is believed to contain precise statements of acceptable current practices for commercial nuclear power plants-practices which are practical, currently available and judged necessary to achieve required levels of quality."
>
> "Whereas AEC regulations and the Code are mandatory regulations establishing firm requirements for the areas they cover, and hence, include assignments of responsibilities, the N45.2 series are not written as self-sufficient regulatory documents and are intended to be supplemented by:
>
> a. a regulatory requirement prescribing its use (i.e., the AEC's codes and standards rules 10 CFR Part 50 or other statements of AEC requirements, such as the AEC Regulatory Guides)
>
> b. a power plant applicant's license commitments or
>
> c. an appropriate procurement document.
>
> Another significant difference between the ANSI standards and the regulations is that the ANSI standards are intended to apply to features of the plant which affect operational reliability as well as those which are important to safety. Naturally, the extent to which these standards would be applied to plant features which affect reliability is a matter for determination by the utility and hopefully a mutual agreement between the utility and his principal contractors; but there appears to be a general consensus of opinion that judicious application of quality standards to the total plant will prove beneficial."

In 1971, ANSI N45.2 was published, basically repeating Appendix B of 10 CFR 50 but describing the requirements in more detail. Shortly thereafter the AEC issued Regulatory Guide 1.28 endorsing ANSI N45.2-1971.

In 1973 and 1974, the AEC Regulatory Staff issued "Guidance on Quality Assurance Requirements During Design and Procurement Phase of Nuclear Power Plants" (Gray Book) and "Guidance on Quality Assurance Requirements During the Construction Phase of Nuclear Power Plants" (Green Book) to provide guidance for establishing and implementing Quality Assurance Programs. Most of the guidance was in the form of AEC regulations, Regulatory Guides, and draft

standards developed by the American National Standards Institute Subcommittee N45.2.

In 1973, it was recommended to the Director of Regulation (Davis and Brown 1973) that Regulatory host a series of conferences for utilities with participation of the Commissioners to demonstrate the Commission's commitment to QA and to explain the mini-review procedure. During July of 1973, AEC senior staff, including two Commissioners, participated in regional one-day conferences with utilities to explain the role of quality assurance in design, construction and operation of nuclear power plants.

The AEC also announced that it would hold meetings with prospective applicants to discuss in detail the quality assurance criteria in sufficient time for the utility to include the requirements in contracts for design and procurement.

In 1975, the NRC issued a Standard Review Plan to define the scope of review and acceptance criteria for the NRC's approval of Safety Analysis Reports.

The NRC continues to use Appendix B of 10 CFR 50 as the primary requirements for Quality Assurance Programs and supplements Appendix B with Regulatory Guides.

3.4.2 Analysis

3.4.2.1 Evolution of Standards

The role of the AEC, and subsequently the NRC, as a regulator of the commercial nuclear industry has been ill defined since the origin of the program. The primary guidance to the regulators was to protect the "health and safety of the employees and the public". Early AEC interpretation of this mandate minimized specific quality assurance controls, which undoubtedly reflected the then current attitude towards safety in fossil plants or the military nuclear program. The development and application of quality assurance standards have evolved with the growth of the nuclear industry. The role of the AEC and NRC has been a reactive one as both the industry and its regulators have grown to understand the significance of quality assurance.

Although 10 CFR 50 became a regulation in 1954, it was not until 1967 that Appendix A of 10 CFR 50, containing the first mention of a quality assurance program requirement, was published for comment. Until 1967, AEC regulations were intended to encourage research and development of commercial activities and to let the commercial nuclear power industry regulate itself. The AEC recognized the need for defining specific criteria of quality assurance programs as a result of hearings on the Zion Nuclear Station in 1968 and as a result, issued Appendix B of 10 CFR 50 in 1970.

The industry ANSI Standard N45.2 was being prepared about the same time with similar quality assurance requirements. By the use of Regulatory Guides, the NRC has modified the ANSI 45.2 Standard and further defined the Appendix B requirements.

3.4.2.2 Applicability of Standards

The AEC and NRC have failed to fulfill the original intent of Appendix B to 10 CFR 50. As Appendix A and Appendix B of 10 CFR 50 were published, Appendix B was to complement Appendix A and thereby apply to all aspects of a reactor, without separate classes of applicability for items important to safety and safety-related items. The AEC and NRC have failed to clearly define safety-related items and items important to safety and have not adequately defined the applicability of quality assurance program requirements in its regulations. The determination of how and to what extent quality assurance requirements are applied has been left to the discretion of the applicant. Although the applicant must identify safety-related systems in the PSAR, there is no requirement to identify specific safety-related items within the systems and there is no NRC review of classification of such items for completeness or adequacy. Each applicant determines which items it considers safety-related, resulting in lack of uniformity of classification of items as safety-related and lack of uniformity in quality assurance program application.

Several previous studies have suggested that changes be made in the methods used in defining safety related and importance to safety classifications of components and systems.

NUREG 0321 (A Study of the Nuclear Regulatory Commission Quality Assurance Program - 1977) stated:

> "10 CFR 50 Appendix B should be used in the regulation of all areas of power reactor design, construction and operation which are judged to have sufficient importance to safety to fall under NRC regulation. The selective application of QA elements now applied to safety-significant items not interpreted as falling under Appendix B should be replaced by an approach in the degree to which the 18 Criteria of Appendix B are applied would reflect the safety significance of the item."

The Staff Report to the Presidential Commission on the Accident at Three Mile Island - Volume IV - 1979 also addressed the subject as follows:

> "Quality assurance requirements apply only to a narrow portion of the plant defined as safety-related or safety-grade. Many items vital to the safe and reliable operation of the plant are not covered by the quality assurance program because of this definition." And also
>
> "Safety and reliability requirements and analysis are not required to be applied to many plant systems which may be vital to the safe operation of the plant but are not labeled safety-related."

NUREG/CR-1250, Volume II, Part 1 (Three Mile Island: A Report to the Commission and the Public - 1980) stated:

> "Although the requirements of Appendix B are sufficiently broad to adequately address most aspects of acceptable quality assurance programmatic requirements, one important shortcoming of the regu-

latory program arises from the absence of a definition of "safety-related," a concept central to the entire structure. Although Appendix B contains numerous references and applications of "safety-grade equipment," "safety-related equipment," and "equipment required for safety-related functions," NRC regulations contain no definition of "safety-related" or comparable terms. No other general regulatory guidance for defining or applying these terms is found and NRC staff members have different interpretations of these terms. Failure to define "safety-related" has restricted the scope of the NRC's quality assurance programs. Identification of particular "safety-related" structures, components, and systems is the responsibility of the applicant utility. The absence of definitional guidance supports the applicant's narrow interpretation and, correspondingly, decreases the staff's ability to insist that a particular system or function is "safety-related."

"This lack of clarity has generated staff disagreement concerning the identification of equipment to which Appendix B should be applied and concerning the differences and similarities between Appendix A, which applies to components that are "important to safety" and require a graduated quality standard, and Appendix B, which imposes a higher quality standard on the systems and functions to which it applies. This disagreement has frustrated efforts to formulate a regulatory guide for implementing Appendix B."

Regarding the applicability of quality assurance programs, the EDO stated in SECY-82-352:

"Current rules are not specific on whether or not a licensee or permit holder is required to notify the NRC of changes to the quality assurance program description previously accepted by the NRC in the Safety Analysis Report (SAR). Additionally, current regulations do not explicitly require licensees or permit holders to implement the accepted NRC SAR quality assurance program description. Rulemaking action is currently in progress which will clarify the NRC staff position regarding the types of changes to the licensees' and applicants' quality assurance program descriptions that can be made without informing the NRC and clarify, in the regulations, the requirement to implement the accepted quality assurance program description."

The NRC should more clearly define the applicability of quality assurance program requirements in regulations.

3.4.2.3 Prescriptiveness

Regulations concerning quality assurance have not been sufficiently prescriptive to assure their clear understanding by the nuclear industry, the AEC and the NRC. Because both Appendix A and Appendix B of 10 CFR 50 were vague and contained undefined subjective terminology, there were misunderstandings and differences of opinion in what the requirements were and how to comply with them. As a result, the Gray and Green Books, Safety Guides and later Regulatory Guides were established to clarify the AEC and NRC positions.

In 1973, it was recommended to the Director of Regulation (Davis and Brown 1973) that Regulatory explain precisely what the key QA criteria for design and procurement mean. Davis and Brown reported:

> "Some utilities do not know how to implement the 18 QA Criteria. These utilities understand the intent of Appendix B, but, without further guidance from the AEC, they continue at a loss to put them into effect. This has been a problem since the AEC adopted Appendix B, and many of the persons we interviewed emphasized it. One industry representative, for example, stated that both the AEC and the industry have 'all along been fumbling to explain the criteria'."

> "Until the 1972 reorgnization, the development of standard to explain the application of Appendix B was not keyed specifically to the practical needs and priorities of Licensing and Regulatory Operations. Substantial efforts have been made since that time to improve this situation by obtaining greater involvement of these Directorates in the development of standards; but, there is still not sufficient interplay among the Directorates in the entire standards-setting process."

In 1976, the Advisory Committee on Reactor Safeguards wrote to the chairman of the NRC (Moeller 1976):

> "An increased effort between the NRC and appropriate code or standards groups to develop better criteria and codes or standards comparable to the ASME Nuclear Codes for fire prevention, for electrical systems, and for other safety-related components, is desirable. Current requirements often are ill-defined and amorphous so the "inspector" lacks adequate criteria to determine acceptability. Until these criteria are better defined, there will continue to be confusion concerning acceptable limits as evaluated by the NRC-IE organization."

The difficulty in determining whether a quality assurance requirement is applicable to a particular situation is compounded by the necessary cross references required between the Standard Review Plan, the Safety Analysis Report, the industry codes, the regulations and the Regulatory Guides.

Licensees, in compliance with Appendix B of 10 CFR 50, pass quality requirements on to their contractors and vendors. This typically includes a requirement to implement a quality assurance program that complies with Appendix B of 10 CFR 50 for safety-related items. With approximately 1,000 vendors involved in supplying safety-related items to construction sites, a wide variety of interpretations of requirements has resulted. Normally, quality requirements passed on to vendors have not required or even referenced Regulatory Guides as a source of guidance to the vendors. They have, however, often required compliance with or referenced ANSI Standards.

Utilities, contractors and NRC Regional personnel contacted during this study stated that new regulations are not required, but that better definition of requirements in existing regulations and guidance is necessary. Regulations must be clear and criteria must be well defined. Regional personnel stated that:

- the NRC needs to put some teeth into ANSI standards or Regulatory Guides
- Technical Specifications and the Standard Review Plan need to be upgraded
- existing regulations fail to adequately address timeliness of activities and corrective actions
- requirements are vague enough to permit licensee interpretation to fit their needs at any given time
- regulations have encouraged slow decisions within the NRC (it may take a year to resolve a 50.55(e) finding after it has been reported)
- clear definitions of safety-related items and items important to safety are needed.

The NRC should better define requirements in regulations to assure their clear understanding.

3.4.2.4 Guidance Documents

Guidance documents are not mandatory and have not been sufficiently prescriptive to assure their clear understanding by the nuclear industry, the AEC and the NRC. The Safety Guides and Regulatory Guides adopted industry standards, either in whole or in part. Industry Standards were written by the nuclear industry and tended to reflect the state of the art, not necessarily stringent requirements that might be necessary to assure the health and safety of the public. Guidance documents heavily contain the word "should" and not "shall". Even though utilities commit to using the Gray and Green Books and Regulatory Guides in their Preliminary Safety Analysis Report, confusion has resulted when inspectors tried to verify compliance. Utilities have agreed they committed to use the guidance documents and have then argued it is just guidance and is not even considered mandatory by the AEC or NRC. The need to hold conferences and meetings to define requirements and the need to produce so many industry standards, and guidance documents indicates the regulations themselves have not been in sufficient detail to assure their clear understanding.

3.4.2.5 Changing Standards

Many of the uncompleted nuclear plants have been under construction for a number of years. As a result, current reviews by the NRC may be against standards or regulations that were moderately enforced or non-existent six to eight years ago. With loosely written or reviewed safety analysis report requirements serving as a base, many arguments and discussions between the licensee and the NRC revolve around interpretation of the original commitments and agreements made by the licensee.

The situation is further exerbated by the so called ratcheting or backfitting requirements. With an increasing number of plants becoming

operational, the experience and knowledge level of the NRC has increased. As a result, efforts have continually been made to increase the safety and reliability of the plants under construction and in operation. However, there is a need to establish more stability in the regulatory process. From 1970 through 1979, there were a total of 216 regulatory criteria issued or changed. Design changes and construction modifications made to meet the criteria resulted in longer construction time and more opportunities for errors. Utilities and contractors indicated during the NRC Case Studies that the cost of a nuclear plant had increased significantly in the last 10 to 15 years as a result of AEC/NRC requirements. They questioned whether all the requirements and retrofits were really necessary. They indicated there was too much uncertainty in the regulatory process and there were constantly changing targets. Regional personnel indicated that as construction times increased, there were problems resulting from changes in site personnel and procedures. The quantity of criteria changes indicates insufficient preventive action and planning.

The NRC needs to devote greater attention to preventive action and planning and to establish stability in the regulatory process.

While discussing the effect changing regulations and standards have had on the nuclear industry, it must be kept in mind that two different environments currently exist. The plants now under construction have been built during a period of learning and understanding the beneficial effects of an effective quality assurance program. The requirements have been and will continue to be changing. Therefore, the end result will be somewhat less than had the current requirements been in effect throughout the entire project. We must not judge the entire developing program by the standards we have today.

The next generation of nuclear plants will have the benefit of many man years of construction quality assurance experience. It is vital that the knowledge and understanding gained to date be properly incorporated in the NRC requirements for future nuclear installations.

3.5 LICENSING PROGRAM FOR ASSURANCE OF QUALITY

3.5.1 Description

Prior to 1970, the AEC performed little review of applications before issuance of permits and there was no documented guidance for reviews of Quality Assurance Programs.

Following issuance of Appendix B of 10 CFR 50, the AEC developed a Quality Assurance Program Review Checklist for Nuclear Power Plants and used it in their review of applications. The checklist was based upon Appendix B requirements and provided guidance through defining what was to be included in Quality Assurance Programs. The judgment of the individual reviewers was the determining factor in deciding if the quality assurance information in the application was adequate.

In 1971, 10 CFR 50.34(a)(7) became mandatory requiring applicants to submit a description of their Quality Assurance Program for design, procurement and construction in a Preliminary Safety Analysis Report (PSAR) to the AEC. The program had to satisfy the requirements of Appendix B of 10 CFR 50.

In 1973, it was recommended to the Director of Regulations (Davis and Brown 1973) that:

> "Regulatory docket an application only if the utility has a satisfactorily implemented QA Program for existing design and procurement activities and Regulatory upgrade its mini-review of the program."

At that time, the AEC Regulatory Staff initiated the practice of refusing to docket a Construction Permit application until it was determined that it was complete enough to permit substantive review. The reviews performed of the Quality Assurance Program descriptions were primarily a screening for completeness.

In 1973, regulatory procedures were issued which included review by the Directorate of Licensing of the applicant's QA Program description as it applied to design and procurement activities for satisfying requirements of Appendix B of 10 CFR 50. Inspection by Regional Offices of the implementation of the QA Program for these activities was also started.

Regulatory Guide 1.70 was issued covering the preparation of Safety Analysis Reports and included a Standard Format for the Content of Safety Analysis Reports. Chapter 17.0 indicated that the applicant was to provide a description of the Quality Assurance Program which he intended to establish and implement during design and construction. The program was to be started at the earliest practical time consistent with the schedule for accomplishing the activity and the applicant was to provide a schedule for implementation of the portions of the program not yet established at the time the PSAR was prepared. The program was to address each criteria of Appendix B of 10 CFR 50 and could reference appropriate portions of other sections of the PSAR.

In an effort to further define the Quality Assurance Program requirements, the Rainbow Books were issued in 1974. Each book covered a different area of quality assurance -- gray - design and procurement; orange - operations; and green - construction. The books were intended to provide guidance for establishing and implementing an acceptable Quality Assurance Program. The PSAR was to specifically state which portions of the books were used. The applicant was to indicate any specific alternate methods of accomplishing the Appendix B objectives that were not in conformance with the recommendation of the Rainbow Books.

In 1975, the NRC issued a Standard Review Plan to be used as a reference for evaluating the applicant's PSAR submittal. It also served as a guide which the applicant could use during the preparation of the PSAR. Chapter 17 established the criteria to be used in approving the applicant's Quality Assurance Program. The Plan has been modified several times to reflect the changing conditions in the industry.

In 1979, after the Three Mile Island incident, the NRC added Chapter 13 to the Standard Review Plan. Chapter 13 required the applicant to include information in the PSAR about the organizational structure that was to be used during the construction and operation of the facility. Included was to be a description of the corporate management structure and controls. Further, the responsibilities and duties of any technical staffs was to be stated. There was to be a description of the applicant's past experience in design and construction of nuclear plants or projects of equal magnitude. A program for planning and implementing design and construction activities and responsibilities was to be included. The applicant was to identify the general qualification requirements for certain specified positions or classes of positions as well as assigned management and supervisory positions. Required educational backgrounds and experience was to be included for each position.

3.5.2 Analysis

3.5.2.1 Guidance Documents

Prior to 1970, there was no documented guidance for licensing review of Quality Assurance Programs before issuance of permits. Following issuance of Appendix B of 10 CFR 50, early guidance documents for reviews of Quality Assurance Program descriptions indicated that neither the complete program nor a detailed description of how the applicants commitments were to be implemented had to be described. The Quality Assurance Program Review Checklist stated:

> "It should also be noted that the applicant is required to submit only "...a description of the quality assurance program..." and not the full program documentation. An appropriate designation for this description of the QA program is the "Quality Assurance Program Plan"; however, the use of this term is not mandatory."
>
> "The QA Program Plan presented in the PSAR should contain sufficient information to enable to reviewer to decide whether an appropriate basis has been established for a detailed QA program which meets the requirements of Appendix B. DRL approves the QA program at an early stage, before it is completely documented,

solely on the basis of a description of the program (Quality Assurance Program Plan). Later the detailed QA program (QAP) and its implementation will be under the surveillance of CO. If the QA program or its implementation fails to meet the requirements of Appendix B, this will be duly noted by CO and brought to the attention of DRL. This relieves DRL of a time-consuming review of a detailed program and permits the applicant to set up the program in the course of coordinating the operations of the participating organizations in the project at the appropriate stages."

Guidance for Submittal of Quality Assurance Program Description - Section 17 of PSAR stated:

"To demonstrate the framework for the implementation of 10 CFR 50 Appendix B criteria, a listing of the QA Program procedures which describe the implementation of each of the 10 CFR Part 50 Appendix B criteria, should be provided in the PSAR and identified to the applicable corresponding criterion. In the event that certain required procedures are not established a schedule for their preparation should be provided in the PSAR."

The Standard Review Plan issued in 1975 required evaluation of the entire Quality Assurance Program description included in the PSAR. Section 17.0 of the Standard Review Plan states:

"Prior to docketing a CP application, the NRC performs a substantive review of the applicant's QA program description relative to ongoing design and procurement activities."

"The pre-docketing substantive review places particular emphasis on the areas of organization, QA program, design control, procurement document control, and audit. The application is not docketed unless the established and implemented program in these areas has no substantive deviation from NRC QA guidance applicable to activities conducted prior to docketing."

"Where an NRC-accepted QA topical report is referenced in the application, the referenced QA program is not re-reviewed except for conformance to the applicable Regulatory Guides in effect at the time of tendering the application. For the case of CP applications referencing a standard design that includes an approved QA program directly or by reference, the applicant need not conform to new Regulatory Guides unless they contain regulatory positions determined to be significant to safety."

"The QAB review, after docketing, covers the QA controls to be applied by the applicant and principal contractors to activities that may affect the quality of structures, systems, and components important to safety. These activities include site testing and evaluation (starting with evaluation of exposed excavated surfaces, soil compaction, and testing), designing, purchasing, fabricating, constructing, handling, shipping, storing, cleaning, erecting, installing, inspecting, and testing. This review extends to the determination of <u>how</u> the applicable requirements of the eighteen

criteria of Appendix B to 10 CFR 50 are satisfied by the proposed QA program."

"The acceptance criteria include a commitment to comply with the regulatory positions presented in the appropriate issue of the Regulatory Guides including the requirements of ANSI Standard N45.2.12 and Branch Technical Position listed in subsection V. Thus, the commitment constitutes an integral part of the QA program description and requirements. Exceptions and alternatives to these acceptance criteria may be adopted by applicants provided adequate justification is given; the QAB review allows for considerable flexibility in defining methods and controls while still satisfying pertinent regulations. When the QA program description meets the applicable acceptance criteria of this subsection or provides acceptable exceptions or alternatives, the program is considered to be in compliance with pertinent NRC regulations."

The applicant and its contractors were to prepare Quality Assurance Manuals and implementing procedures to fulfill commitments made in the PSAR and to describe the actual program in more detail. The responsibility for reviewing the more detailed Quality Assurance Manuals and implementing procedures to determine if the program to be used complies with the requirements of Appendix B of 10 CFR 50 had been assigned to the Regional Offices.

3.5.2.2 Quality Assurance Program Review

Reviews of Quality Assurance Program descriptions have primarily consisted of determining the completeness of PSAR commitments in meeting the requirements of Appendix B of 10 CFR 50.

A study in 1980 (NUREG/CR-1250) contained the following appraisal of PSAR reviews:

"The review conducted by the Quality Assurance Branch (QAB) in NRC's Division of Project Management is limited to an evaluation of the description of the applicant's QA program in the PSAR and FSAR, and an assessment of whether that proram complies with the 18 criteria of Appendix B. However, no attempt is made by the QAB to determine how or to what extent the QA programmatic requirements are applied. This determination is left to the discretion of the applicant, who is responsible for identifying safety-related items, determining the extent that QA requirements are applied to these items, identifying the activities to which Appendix B applies, and imposing QA requirements on its contractors and vendors. The majority of the applicant's QA programs are found in its implementation procedures, which are not even submitted to the NRC for review or approval. These implementing procedures, which constitute several volumes of documents, are retained by the utility."

"The QAB does not review the applicant's procedures that implement its QA program. Review of implementation is the responsibility of IE. However, IE does not review the substance of the utility's procedures to determine their adequacy or to give NRC approval. The IE review assumes that the utility's procedures for

implementing its QA program are adequate, and simply attempt to determine whether they are being followed."

Contrary to the above, regional personnel generally indicated during this study that adequacy of Manuals was reviewed in addition to their compliance with PSAR commitments. However, there were difficulties in determining between commitments and requirements and personnel did not receive training in how to review the Manuals. Procedures were reviewed by project inspectors on a sample basis and the procedures reviewed were documented in inspection reports. There was no formal overview performed to assure all appropriate procedures were reviewed prior to permitting work to proceed.

NRC regulations have not required the QA Program to be included as a condition of the permit and once Licensing approved the PSAR, submittal of changes to the Quality Assurance Program description, for Licensing's review and approval, were not required. A regulation change in 1983 requires that changes to Quality Assurance Program descriptions in PSAR's be submitted to Regional Offices for review. If in the opinion of the licensee, a reduction of commitment to quality occurs, then changes must be submitted prior to their use. Otherwise the licensee has one year in which to make the submittal. Permitting the licensee to make such a determination may result in differences of opinion between the NRC and licensee after the fact. The NRC should consider requiring submittal of all changes for NRC acceptance prior to their use.

Regional personnel stated during this study that there is a great lack of uniformity in what is required during the PSAR review from one reactor to another, especially in the Q-Lists defining safety-related systems, and that too much depends on the whims of the NRC Project Manager and what the licensee is able to negotiate or get by with in the licensing process.

Opinions were expressed that applicants were allowed to do an excessive amount of general design work and purchasing of major components prior to submittal of the PSAR. The applicant's Quality Assurance Program in effect during this period of time has not been reviewed until submittal of the PSAR. Considerable pressure could be placed on Licensing to accept a less than satisfactory applicant Quality Assurance Program if the major components were partially fabricated or areas of design completed. It was suggested that the NRC be involved at the very start of the applicant's work.

3.5.2.3 Management Capability

The NRC has not placed sufficient importance on licensee and contractor attitude and management capability. In 1973, it was reported to the Director of Regulations (Davis and Brown 1973) that:

> "The AEC's visible QA efforts date back to the mid-1960's, and there has been some success: a growing number of utilities have responded with improved QA programs. However, it is clear that this success has been gained only through the continuous efforts of the AEC with the utility industry. It is indeed fair to conclude that, throughout this period, status quo considerations have strongly influenced the utilities' attitudes on QA. Today, virtually all

utilities are aware that QA is important--but there is still no widespread sense of urgency."

"Some utilities are not philosophically committed--with attitude and resources--to a high level of QA. They do not acknowledge that nuclear technology is in substance different from conventional power technology, and that a new order of management involvement is required. These utilities have successfully constructed and operated fossil fuel plants with unstructured QA programs. They believe that these programs are equally applicable to nuclear reactors."

Following Three Mile Island, it was reported in 1979, (NRC 1979) that: "There is little I&E assessment of the utility's management capabilities."

In an analysis of the experience at problem plants, the EDO stated (NRC 82) that primary problems included:

- "failure of the project management team to provide adequate management controls to prevent a significant breakdown in quality from occurring"

- "failure of the owner's quality assurance program to detect the breakdown in a timely manner and to obtain the necessary corrective action"

He also stated:

"The problem areas are fundamentally derived from a lack of total management commitment to quality at the nuclear projects inception. This lack of commitment has been exacerbated by the lack of understanding of the role of quality assurance in project management and the lack of total understanding of what is required by personnel at all levels of the process."

"Historically, the NRC's licensing and construction inspection programs have not sufficiently examined the project management controls at sites under construction, but have been oriented towards establishing adequacy within major technical and functional areas, e.g., concrete, electrical, etc. The systematic assessment of management performance and evaluation of all other available information have not received the same level of effort as operating sites."

The NRC Case Studies have revealed that the NRC has not sufficiently evaluated whether licensees and their contractors had the experience, knowledge, staffing or ability to effectively manage the design and construction of a commercial nuclear power plant.

Several adverse comments were received about the vague subjective terminology used in Standard Review Plan 13.1.1-Management and Technical Support Organizations. Phrases such as "clear unambiguous management control and communications exist between organizational units" and "substantive breadth and level of experience and availability of manpower to implement the responsibility for the project" used as acceptance criteria makes evaluation on a

uniform basis difficult. Evaluation criteria for management and all elements of Quality Assurance Programs need to be prescriptive enough to permit a meaningful review.

3.6 INSPECTION PROGRAM FOR ASSURANCE OF QUALITY

3.6.1 Description

3.6.1.1 General

Prior to 1968, the AEC performed little inspection at nuclear power plants under construction. Few inspection procedures and minimal guidance were available to inspectors. There were 4 or 5 inspectors in each Region (a total of about 20 inspectors) who had nuclear research or nuclear navy experience and were expected to know how to perform adequate inspection.

As a result of many quality related problems at nuclear power plants, including serious problems at Oyster Creek, the AEC recognized a need to look at construction activities and develop more formalized programs. The AEC moved inspectors from operations to construction and later hired personnel with construction background. As the number of inspectors increased, the need arose for more guidance. The AEC began developing a "General Facility Under Construction Inspection Program" and writing inspection procedures. In late 1969, the AEC issued a directive to implement the procedures.

In the early 1970's as Appendix B of 10 CFR 50 became mandatory, there was lack of coordination between the existing inspection procedures and requirements of Appendix B. In 1972, a procedure titled "QA During Design and Construction" was issued addressing Appendix B of 10 CFR 50 and requiring a review of the licensee's Quality Assurance Manual, a meeting with corporate utility management, and an initial inspection subsequent to docketing a Construction Permit application. In 1973, procedures were issued covering pre-docketing and pre-construction permit inspections. The AEC initiated preparation of a more comprehensive inspection program, which was later taken over by the NRC and issued in 1975 as the Inspection and Enforcement Manual.

The NRC used regionally based inspectors to implement the construction inspection program. A generalist inspector, possessing a broad range of technical knowledge and often specific expertise, had overall responsibility for a given plant and assisted in inspecting other plants. Specialist inspectors expert in specific technical areas conducted inspections in their technical specialties at the various plants within their Region. A minimum of six inspections a year were to be performed at construction sites. Until the incident at Three Mile Island, inspections tended to be oriented toward documentation and records review. In 1979, inspection orientation began moving more towards hardware and results.

As a result of numerous problems at construction sites, the NRC regionally based inspection program was criticized for too few inspections, too little of an inspector's time being spent on site, too much onsite time being spent reviewing records instead of observing work in process or conducting independent measurements and tests, and too little evaluation of licensee performance with appropriate NRC response. A General Accounting Office report (GAO. 1978) stated:

> "We believe that NRC's inspection process needs to provide a more thorough and independent evaluation of the quality of

powerplant construction work. Without such an evaluation, NRC has to rely to an undue extent on the credibility or validity of evaluations made by utility companies. Thus NRC's inspection program cannot independently assure that nuclear powerplants are constructed adequately. The following simple description of the enormity of nuclear powerplant construction activities and the current NRC inspection level underscores our position."

"Seventy-eight nuclear powerplants are now in various stages of construction. A typical powerplant construction site may involve several thousand construction workers and supervisory personnel--in many cases, working 24 hours a day, 7 days a week. A single powerplant requires making about 25,000 welds, pouring about 360,000 tons of concrete, and using 726 tons of copper and 34,662 tons of iron. Many complex electrical and computerized systems are also involved."

"In answer to our questionnaire to NRC inspectors, the 63 respondents indicated that collectively they each spend only about 22 percent of their official working time, or about 50 days per year, at construction sites. They further indicated that they used only about 34 percent of that time (about 16 days per year) to determine for themselves the quality of construction by performing or observing tests of completed construction work, observing construction work in progress, and talking with construction workers. Therefore, in 1 year, all 76 NRC construction inspectors and supervisors spent about 1,216 staffdays--or about 5-1/2 staffyears effort--in direct inspection work. At each of the 78 powerplants then, NRC's annual direct inspection is about 16 days."

"For most of the past 2 years, however, NRC has been reevaluating its inspection philosophy and approaches. It recognizes many of the shortcomings of the present system, such as the limited amount of direct inspections and verification and the limited time its inspectors spend onsite observing construction work and talking with construction workers. NRC is evaluating the need to perform some type of independent verification of the quality of construction work and is instituting a program to assign resident inspectors to powerplant sites--both under construction and in operation. This, NRC anticipates, will increase an inspector's onsite inspection time from about 22 percent to 75 percent, will permit greater observation and surveillance of construction activities, and will make its inspectors more accessible to construction craftsmen."

"NRC plans to have 20 such inspectors at plant sites by October 1978. Five of these will be assigned to powerplants under construction. Depending on congressional approval, NRC plans to expand the program and provide a resident inspector at every powerplant in operation or under construction by 1981. Currently, a request is before Congress for a supplemental appropriation in fiscal year 1978 to provide 61 people and $2.65 million to get the program started. These people have to be hired now, according to NRC, because it will take a minimum of 2 years of training and experience before they are qualified to take over a resident site. In the meantime, existing NRC inspectors will fill the resident positions."

Due to budgetary restrictions, plans did not envision putting a resident inspector at a construction site until the later stages of construction, when the critical safety-related construction work was being done.

In 1978, the NRC began revising the inspection program. The objectives remained the same but the means of achieving them changed.

Resident inspectors were placed onsite on a full time basis to increase the amount of time spent directly verifying licensee activities and performing independent measurements and to motivate licensees to improve their performance. Resident inspectors were placed at operating plants during 1978-1980 and at construction sites in 1980. The resident is the principal inspector for the site and is supported by specialist inspectors at the Regional offices. Regional offices provide supervisory and administrative support and process noncompliances found by the residents. The current policy is that every construction site have one resident and every operating site have one resident for each operating plant. Residents file a monthly summary inspection report with headquarters and regional inspectors file trip reports.
Residents perform both planned and reactive inspections, with planned inspections budgeted for two-thirds of the inspector's time and reactive inspections budgeted for one-third of the time.

In addition to the resident inspectors, the NRC initiated the following inspection activities:

- Performance Appraisal Teams in 1978 to obtain a National perspective of evaluating the effectiveness of the inspection process, assessing licensee performance, and evaluating the objectivity of residents
- Systematic Assessment of Licensee Performance in 1979 to provide an annual review of regulatory performance of licensees
- Construction Assessment Teams in 1980 to provide periodic in-depth inspections of the overall construction project
- Independent Design Verification Program in 1981 to verify design
- Integrated Design Inspection in 1982 to verify the implementation of the licensee's quality assurance program during the design process

A more detailed discussion of the elements of the inspection program follows.

3.6.1.2 Pre-CP Phase

The Light Water Reactor Inspection Program - Pre-CP Phase, issued in May of 1975, is applicable from the time the NRC receives formal notification of a utility's intentions to build a plant, up to issuance of the construction permit. Principal areas covered include inspection of the establishment, execution and administration of the QA Program relating to Preliminary Safety Analysis Report development, design, procurement and construction.

The Light Water Reactor Inspection Program (NRC 1975) provided for examination of objective evidence to determine whether the applicant, consultants, and the constructor have placed into effect:

- Planning and scheduling necessary to assure timely implementation of organizational staffing, procedures and instructions, quality assuring activities and administrative controls consistent with NRC requirements and the description of the quality assurance program provided in the application for a construction permit.

- An implemented quality assurance program consistent with NRC application requirements, which has translated the PSAR commitments into an aggregate collection of procedures and instructions (QA Manual), and is being executed as required for each organization performing and/or verifying the attainment of quality objectives established for the design, procurement and construction of safety-related structures, systems and components of the nuclear facility.

- The means to ascertain and document the adequacy and utilization of procedures and instructions necessary to achieve quality objectives.

- The means to evaluate and document the effectiveness of the implemented quality assurance program for each organizational element assigned responsibility for attainment or verification of safety-related quality objectives.

Until docketing of the application, the inspector was to use the "Guidance on Quality Assurance Requirements During Design and Procurement Phase of Nuclear Power Plants" (Gray Book) as guidance in evaluating activities. After docketing he was to use the PSAR commitments. QA Manual inspection was to be performed at the Regional Office prior to conducting implemention inspection.

Inspection Procedure 35100B (Review of QA Manual), issued in March of 1975, had the objective of ascertaining whether quality assurance plans, instructions and procedures have been established in the QA Manual and conform to PSAR commitments for organizational structure and QA personnel, audits, quality requirements, work and quality inspection procedures, control of material, control of processes, corrective action, document control, test control and control of test equipment and quality records.

Inspection procedure 35003B (QA Manual Review), issued in May of 1975, had the objective of providing for uniform application of IE inspection requirements when reviewing and examining procedures and instructions of the implemented QA Program. The inspector was to complete review requirements of the procedure only when another procedure of the LWR Inspection Program Pre-CP Phase or other MC 2500 program referenced the procedure as a requirement for that inspection activity. The procedure referenced three attachments to be considered in reviewing the QA Manual of the applicant where major elements of the applicant organization perform a significant part of design, procurement and construction but identified all three as being under development. The same procedure is currently in the IE Manual without the specified attachments. Enclosure 1 to the procedure was identified as partially completed and still exists in that same form.

Inspection Procedure 35016B (Initial Pre-CP QA Inspection), issued in May of 1975, had the objective of determining if the establishment and execution of the quality assurance program for activities of design, procurement and planning for construction was consistent with the status of the project and the program described in the application. A Quality Assurance manual review was to be performed during the fourth month after docketing and an inspection of program implementation was to be performed following the manual review.

Inspection Procedure 35004B (Initial Predocketing QA Inspection), issued in October of 1976, had the objective of determining if the establishment and execution of the quality assurance program relating to criteria I-VII and XVI-XVIII of Appendix B of 10 CFR 50 was being implemented consistent with the status of activities of PSAR development, design and procurement without substantive deviations from NRC QA guidance for design and procurement. A Quality Assurance Manual review was to be performed with deficient findings forwarded to IE headquarters for submittal to NRR before the application was tendered. If serious deficiencies did not exist, an inspection of the program implementation was to be performed and results were to be forwarded to IE headquarters for submittal to NRR.

Inspection Procedure 35012B (Second Predocketing QA Inspection), issued in July of 1975, had the objective of repeating initial predocketing activities for areas determined deficient after applicant corrective action.

Implementation reviews were to include availability of instructions, understanding of their content and purpose by personnel using them, establishment of in-process and permanent files for records, acceptable implementation of the program, and consistency of the planning and scheduling of program implementation with engineering schedules.

Inspection Procedure 35100 (Review of QA Manual) issued in 1983 has the objective to determine whether quality assurance plans, instructions, and procedures for specific safety-related activities have been established in the QA Manual and implementing procedures and whether these documents conform to the QA Program as described in Chapter 17 of the facility Safety Analysis Report (SAR). The review is to be performed by the inspector, who is to refer deficient items to the Region for resolution.

3.6.1.3 Construction Phase

The Light Water Reactor Inspection Program - Construction Program, issued in March of 1975 and effective in October of 1975, is applicable from the time a Construction Permit or Limited Work Authorization is issued until issuance of an Operating License. Final activities of the program overlap with the preoperational testing and operational preparedness phase activities, which are covered by another program.

Upon notification that a utility intends to seek a license for construction of a nuclear power plant, the NRC meets with the utility to describe the NRC inspection program and procedures and gives the utility a copy of the NRC Standard Review Plan to be used in the review of the utilities Preliminary Safety Analysis Report (PSAR).

Upon receipt of an application for a Construction Permit and the PSAR, the NRC reviews PSAR commitments for compliance with regulations and accepts or rejects the application. The Division of Licensing of the Office of Nuclear Reactor Regulation directs a program for safety and environmental review and evaluation of applications, including a review of organizational structure of the utility, qualification of management and acceptability of the Quality Assurance Program description.

Following acceptance of an application, Inspection and Enforcement performs a review of implementation of the organizational structure and management controls over design, procurement and project management of the utility, Architect Engineer (AE) and Nuclear Steam System Supplier (NSSS) to ensure programmatic controls are in place prior to their use. If the same AE or NSSS was recently reviewed on another project, it has not been necessary to review them again.

If a Limited Work Authorization is requested, the implementation review includes verification of capability to perform the work identified in the request.

During design, procurement and construction activities, Inspection and Enforcement's efforts have been about equally divided between reviewing programmatic controls, observing work in process and reviewing records. As a result of criticisms of looking too much at paper and not enough at hardware, the emphasis has changed to expending 60% of the effort observing work and 20% of the effort in reviewing programmatic controls and 20% in reviewing records.

The Inspection Manual consists of inspection modules prepared by Inspection and Enforcement at headquarters and provides a framework for inspection. Inspections are performed to the commitments of the licensee, which can be a different vintage for different plants. As regulatory standards are upgraded, backfit is often required of older plants. Old plants then have mixtures of old and new standards to comply with. Implementation of changes in the inspection program is determined by the Regions based upon the construction status of the plant.

About two years prior to fuel loading, the NRC begins inspection of startup operational procedures. The project passes from construction to operations within the NRC at the time of hydrostatic tests and an additional resident inspector is assigned for preoperational and startup activities. The Division of Licensing reviews the Final Safety Analysis Report (FSAR) commitments for compliance with regulations. The preoperational inspection program consists of verifying implementation of FSAR commitments covering preoperational tests and startup, reviewing test procedures, witnessing tests, evaluating test results, and reviewing management control systems for operations. Normally the resident inspector assigned for preoperational and startup activities becomes the resident inspector for operations.

At the end of preoperational activities, the Regional Administrator sends a report to the Office of Nuclear Reactor Regulation indicating the status of construction and preoperational and startup inspection programs, identifying a list of open items, recommending any conditions for the Operating License and stating the reactor can startup.

Following issuance of an Operating License, NRC holdpoints are established for fuel load, low power testing, power ascention testing, and full power testing. The resident inspector for operations performs operations inspections.

The objective of construction inspections is to ascertain whether construction and installation of safety-related components, structures and systems meet applicable requirements. Since inspection activities must be coordinated with construction activities, inspectors must be cognizant of construction status and must plan their inspections in the proper sequence of activities. Inspection procedures identify frequency of inspections and time frames for completion based upon milestones relating to the status of work activities. Inspectors are to conduct inspections outside the scope of the program and are to annually determine if QA Manual changes have been made and if such changes are appropriate and adequate. For multi-unit sites, inspection is required for each unit under construction. Records for material or items are to be reviewed prior to use or installation.

Limitations on construction inspection resources has precluded completion of all procedures at all sites. To provide guidance to inspectors concerning which procedures and portions of procedures should be completed, a Construction Inspection Program Priority Plan was established which varied emphasis on different facets during the construction period. The use of the plan was optional but preferred.

On the basis that the amount of inspection required to assure the same degree of confidence that construction was adequate would vary from site to site and that different types of activity at the same site may require varying levels of inspection to provide the same degree of assurance, Regional management has been permitted to modify the priority plan. Reductions or additions in inspections could be initiated by an inspector with concurrence of his supervisor.

Regional Section Chiefs have been responsible for the inspection program implementation and inspection status for their assigned plants.

The construction inspection program has been intended to provide the framework for managing resources without being totally prescriptive. Inspectors have been expected to apply judgment regarding the need to complete each line item of inspection procedures.

3.6.1.4 Performance Appraisal Teams

Performance Appraisal Teams (PAT) were established in 1978 to obtain a national perspective of evaluating the effectiveness of the inspection process, assessing licensee performance and evaluating the objectivity of residents.

Inspections were designed to determine how well all levels of licensee management and operational personnel understood and performed their duties.

Inspections were conducted through a series of interviews with both corporate and operations personnel, and review of licensee-generated records,

logs, and other documents. For each functional area examined, the PAT determined whether:

- the licensee had written policies, procedures, or instructions to provide management controls
- the policies, procedures, and instructions were adequate to assure compliance with NRC regulatory requirements
- the personnel with responsibility in any given area were adequately qualified, trained, and retrained to perform their duties
- the individuals assigned responsibilities in a given area understood their responsibilities
- the requirements for a given area were implemented to achieve full compliance and appropriately documented

As part of PAT, the NRC established the "Module Sample Performance Inspection" as the means of assessing the adequacy of the NRC's modular inspection program and to determine if the NRC's current sampling rates were adequate for detecting noncompliance. Inspections were performed for procedures previously performed by regional inspectors. The time period reviewed and the procedures used were identical to those used by the regional inspectors in every aspect except the sampling rate, which was much higher.

The NRC planned to have four teams of five or six personnel each, performing about six inspections a year and appraising each operating plant every three to four years. PAT activities were interrupted as a result of Three Mile Island and resumed in 1980. In 1981, there were two teams performing 10 to 12 inspections a year. In 1981-1982, the Institute of Nuclear Power Operations (INPO) initiated programs for inspecting operating plants every 15 months. The NRC entered into agreements with INPO, reviewed their program, participated in their inspections as observers and backed off the PAT program. Currently, there is one team performing 3 or 4 PAT inspections a year with the objectives being to assess Regional performance and the inspection program and to determine the effectiveness of INPO activities. PAT monitors INPO by reviewing their reports, talking to INPO personnel and performing inspections after INPO has performed their inspection at a site. PAT findings are followed up by Regional personnel.

The NRC requires corrective action for PAT findings within the NRC inspection program and presents findings outside the NRC inspection program as weaknesses without requiring corrective action.

3.6.1.5 Systematic Assessment of Licensee Performance

Following problems at Three Mile Island, the NRC initiated a program for Systematic Assessment of Licensee Performance (SALP), consisting of annual reviews of regulatory performance of licensees by a team of inspectors and regional supervisors involved at the site and headquarters personnel.

Chapter 0516 of the NRC Manual addresses the Systematic Assessment of Licensee Performance (SALP) program and identifies the objectives to be:

- to improve the NRC Regulatory Program with emphasis on resource allocation
- to improve licensee performance
- to collect available observations on an annual basis and evaluate licensee performance based on those observations.

The SALP assessment is intended to be sufficiently diagnostic to provide a rational basis for allocating NRC resources and to provide meaningful guidance to licensee management.

For construction activities, the functional areas reviewed are:

- soils and foundation
- containment and other safety-related structures
- piping systems and supports--including welding, NDE and preservice inspection
- safety related components--includes vessel, internals, pumps
- support systems--includes HVAC, radwaste, fire protection
- electrical power supply and distribution
- instrumentation and control systems
- licensing activities
- others (as needed).

For reactors in the preoperational phase, functional areas from the listing for either Operating Reactors or Reactors under Construction are selected as appropriate for evaluation.

The evaluation criteria are as follows:

- management involvement in assuring quality
- approach to resolution of technical issues from safety standpoint
- responsiveness to NRC initiatives
- enforcement history
- reporting and analysis of reportable events
- staffing (including management)
- training effectiveness and qualification.

The evaluation process is comprised of a SALP Board assessment, a meeting with licensee management to discuss the assessment, and issuance of the

report. To provide a consistent evaluation, attributes associated with each criterion are listed in the procedure to describe characteristics applicable to the three categories. The attributes are intended only as guidance.

Each functional area evaluated is assigned a Category. Not all functional areas need be covered in a given review. If a functional area appropriate to a licensee is not covered, the reasons are to be given in the report. The functional area being evaluated may have some attributes that would place the evaluation in Category 1 and others that would place it in either Category 2 or 3. The final rating for each functional area is a composite of the attributes tempered with judgment as to significance of individual items.

Performance Categories

Category 1. Reduced NRC attention may be appropriate. Licensee management attention and involvement are aggressive and oriented toward nuclear safety; licensee resources are ample and effectively used such that a high level of performance with respect to operational safety or construction is being achieved.

Category 2. NRC attention should be maintained at normal levels. Licensee management attention and involvement are evident and are concerned with nuclear safety; licensee resources are adequate and are reasonably effective such that satisfactory performance with respect to operational safety or construction is being achieved.

Category 3. Both NRC and licensee attention should be increased. Licensee management attention or involvement is acceptable and considers nuclear safety, but weaknesses are evident; licensee resources appear to be strained or not effectively used such that minimally satisfactory performance with respect to operational safety or construction is being achieved.

Regional Administrators are responsible for implementing the SALP Board assessment including the following activities:

- obtaining assessment data from NRR, AEOD and NMSS applicable to the appraisal period
- tabulating and analyzing the data obtained, including summary of numbers and types of inspections performed and findings, number of LER's submitted under each cause category, number of Construction Deficiency Reports and Part 21 reports submitted, abnormal occurrences, and number and nature of unplanned trips
- developing the performance analysis for each functional area
- conducting the SALP Board meeting with senior regional management, the NRR Project Manager, resident inspectors and others as determined by the Regional Administrator to review the analysis and supporting data and to develop the report
- conducting meetings with licensees to provide assessment findings to utility management

- after considering the licensee's oral and written comments, transmitting the report by letter to the licensee with the letter including a characterization of overall safety performance.

3.6.1.6 Construction Assessment Teams

In 1980, the NRC initiated Construction Assessment Team inspections to provide periodic in-depth inspections of the overall construction project by concentrating on the examination of safety-related hardware after installation and the licensee's inspection is completed. Objectives of the CAT program (NRC 1982. SECY-82-150A) are:

- to evaluate the effectiveness of design controls and construction practices used to ensure that as-built conditions are in accordance with the design basis

- to provide a means of monitoring the progress of INPO activities related to construction reviews performed by INPO and the INPO-sponsored utility self-evaluation program

- to assess the effectiveness of regional implementation of the IE inspection program at reactors under construction.

During 1980-1981, eight trial CAT inspections of two weeks onsite were performed by five man teams from Regional offices. The inspections obtained useful results but strained Regional resources and reduced normal inspection efforts. In 1982-1983, the CAT program was revised and CAT inspections are now performed out of headquarters by teams of Inspection and Enforcement personnel and consultants with Regional participation. A team consists of one leader and 10 engineers and consultants and spends two weeks at the site, one week at headquarters and two more weeks at the site. The NRC plans to perform four CAT inspections a year and is monitoring the INPO Construction Project Evaluation Program.

3.6.1.7 Independent Design Verification Program

The Independent Design Verification Program (IDVP) was created in 1981 as a method of design verification after a serious design error was discovered in a nearly completed nuclear plant.

Although originally intended to be a program to review the one error, the verification process revealed that other design errors had occurred at the same plant. As a result, the NRC concluded that other plants nearing completion should be considered for a design review. The NRC examines several factors about a licensee in deciding if a review is necessary. Included is previous plant construction experience of the licensee, architect engineer and constructor, the complexity of the design interfaces, the general plant construction record and the length of time since the Construction Permit was issued.

The qualifications of the Independent Design Verification team is carefully reviewed by the NRC. Technical competence and complete objectivity are of major importance.

The program, to date, has revealed some design inadequacies but nothing of major proportions. The NRC is currently using the IDVP approach as an interim one and intends to utilize the continuing IDI/CAT program for long term license review. The NRC does suggest that the licensees institute their own ongoing IDVP program for their own benefit.

3.6.1.8 Integrated Design Inspection

The Integrated Design Inspection (IDI) program was started in 1982 as a means to verify the implementation of the licensee's quality assurance program during the design process. IDI teams consisting of personnel from the Office of Inspection and Enforcement, Office of Nuclear Reactor Regulation, the applicable Region, and consultants spend about four weeks examining procedures records, and training of design personnel and inspecting a system as installed in the plant. Emphasis is placed upon reviewing the adequacy of design details as a means of measuring how well the design process functioned for the selected system. Sample systems are chosen from five major disciplines. Common areas with in these disciplines are examined for adequacy and consistency of design details.

The results of the IDI program are being used with similar information from the CAT program to evaluate the licensee's compliance to commitments. Three Integrated Design Inspections are currently planned per year and are to be performed midway through the plant construction period.

3.6.1.9 AEC and NRC Philosophy

The basic philosophy of the AEC and NRC has not changed significantly over the years. IE Office Procedure 0300 presents the current philosophy and policy upon which the IE program is based. The philosophy can best be stated that the industry is responsible for the safety of its activities and safeguarding of nuclear facilities and materials used in its operation and the NRC ensures the industry adequately discharges this responsibility.

Inspection is on a planned sampling basis with the focus on areas of greatest safety significance in order to evaluate the overall adequacy and effectiveness of licensee performance. Objectives of inspection are: to provide a basis for recommending issuance, denial, continuation, modification, or revocation of an NRC permit or license; to identify conditions within areas inspected that may adversely affect public safety; and to ascertain the status of compliance with NRC regulations, licenses and orders.

Enforcement actions are to ensure licensees comply with Commission requirements with a goal of making noncompliance more expensive than compliance. Objectives of enforcement are to assure maximum compliance practicable with Commission requirements through consistent application of reasonable enforcement actions in accordance with established and well understood procedures and to ensure that licensees who do not comply with regulatory requirements will promptly implement corrective action to do so.

Regional Administrators have the authority to modify the inspection program at individual facilities based upon licensee's performance during the SALP process. The scope, depth and emphasis of inspection is affected by the

program requirements in NRC rules and regulations, the relative safety significance of licensee functions and aspects of operations being inspected, and the budgeted inspector resources to perform the program.

Inspection requirements and guidance is expressed in the form of performance objectives and evaluation criteria.

3.6.1.10 Inspector Qualification

Inspectors receive regional, formal classroom and on-the-job training. Inspectors must attend required training classes or successfully complete a written equivalency examination. The passing grade for examinations is 70%. Training activities encompass regulatory, administrative and technical practices pertinent to each area of inspection. Self-study is required in the subjects of the Code of Federal Regulations, NRC and IE Manual Chapters, technical areas of inspection, methods and knowledge.

If regional management evaluates the background and performance of an individual inspector and concludes the inspector has demonstrated an ability to perform inspections in specific areas, it can authorize the individual to perform inspections in those areas while completing training.

Training at the site or regional offices consists of:

- Regional and/or Site Orientation
- Code of Federal Regulations
- Final Safety Analysis Report
- Regulatory Guides
- NRC/IE Manual
- Industry Codes and Standards
- Onsite Training
- Construction Inspection Accompaniments

Training at the NRC Technical Training Center consists of:

- BWR Technology Course
- PWR Technology Course
- Concrete Technology and Codes Course
- Welding Technology and Codes Course
- NDE Technology and Codes Course
- Electrical Technology and Codes Course

- Instrumentation Technology and Codes Course
- Fundamentals of Inspection Course

Optional courses, dependent upon the inspector's previous work experience and planned inspection activities, are required for performing inspections in specific areas. For resident inspectors in construction, optional courses consist of:

- Inservice Inspection Course
- Radiation Contamination Protection Course or equivalent plant training
- Quality Assurance Construction Course
- Quality Assurance Modifications Course

Personnel assigned as resident inspectors after January 1, 1984, must complete the training/qualification requirements for self-study, on-the-job training, and required training identified in the Regional Training and Qualification Journal.

Inspectors who have been trained/qualified under existing Regional Inspector Journals do not have to requalify under the Regional Training and Qualification Journal.

At the discretion of regional management, inspectors currently working to complete their training/qualification under existing Regional Inspector Journals may transfer appropriate self-study, on-the-job training, and required training courses to the Regional Training and Qualification Journal.

All newly hired personnel and new assignees are required to complete the required regional training activities or take and pass equivalency examination(s) within the first 24 months after being assigned.

Refresher training is required in concrete technology and welding technology every 48 to 60 months after completion of the concrete and welding courses and in NDE 36 to 48 months after completion of the NDE course.

3.6.2 Analysis

3.6.2.1 General

Inspection Programs of the AEC and NRC have evolved as a result of the learning process and in reaction to industry events.

- Prior to 1968, the AEC performed little inspection at construction sites.
- Following quality problems at construction sites, including Oyster Creek, the AEC formalized inspection programs.

- As a result of the Zion hearings in 1968, the AEC issued Appendix B of 10 CFR 50 in 1970, specifying quality assurance criteria.

- Two years after issuance of Appendix B of 10 CFR 50, the AEC issued an inspection procedure addressing its requirements.

- Three years after issuance of Appendix B of 10 CFR 50, the AEC issued procedures for pre-docketing and pre-Construction Permit inspections and developed a more comprehensive inspection program.

- Following the Browns Ferry Fire in 1975, the NRC developed additional programs for fire protection.

- Following problems at construction sites and criticism of the regionally based inspection program, the NRC began revising the inspection program in 1978 and initiated Performance Appraisal Teams.

- Following problems at construction sites and at Three Mile Island in 1979, the NRC initiated Systematic Assessment of Licensee Performance, Construction Assessment Team, Independent Design Verification, and Integrated Design Inspection programs.

Budget and manpower restraints have generally precluded completion of construction inspection programs. In recognition of this problem, the NRC established a Construction Program Priority Plan varying the emphasis on different facets of activity during the construction period.

The regionally based inspection program was changed in 1978 as a result of too few inspections, too much of an inspector's time being spent reviewing records instead of observing work in process or conducting independent measurements and tests and too little evaluation of licensee performance.

The current inspection program is being rewritten in recognition of budget and manpower restraints. A goal in rewriting the inspection program is to reduce it by 40% to bring it in line with available resources.

Regional personnel stated during this study that:

- the level of resources is inadequate for the inspection required

- completion of the inspection program has ranged from 60-70% to 90-100%

- inability to complete the program has resulted from diverting personnel from the program to perform reactionary inspections, investigate allegations and follow-up findings of team inspections and program evaluations (10 man-years of effort at one site and 14 man-years of effort at another site)

- diverting of personnel has resulted in missing inspection "windows of opportunity", periods of construction during which an inspection must be performed because it cannot be performed later (i.e., placement of rebar before pouring concrete)

- about 50% of the inspection program was being implemented at most sites in one Region as a result of diverting personnel to other sites

- a Construction Assessment Team inspection at one site took three times as many man-hours as was budgeted for program inspections for a year and it was expected follow-up activities would take as long.

The impact of investigating allegations of poor construction work on normal inspection work was reported in an earlier study (GAO. 1978).

> "Commission inspectors are spending more of their time investigating allegations of improper construction activities, often at the expense of their normal inspection activities. A new regulation requires utility companies to post notices informing workers that they may report suspected defective work to the Commission. This new publicity will increase the number of allegations received by the Commission. However, the Commission should review organizational elements and seek additional staff to investigate these allegations without disrupting the normal inspection work."

3.6.2.2 Pre-CP Phase

The AEC and NRC have done too little too late in the pre-Construction Permit stage. Pre-Construction Permit inspection activities are designed to verify the establishment, execution and administration of the quality assurance program relating to PSAR development, design, procurement and construction activities before issuance of a Construction Permit. Inadequate attention has been paid to design and the inspection program for design has not been changed two years after the problems at Diablo Canyon. General design work may be performed and major components may be purchased 18 months ahead of issuance of a Construction Permit, without prior review of the applicable Quality Assurance Program. Reviews of Preliminary Safety Analysis Report quality assurance commitments have been to assure completeness in addressing requiremehts of Appendix B of 10 CFR 50. Project Inspector reviews of licensee quality assurance manuals and procedures have been for ongoing work only and have tended to be cursory in nature in determining the compliance of management controls with PSAR commitments. Evaluations of licensee and contractor management have not been adequate to assure management had the ability to assure quality in design and construction activities. It was previously recommended to the Director of Regulation (NRC 1974) that inspection effort be increased in the management of QA inspection programs.

During this study, regional personnel stated that quality assurance manuals are so general that procedures can be changed by deleting requirements and yet still comply with the manual. There are also difficulties in differentiating between commitments and requirements and manual and procedures reviewers have received little training in how to perform their tasks. The review of manuals and procedures by a number of inadequately trained inspectors has produced inconsistent results.

The AEC and NRC have not made adherence to Preliminary Safety Analysis Report commitments a condition of the Construction Permit and until 1983 did

not require submittal of PSAR changes for acceptance. Once the PSAR was accepted by the NRC, licensees could change their commitments.

3.6.2.3 Construction Phase

Inspection programs have been viewed more as guidance than mandatory requirements. The AEC and NRC have relied on qualified engineers to use their best judgment in determining which inspections are to be performed and the degree of inspection necessary. During the 1960's and early 1970's, inspections were performed by inspectors with years of broad experience in research or Navy reactors using little procedural guidance. These inspectors were expected to have good engineering judgment and to know what to do and how to do it. As the number of plants to be inspected increased and more inspectors were required, additional guidance was provided through written programs. The inspection program permits Regional management to adjust the priority plan of inspection to meet the specific needs required at each site. This may cause the level of inspection activities to vary from site to site and different types of activities at the same site may receive varying amounts of inspection. Ultimately each inspector is responsible for determining the total inspection effort he feels is necessary.

The Reactor Inspection Program states:

> "The credibility of the inspection program is based upon completion of inspection procedures and the conduct of each procedure in a technically adequate manner."
>
> "Line items in inspection procedures reflect the collective judgment and experience of personnel responsible for program development and personnel responsible for program implementation. Line items are to be placed in the perspective of the objective of the inspection and considered in the inspector's evaluation of whether activities are safe and in compliance with requirements."
>
> "Failure to complete the inspection program is inferred that less than the desired level of assurance is obtained and the Division Director's decision to relax inspection program requirements is to be governed by whether the resulting level of safety assurance remains adequate to allow issuance of a license."

Implementation of inspection programs has varied among the Regions as a result of management's attitude toward regulations and programs and the capability of personnel. In some Regions, all problems are documented and reported to regional management, while in other Regions some problems are handled more informally at an inspector/craft level. Meaningful NRC data on inspection program implementation was difficult to obtain during this study. Regions which have tracked the status of the completion of inspection modules can produce computer printouts listing the modules implemented. However, the degree of implementation of the modules cannot be easily determined. As the inspection program has evolved over the years, it has been possible to inspect an area once, close out the inspection module as complete, and never go back and inspect that area again. Since many construction activities may extend for a period of years, personnel performing the activity and procedures may have changed. Initial acceptance of the adequacy of the activity does not

ensure continued adequacy. When plants drag out in time, this situation becomes more acute. Instructions to Regional personnel in implementing the inspection programs have varied. Some Regions have relied more heavily upon engineering judgment than paperwork while other Regions have placed more emphasis on paperwork. Portions of inspection modules may be worked over a long period of time by as many as four different inspectors resulting in a need for good recordkeeping so that each inspector is aware of the effort previously expended . Inspections of continuous activities generally need to be performed throughout the duration of the activities. Licensee and contractor personnel indicated during the NRC Case Studies that legality was often a matter of geography and compliance was a matter of where you are.

There is a general feeling within Regions that the inspection program has been too fragmented and more attention should be paid to meshing inspection requirements more closely with the construction schedule.

3.6.2.4 Performance Appraisal Teams

To supplement the resident inspection program, and to obtain a national perspective of inspection activities, Performance Appraisal Team inspections were initiated. The Performance Appraisal Team Program has been an effective method of measuring one aspect of operating plant performance. The program does not apply to plants under construction. Most of the subjects covered during the review relate to the licensee management and are therefore not covered during the normal inspection program.

Due to budget and manpower restraints, the program has not been implemented as intended and has been modified to utilize INPO efforts. The use of INPO teams with NRC observers and later spot follow-up of an NRC team has been successful.

3.6.2.5 Systematic Assessment of Licensee Performance

The Systematic Assessment of Licensee Performance is an annual review of licensee performance by inspectors and supervisors involved at the site and by headquarters personnel. Available observations on licensee performance is collected and evaluated to provide a rational basis for allocating NRC resources and to provide meaningful guidance to licensee management. While being a trend analysis of licensee performance, SALP is limited in effectiveness to the available observations. If the observations are inadequate or misleading, the SALP results will also be inadequate or misleading.

3.6.2.6 Construction Assessment Teams

To provide periodic in-depth inspections of overall construction, the NRC initiated Construction Assessment Team inspections in 1980. These inspections concentrate on examination of safety-related hardware after installation and license inspection is completed. The inspections have obtained useful results but have been resource intensive. Initial CAT inspections were performed by Regions and reduced the normal inspection efforts by diverting personnel to the CAT inspections. Now personnel for the inspections is furnished by headquarters. Performing follow-up activities resulting from CAT findings has

been found by regional personnel to take as much time as was spent in performing the original CAT inspection. Current inspections are taking five weeks to perform. At one site, the CAT inspection took three times as many man-hours as was budgeted for routine inspections for one year. The performance of four CAT inspections a year will result in all plants under construction not having a CAT before construction is completed. It appears that budget and manpower restraints will prohibit the CAT program from being effective at all plants under construction. Sites selected for CAT's may feel singled out for unwarranted extra NRC inspection.

3.6.2.7 Independent Design Verification Program

The Independent Design Verification Program (IDVP) is another positive step in NRC review of the design process. It is to be applied on a selective basis at the near term operating license period. All plants under construction will not have an IDVP inspection before being granted an operating licence. It appears that budget and manpower restraints will prohibit the IDVP from being effective at all plants and that sites selected for IDVP's may feel singled out for unwarranted extra NRC inspections.

3.6.2.8 Integrated Design Inspection

The Integrated Design Inspection program is a positive step in NRC review of the design process and inspections performed to date have produced meaningful results. Since the inspections are of a limited portion of work, problems detected are an indicator of potential problems on a more widespread basis. The NRC needs to assure that licensee's response to adverse findings include a review of similar activities in other areas or systems and root causes of the problems are identified and corrected.

The IDI is to be performed midway through the plant construction period. Since much of the design work is completed before or early into construction and extensive design changes tend to complicate attaining assurance of quality during design and construction, the NRC should supplement the IDI with a program performed earlier in the design process. Thorough review of the design process at the Pre-Construction Permit stage or before would result in early detection of design process deficiencies and permit their correction before the start of construction.

Three IDI's are to be performed a year. Such a limited number of inspections will result in all plants under construction not having an IDI before their construction is completed. It appears that budget and manpower restraints will prohibit the IDI program from being effective at all plants under construction. Sites selected for the IDI's may feel singled out for unwarranted extra NRC inspection.

3.6.2.9 AEC/NRC Philosophy

Regulatory agencies in other industries are generally perceived to be on the side of the general public. Because the original AEC mandate was to both promote and regulate nuclear power the NRC has struggled with the image that they are more favorably inclined towards the nuclear industry than the general

public. Even though the NRC has an adversarial role and, through its enforcement actions, has levied large fines, any attempt made by the NRC to work with the industry is taken as showing favoritism.

Changing such incorrect perceptions is a lengthy but worthwhile process. It can best be accomplished by maintaining a vigorous enforcement program and implementing it in the design and construction areas.

The AEC and NRC have made nuclear utilities responsible for assuring that the health and safety of the public is not adversely affected by the operation of their nuclear plants. The role of the NRC as a regulator has been to see that the industry discharges that responsibility. The NRC performs its function through inspections and reviews during design, construction and operation activities. The extent of the overview is governed by engineering judgment and available resources.

It was stated by headquarters and regional personnel that about one percent of the licensee design and construction activities are currently reviewed by the NRC. Budgetary limitations may cause this level of inspection to remain about the same in the future.

In order to achieve maximum benefit from the current program it becomes imperative that ways be found to:

- allocate additional resources.
- Upgrade the quality of inspectors.
- Provide the inspector with a workscope which will best utilize his time and knowledge.
- Require the licensee to perform more effective internal audits and utilize more outside organizations to review their operations. The scope of such audits and reviews should be controlled by the NRC.
- Upgrade the status and earning potential of the resident inspector.
- Provide all inspectors and other employees involved in this area an opportunity to contribute to the identification and solution of problems.

The AEC and NRC attitude toward construction deficiencies and inadequacies has been that there is no threat to the health and safety of the public until a plant becomes operational. If construction deficiencies were found and rework was required, even on a repetitive basis, it was not an area of great concern. Plants would not be licensed for operation unless ready for operations, which would be determined by prerequisite, preoperational and start up testing. As a result, the threshold for enforcement action in some Regions was too high.

This study found that there was still resistance to recognizing the importance of quality assurance in both the NRC and the licensee organization. The NRC must continue to work with all employees of the Commission by having lectures, workshops and training sessions on the subject. Meetings should be

held between NRC and licensee management to verify that the proper quality attitude is present on the licensee organization.

The AEC and NRC have often been unable to identify specific problems as a symptom of a larger system problem. Hardware problems have been easier to isolate and identify. It has been necessary to build a history and volume of hardware problems before recognition of a system problem. The NRC must recognize that problems found during inspections on limited sampling of work activities and records is an indicator of more widespread problems and must require licensees to determine the extent of the problem and to take effective action to correct the cause of the problem.

One of the recommendations included in the Staff Report to the Presidential Commission on the Accident at Three Mile Island - Volume IV 1979 stated:

> "Region's on-site inspections appear to miss signals and symptoms that indicate potential plant operating problems and weak utility management."

NRC management didn't recognize the significance, magnitude or complexity of problems. Licensee, AEC and NRC management has tended not to listen unless there has been a major problem or a "smoking gun." Management has tended to think quality control instead of quality assurance. The AEC and NRC have not forced expeditious handling of corrective action.

The AEC and NRC has had a lack of understanding of quality assurance. The Compliance Manual didn't address quality assurance. Appendix B of 10 CFR 50 was not initially used as the basis of inspections. Quality Assurance for operations has only been required since 1977-1978. It was stated during this study that the practice was to look at quality assurance up front and then not look at it again.

3.6.2.10 Inspector Qualifications

A part of the training program requires self study in the Code of Federal Regulations, NRC and IE Manual chapters, and various other technical areas. Self study has been recognized as a means of obtaining basic information and knowledge, however, it does not provide adequate training in how to apply the basic information.

AEC and NRC training programs have not kept pace with the increasing needs of the organization. It was stated during this study that the level of experience of inspectors has declined over the last 10 years.

This has been partially attributed to:

- expansion of the nuclear industry in the early 1970's and the resulting need for more inspectors
- implementation of the resident inspection program, in which experienced inspectors were initially placed at operating sites and replaced with less experienced inspectors

- promotion of good inspectors as part of a career path and replacement with less experienced inspectors

- NRC inability to remain competitive with the industry in salaries.

An NRC Office of Personnel and Management study indicated NRC inspection salaries to be 21 percent below an industry average. Frequently, inspectors have left the NRC for higher salaried positions in the utility industry. This is particularly disturbing if it occurs right after they have completed the initial training period and are just becoming a major part of the NRC program.

Early training to Appendix B of 10 CFR 50 was through on the job training with experienced personnel. In 1975, training in Appendix B consisted of self-reading. In 1976, one hour of a fragmented course whose schedule was diverted by the class, was allocated to Appendix B. A longer formalized course on Appendix B was not developed until 1983. During this study, it was stated there is a great need for more training in quality assurance, standards and Appendix B of 10 CFR 50. It was also stated that there was practically no training in how to apply modules or how to do inspections. These skills come mainly from on-the-job training. More training is needed to improve the caliber and qualifications of inspectors.

Regional personnel stated during this study that inspectors in one discipline have been assigned duties in disciplines for which they have not been trained and that they would like more guidance from headquarters to better understand their responsibilities.

3.7 LICENSEE CONTRACTOR AND VENDOR INSPECTION PROGRAM

3.7.1 Description

Prior to 1969, AEC philosophy regarding vendor activities was that qualification and monitoring of vendors was the licensee's responsibility. If problems with vendor equipment existed, they would be identified during start up testing.

Major quality problems in the reactor pressure vessel, piping systems and installation of second hand, non-pedigree valves at Oyster Creek and subsequent problems having safety significance at other facilities, made the need to re-evaluate the NRC policy evident.

AEC recognized that new standards needed to be written, old standards needed to be upgraded, and all standards needed to be enforced. They also recognized that inspection of work and enforcement of standards cannot always wait until final assembly at the site and that it was frequently impossible to make a repair at the site without compromising the final quality of the product.

In 1970, 10 CFR 50 Appendix B introduced the quality assurance concept and made the licensee responsible for the evaluation and selection of procurement sources. Regional site construction inspectors were directed to evaluate licensee vendor inspection programs as part of evaluating the licensee's QA Program and to periodically accompany selected licensees on their inspections of selected vendors. This "Host - Concept" didn't work well and was discriminatory in that the selected licensees were expected to follow through on corrective action of generic type problems for all licensees. Inspections were difficult to coordinate and administrate and were ineffective. The presence of the NRC inspector as an observer inhibited the detection of deficiencies.

In 1973, the AEC initiated a trial vendor inspection program covering fuel fabricators and discovered that greater conformance to quality standards and a subsequent reduction in major quality problems could be achieved through an effective direct vendor inspection program.

Analysis of Licensee Event Reports indicated that about 63% of construction and operation problems were traceable to vendor errors in design or fabrication performed off-site during the design and construction stages and indicated a need for improved vendor performance.

In 1974, the NRC initiated the Licensee Contractor and Vendor Inspection Program (LCVIP) as a 2-year trial program covering all types of vendors. The program was administered by Region IV in Arlington, Texas. In about the same time frame, a special Regulatory Task Force study (Study of Quality Verification and Budget Impact) recommended expansion of the trial vendor inspection program as a result of increases in the number of reported problems and difficulties experienced in performing inspections of vendors.

With the large number of vendors and suppliers worldwide involved in the U.S. Nuclear industry and with budget and manpower restraints, a priority for

inspection of vendors was established. Emphasis was placed on vendors supplying important safety-related products or services, such as the 5 Nuclear Steam System Suppliers (NSSS), fifteen Architect Engineers (AE) firms and approximately 120 suppliers of ASME class 1 and other safety-related parts or components.

Vendors of NSSS and AE services were inspected to assure their Topical Reports, previously approved by the Office of Nuclear Reactor Regulation (NRR), were transferred into procedures and the procedures were implemented. Vendors without Topical Reports were inspected to PSAR commitments.

Vendors of mechanical components having ASME Certification were inspected to their ASME program and vendors without ASME Certification were inspected for the same type of detail required by the ASME. Vendors to be inspected were selected based upon their doing a large volume of business on a continuing basis.

In 1977, the importance of inspecting electrical equipment vendors was recognized and two inspectors with electrical experience began a limited program of reviewing 4 to 5 Quality Assurance Program areas of vendors every 2 to 3 years. Inspections were often performed to draft procedures and some procedures were never formally issued.

In 1978, the LCVIP began looking at the effectiveness of vendor design programs, including verification of design inputs and checking design calculations at suppliers of NSSS and AE services.

Until 1978, the LCVIP functioned under an edict of not identifying the project or site to which the vendor being inspected was supplying equipment or services, resulting in the inability of Regions, headquarters and resident inspectors to correlate problems to the sites under their responsibility. In 1978, the policy was changed to identify such sites.

In 1979, following the problems of Three Mile Island, the LCVIP began getting requests for performing reactive inspections and follow-ups at vendors. There was no guidance for these inspections so Region IV prepared a program which was issued through headquarters. Vendors are chosen for reactive inspections based on the number of requests for inspections and the significance of problems. As a result of more sensitivity within the NRC, there has been an upward trend in requests for reactive inspections, increasing to about 200 requests in 1981 and about 350 requests in 1982.

The NRC issues a Letter of Acceptance to NSSS, AE, and Fuel Fabricator organizations verifying the capability of their program to meet PSAR Commitments and uses withdrawal of the letter to obtain corrective action. Licensees may accept the NRC Letter of Acceptance as evidence of qualification of the vendors but must retain the final responsibility for acceptability of the product or service provided.

If a utility performs its own engineering function, the Region in which it is located has the responsibility for inspection activities, including reactive inspections.

Inspections of vendors are performed 1 to 4 times a year on a 3-year repetitive cycle with a detailed review of the QA Program and its

implementation in the first year and sampling the quality of work to determine QA Program effectiveness in the second and third years. There is no scheduled interface of the LCVIP with the licensing process.

The NRC is currently re-evaluating the LCVIP and is studying the licensing of vendors as well as utilization of third party inspection.

3.7.2 Analysis

The Licensee Contractor and Vendor Inspection Program (LCVIP) evolved as a result of the learning process and of licensee inability to assure the quality of items and services supplied by their vendors.

- Prior to 1969, vendor qualification and monitoring was viewed as the licensee's responsibility.
- In 1970, regional inspectors evaluated licensee vendor inspection programs.
- In 1973, a trial vendor inspection program was initiated for fuel fabricators.
- In 1974, a trial LCVIP was initiated because 63% of construction and operation problems were traceable to vendor errors in design or fabrication.
- In 1974, a task force recommended expansion of the LCVIP as a result of increases in vendor-related problems.
- In 1977, electrical equipment was added to the program.
- In 1978, the effectiveness of vendor design programs began being evaluated.
- In 1979, inspections became reactionary as a result of Three Mile Island.

The legal base for direct NRC inspections of vendors and enforcement is not clearly addressed in Section 206 of the Energy Reorganization Act of 1974 or in 10 CFR 50 Part 21, which results in difficulty in taking enforcement action with vendors. It is not easy to determine, for example, if an executive willingly and knowingly fails to report a deficiency. The NRC may conduct reasonable inspections to insure compliance with part 21. However, corrective action must occur through the licensee. There has only been one civil penalty issued as a result of 10 CFR 50 Part 21. That penalty was issued to Babcock & Wilcox for failure to notify the NRC of precursor events to Three Mile Island.

The NRC has been slow to respond to findings and recommendations of previous studies of the LCVIP.

In 1977, it was recommended (F. Muller and others. 1977) that:

- NRC take steps to assure each vendor inspected under the LCVIP is aware of the responsibility and authority of the licensee

- vendors to be inspected under the LCVIP be selected on a basis which ensures every vendor has a likelihood of being inspected

- IE inspection of material produced under the ASME Code be eliminated provided ASME requirements are expanded to include operation.

In a report to Congress in 1978 (Controller General 1978) it was stated that:

- the LCVIP has had a positive effect but improvements were needed in inspector's reporting practices, attention to inspection details, documentation of inspections and in investigations

- there was no systematic method of selecting vendors for inspection and all vendors of safety related equipment were not identified

- vendors manufacturing electrical components and instruments controlling critical operations were neglected

- more inspectors be assigned to vendor inspector activity. (There were 11 inspectors reviewing over 200 suppliers at the time)

In a report to the NRC in 1978 (TRW 1978) it was reported that over 50% of a plant by dollar value was designed and/or fabricated off site, that a review of Licensee Event Reports between January 1975 and September 1977 indicated that 60.8% of problems were related to component failures and design errors, (51.2% component and 9.6% design) and that on-site inspection was roughly four times off-site efforts. The report conclusions and recommendations included:

- NRC should perform independent inspections of nuclear contractors and vendors

- third party inspection would supplement and extend vendor inspection effort

- the NRC program should be functionally integrated with programs of licensees

- formalized procedures were necessary for selecting vendors for inspection based on the operating record of the product, previous inspection findings and the safety significance of the product

- emphasis of inspections should be changed from systems administration and management to evaluation of procedures used, implementation of procedures, and quality of resulting product

- reporting include a mechanism through the White Books for licensee acquisition of inspection reports, data relating to vendor performance, and statements pertaining to program compliance with Appendix B and implementation of the program

- documentation of the LCVIP in a Topical Report
- there was under representation of several skill areas among inspectors
- inspection bases other than Appendix B were used prior to 1977
- sampling was based on coverage of prior inspections and areas of suspected weakness
- the statistical adequacy of the sampling process and sample size were not determined
- the LCVIP was not implemented in accordance with MC-2700 of the IE Manual in that suggested schedules weren't followed, no explicit verifications of program content or implementation were issued for competent vendors, and little product sampling was performed.

The LCVIP was being implemented by 21 personnel who in 1977 conducted 236 inspections with about 25% being reactive inspections. The TRW report identified the following issues as needing to be addressed by the NRC:

- NRC must decide who is to perform certification of vendor's Quality Assurance Manuals for conformance with Appendix B
- NRC must determine whether some group should certify that a vendor is implementing its Quality Assurance Program

In addition, the report included an analysis of several alternative approaches in certifying and monitoring vendors.

The current NRC re-evaluation of the LCVIP includes consideration of findings and recommendations of previous reports, but is being performed five years after the last report. Coordination of vendor qualification activities with a third party, the American Society of Mechanical Engineers (ASME) has been ongoing since 1972.

The NRC has assumed licensee responsibility for evaluation of vendors through implementation of the LCVIP. Appendix B of 10 CFR 50 places the responsibility of assuring the quality of vendor supplied items and services, including evaluation and selection of procurement sources, on licensees. The NRC has concentrated its efforts in resolving quality problems with vendor supplied items and services by conducting evaluations and inspections of vendors and has not taken enforcement action against licensees to force them to fulfill their responsibility. Whenever the NRC performs a function that falls within the licensees responsibility, the NRC assumes at least a partial responsibility for the success or failure of that function.

The perception that because the NRC has a "Vendor Inspection Program" it is inspecting all vendors leads to greater expectations by the general public than can be realized. The failure of any vendor therefore, becomes a reflection of the perceived NRC inadequacies to do its job and, hence, the public's health and safety are endangered. As a regulator, the NRC can only monitor that the licensee is performing its functions in a proper and correct manner and take enforcement action when deemed necessary.

It would appear that the requirements of Appendix B of 10 CFR 50 pertaining to the evaluation of procurement sources warrants revision. Multiple evaluations of vendors by licensee and contractors has resulted in ineffective redundancy.

A solution to this problem could be in the establishment of a more intensive vendor evaluation and monitoring program using CASE (Coordinating Agency for Supplier Evaluation) or INPO, or by a Certification program administered by the NRC or a third party.

Standard evaluations could be conducted for different levels of contractors and suppliers, incorporating a graded inspection of "Important to Safety" items as well as the full inspection of safety related products. If a vendor licensing program was installed, the NRC I&E office could certify the licensees, AE's and NSSS vendors with a third party certifying the balance.

The subject of licensing vendors met with a mixed reaction from licensees, contractors and regional personnel. The general attitude seemed to be to try licensing all AE and NSSS vendors but restrict it to that level. Licensing of vendors at lower levels would tend to force vendors out of the industry.

3.8 ENFORCEMENT PROGRAM FOR ASSURANCE OF QUALITY

3.8.1 Description

3.8.1.1 General

Initial AEC enforcement actions consisted of providing written notification of nonconformances to licensees and requesting corrective action. Licensees responded with action to be taken and correspondence continued between the licensee and AEC until the nonconformance was resolved.

In 1970, the AEC issued the Enforcement Procedure For Reactors Under Construction (0700/3), which provided general guidance for the Regions on enforcement actions. The criteria used to determine enforcement action and categories of noncompliance were first published in 1972 (37 FR 21962).

In 1973, the AEC issued Chapter 0800 -- Enforcement Actions to describe the policy and guidelines for the enforcement Program implementation.

In 1975, the criteria used to determine enforcement action and categories of noncompliance was revised (40 FR 820) and the NRC reissued Chapter 0800 -- Enforcement Actions as part of the IE Manual.

In December of 1979, following Three Mile Island, the NRC again revised the criteria used to determine enforcement action and categories of noncompliance (44 FR 77135).

The approval of Public Law 96-295 in June of 1980 amended section 234 of the Atomic Energy Act and raised the maximum civil penalty from $5,000 to $100,000 and eliminated the provision limiting the total civil penalties payable in any 30-day period to $25,000.

In October of 1980, the NRC issued the Proposed General Statement of Policy and Procedure for Enforcement Actions (45 FR 66754) for implementation and public comment. In March of 1982, a revised policy statement, based upon experience gained in implementing the proposed policy statement and comments received during and following public meetings on the policy, was adopted and codified as Appendix C to Part 1 of Title 10 of the Code of Federal Regulations. The fundamental basis of the revised policy remained the same as the proposed policy with changes made in how the steps are accomplished and in clarifying the language.

A more detailed discussion of enforcement programs follows.

3.8.1.2 Chapter 0800

The NRC defined a noncompliance as a failure to comply with a regulatory requirement and categorized noncompliances by severity levels into violations, infractions and deficiencies.

Fabrication, construction, or testing of a Seismic Category I system or structure in such a manner that the safety function or integrity was lost was

a violation. Fabrication, construction or testing of a Seismic Category I system or structure in such a manner that the safety function of integrity was impaired and inadequate management or procedural controls in the QA implementation was an infraction. A deficiency was an item of noncompliance in which the threat to the health, safety, or interest of the public or the common defense and security was remote and no undue expenditure of time or resources to implement corrective action was required. When a licensee failed to conform to commitments which were not licensee requirements, it was referred to as a deviation.

Enforcement actions consisted of notices of violations, civil penalties, and orders.

A Notice of Violation was a written notice to a licensee of a nonconformance. Deviations were identified in the cover letter transmitting a Notice of Violation, on a separate page forwarded with a Notice of Violation or by separate correspondence.

If an acceptable response was not received from the licensee or if items were uncorrected, repeated, or chronic, an enforcement conference was held and/or a strong Notice of Violation from headquarters bearing the signature of the Director of Field Operations or higher authority was issued. An enforcement conference was a meeting arranged by supervision or management of an IE Regional office to discuss with representatives of a licensee's management the status of its compliance with regulatory requirements, the licensee's proposed corrective measures and schedules for implementing corrective action, and the enforcement options available to the Commission. Enforcement conferences could be held at the licensee's facility, in the Regional Office, at IE Headquarters or in any mutually designated place.

If the licensee's program was not brought into compliance with regulatory requirements, a civil penalty could be issued. Civil penalties were monetary penalties to be issued for chronic, deliberate, or repetitive items of noncompliance where a Notice of Violation was not effective and for first of a kind violations if considered serious. Failure to meet licensee commitments was not a basis of a civil penalty but could aggravate items of noncompliance.

The NRC had authority to issue orders to "cease and desist," and orders to suspend, modify, or revoke licenses. Such orders were to be ordinarily preceded by a written Notice of Violation to the licensee providing him with an opportunity to respond as to the corrective measures being taken. In the event the licensee failed to respond to the notice or to demonstrate that satisfactory corrective action was being taken, an order to show cause could be issued requiring the licensee to show why the order should not be made effective. In some instances where the health, safety, or interest of employees or the public so require or deliberate noncompliance with the Commission's regulations was involved, the notice provision could be dispensed with and the particular order could be made immediately effective pending further order.

The signatory of enforcement correspondence was to be escalated as the importance of the enforcement action was escalated. Forms signed by the inspector who performed the inspection and routine notices of violation from the Regional Offices were signed by the appropriate Branch Chief. The Branch Chief escalated the enforcement correspondence with the signature by the Regional Director if difficulties concerning enforcement matters were

encountered with the licensee or when a reply was required to significant items of noncompliance of safety items. Notices of violation escalated to the Headquarters level were to be signed by the Director of Field Operations or by higher authority. Notices of intent to impose civil penalties and orders to invoke civil penalties, to cease and desist, or to suspend, modify or revoke a license were to be signed by the Executive Director for Operations, the Director of Inspection and Enforcement, the Director of Nuclear Reactor Regulation of the Director of Nuclear Material Safety and Safeguards as appropriate.

Inspection and Enforcement Bulletins could be issued for a group of licensees to inspect, report and make commitments to implement certain controls or remedial actions as a result of safety, safeguards, or security related conditions resulting if inadequacies or failures that have occurred at the same or a similar facility, or in similar operations. If a licensee did not make commitments for remedial action as specified in a Bulletin, the NRC could issue an order to require the proposed action.

Inspection and Enforcement Immediate Action Letters could be issued by the Regional Director (with Headquarters' concurrence) for a licensee to inspect, report and make commitments to implement certain controls or remedial actions as a result of safety, safeguards, or security related conditions resulting from inadequacies or equipment failures at the licensee's facility. If a licensee did not respond to an Immediate Action Letter, the NRC could issue an order to make the proposed action a requirement of the license. The Immediate Action Letter was also used to confirm verbal commitments by licensees to take immediate action.

Chapter 0800 also contained guidance to elaborate upon the proper application of the enforcement criteria. Each item of noncompliance was to be categorized as a violation, infraction or deficiency. A review of the licensee's history of noncompliances was to be performed to determine if items identified involved the same basic requirement as items identified during other inspections or investigations based on the last several inspections and generally covering a period of one to three years. Each item of noncompliance was assigned action points. A violation was assigned 100 points, an infraction 10 points and a deficiency 2 points. For a repeated or uncorrected item of noncompliance with the same basic requirement, action points were to be successively increased by a factor of two each time it occurred. When a total of 100 action points or more resulted from an inspection or investigation and items of noncompliance included one or more violations or repetitive infractions or deficiencies, the regional office staff was to review the case to determine whether a civil penalty or show cause was warranted. As a general rule, a civil penalty was to be imposed for noncompliances which did not represent an immediate threat to the health and safety of the public and orders were to be issued for noncompliance that did. Where civil penalties or orders were not issued for violations or cases having 100 or more action points, the mitigating conditions or circumstances were to be documented. A civil penalty or Notice of Violation from Headquarters was to be issued when one letter identified several items of noncompliance in the infraction and deficiency categories with a total of 100 points or more.

An order to suspend, modify or revoke a license was appropriate when there was an apparent breakdown in the licensee's Quality Assurance program, based on the significant nature and number of items of noncompliance resulting

in construction of discrepant Seismic Category I structures, systems, and/or components. The items of noncompliance were generally in the infraction category. It was to be considered a breakdown if there were several significant items of noncompliance with several of the Appendix B of 10 CFR 50 criteria. Procedural matters in themselves were not generally considered to be of prime significance. Failure of a system or failure to implement a program due to failure to develop, review and approve procedures was considered a manifestation of QA breakdown. If several items of noncompliance constituted a QA breakdown, the sanction was to be selected as follows:

"If the licensee cannot demonstrate that the quality of Seismic Category I systems, components or structures under construction or undergoing maintenance meet the stated requirements, an order may be issued to suspend operations or activities which have resulted in doubtful quality. The activities in question will not be resumed until the licensee has properly demonstrated that quality meets the requirements for Seismic Category I structures, systems or components."

"An order to suspend or modify a license may also be issued for a breakdown in quality assurance program implementation which results in a threat to the health, safety or interest of the public or the common defense and security."

"If inspection or investigation findings demonstrate that the quality assurance breakdown has not placed the quality of Seismic Category I systems or components in doubt and that there is no immediate threat to the health, safety, or interest of the public, or the common defense and security, a civil penalty may be the appropriate sanction."

"A civil penalty is the appropriate sanction in those cases where a licensee's history is one of chronic and numerous violations which do not involve an immediate threat to the health, safety, or interest of the public or the common defense and security, and provided that (as a general rule) the licensee's management has been properly apprised of the items of noncompliance. Normally this is done through enforcement conferences."

"The progression of the enforcement conferences resulting from inspections of such cases will normally include, in addition to the inspector's review of his findings with management, a meeting of the appropriate Branch Chief with an appropriate representative of the licensee's management at the site and a telephone discussion or a meeting at the Regional Office, or other designated place, between the Regional Director and the president or a corporate vice president who has authority to implement corrective measures. The Director or Deputy Director of the Office of Inspection and Enforcement may attend enforcement conferences with corporate management in appropriate situations."

"Since one of the basic parameters for civil penalty is items of noncompliance which represent a significant threat (but not immediate) to the health and safety of people or the common defense and security, the basis for this sanction is those items of noncompliance with regulatory requirements in the violation and infraction categories. However, the additive effect of deficiencies in the third category is one of the parameters considered in selecting this sanction. Each item of noncompliance with a regulatory requirement may carry a monetary penalty. Deviations from the provisions of commitments, codes, guides and standards will be listed separately and will carry no

monetary penalty. Civil penalties based exclusively on deficiencies would be difficult to justify and their use for such items of noncompliance, while not excluded, is highly unlikely. Civil penalty or a "Notice of Violation" from Headquarters is the appropriate sanction when one enforcement letter identifies several items of noncompliance in the infractions and deficiencies categories with a total of 100 action points or more. The determination as to which sanction will be used is based on whether the licensee has been duly notified of the probability of such sanctions in previous correspondence and enforcement conferences, and on such judgment factors as the severity of the items of noncompliance, the nature and number of such items, the licensee's past performance, the frequency of noncompliance, and length of time the items of noncompliance have existed, the steps taken to correct them and the licensee's stated intentions of performance in correcting them promptly."

"A Notice of Violation will be issued from the Regional Office for all other items of noncompliance or combinations of items of noncompliance (a Form AEC-591 will be issued in the field by the inspector as appropriate for cases involving materials). The total sanction points for items of noncompliance in such notices from the Regional Offices may, on occasions, be greater than 100."

The above considerations were guidelines and Regional Directors could recommend any enforcement action available if the rationale was provided to support the recommendation.

3.8.1.3 General Statement of Policy and Procedure for Enforcement Actions

Appendix C to Part 1 of Title 10 of the Code of Federal Regulations describes the purpose of the enforcement program as:

"The purpose of the NRC enforcement program is to promote and protect the radiological health and safety of the public, including employees' health and safety, the common defense and security, and the environment by:

- Ensuring compliance with NRC regulations and license conditions;
- Obtaining prompt correction of noncompliance;
- Deterring future noncompliance;
- Encouraging improvement of licensee performance, and by example, that of industry, including the prompt identification and reporting of potential safety problems.

Consistent with the purpose of this program, prompt and vigorous enforcement action will be taken when dealing with licensees who do not achieve the necessary meticulous attention to detail and the high standard of compliance which the NRC expects of its licensees. It is the Commission's intent that noncompliance should be more expensive than compliance. Each enforcement action is dependent on the circumstances of the case and requires the exercise of discretion after consideration of these policies and procedures. In no case, however, will licensees who cannot achieve and maintain adequate levels of protection be permitted to conduct licensed activities."

The first step in the enforcement process is to identify the relative importance of each violation. Violations are categorized in five levels of severity as described in Appendix C. Severity Level I has been assigned to violations that are the most significant and Severity Level V violations are the least significant. Severity Level I and II violations are of very significant regulatory concern. In general, violations that are included in these severity categories involve actual or high potential impact on the public. Severity Level III violations are cause for significant concern. Severity Level IV violations are less serious but are of more than minor concern, i.e., if left uncorrected, they could lead to a more serious concern. Severity Level V violations are of minor safety or environmental concern.

The severity level of a violation may be increased for careless disregard of requirements, deception, or other indications of willfulness. The severity level of a violation involving failure to make a required report to the NRC is based on the significance of and circumstances surrounding the matter.

A Notice of Violation is the standard method for formalizing the existence of a violation and is to normally require the licensee to provide a written statement describing corrective action taken and results achieved, steps taken to prevent recurrence, and the date full compliance will be attained. The NRC does not generally issue a Notice of Violation for a violation identified as severity level IV or V if it was reported, if required, it was or will be corrected within a reasonable time, including measures to prevent recurrence, and if it was reasonably not expected to have been preventable by action to a previous violation.

A Civil Penalty is a monetary penalty generally imposed for Severity Level I and II violations, considered and usually imposed for Severity Level III violations, and may be imposed for Severity Level IV violations that are similar to violations discussed in a previous enforcement conference.

Enforcement conferences are normally to be conducted for all Severity Level I, II and III violations and for Severity Level IV violations considered symptomatic of program deficiencies.

The NRC imposes different levels of civil penalties for different severity level violations, taking into account the gravity of the violation as a primary consideration and ability to pay as a secondary consideration. Civil penalties are not intended to put a licensee out of business or to adversely affect his ability to safely conduct licensed activities. Orders are used when the intent is to terminate licensed activities. The NRC considers increases or decreases to base civil penalties on a case-by-case basis. Civil penalties for continuing violations may be issued on a per day basis up to $100,000 per violation per day. Civil penalties may be increased by as much as 25% based upon enforcement history, prior notice of similar events, multiple occurrences and if initiation of corrective action is not prompt or the action is minimally acceptable. Civil penalties may be decreased by as much as 50% based upon prompt identification and reporting and prompt and extensive correction action.

An order is a written NRC directive to modify, suspend, or revoke a license; to cease and desist from a given practice or activity; or to take such other action as may be proper. Orders are effective immediately without a hearing when determined the public health, interest or safety so requires or

for violations involving willfulness. Otherwise, a hearing is held for the licensee to show cause why the order should not be issued in the proposed manner. Where necessary, the NRC is to issue orders in conjunction with civil penalties. Enforcement actions are to escalate for recurring similar violations.

In addition to Notice of Violation, civil penalties and orders, the NRC uses enforcement conferences, bulletins, circulars, information notices, generic letters, notices of deviation and confirmatory action letters. The NRC expects licensees to adhere to any obligations and commitments resulting from these processes and may issue orders to make sure such commitments are met.

Alleged or suspected criminal violations of the Atomic Energy Act and other relevant Federal laws are referred to the Department of Justice for investigation.

The Director, Office of Inspection and Enforcement is the principal enforcement officer of the NRC and has been delegated the authority to issue Notices of Violation, civil penalties and orders.

The Severity Categories for facility construction as shown in Appendix C are:

A. Severity I -- Very significant violations involving a structure of system that is completed in such a manner that it would not have satisfied its intended safety related purpose.

B. Severity II -- Very significant violations involving:

1. A breakdown in the quality assurance program as exemplified by deficiencies in construction QA related to more than one work activity (e.g., structural, piping, electrical, foundations). Such deficiencies normally involve the licensee's failure to conduct adequate audits or to take prompt corrective action on the basis of such audits and normally involve multiple examples of deficient construction or construction of unknown quality due to inadequate program implementation; or

2. A structure or system that is completed in such a manner that it could have an adverse effect on the safety of operations.

C. Severity III -- Significant violations involving:

1. A deficiency in a licensee quality assurance program for construction related to a single work activity (e.g., structural, piping, electrical or foundations). Such significant deficiency normally involves the licensee's failure to conduct adequate audits or to take prompt corrective action on the basis of such audits, and normally involves multiple examples of deficient construction or construction of unknown quality due to inadequate program implementation.

2. Failure to confirm the design safety requirements of a structure or system as a result of inadequate preoperational test program implementation; or

3. Failure to make a required 10 CFR 50.55(e) report.

D. Severity IV -- Violations involving failure to meet regulatory requirements including one or more Quality Assurance Criteria not amounting to Severity Level I, II or III violations that have more than minor safety or environmental significance.

E. Severity V -- Violations that have minor safety or environmental significance.

3.8.2 Analysis

3.8.2.1 General

Early AEC enforcement action consisted of correspondence between the AEC and the licensee.

In 1973, in a report to the Director of Regulation (Davis and Brown) it was stated:

> "The AEC has neither imposed civil penalties nor taken significant enforcement or procedural actions against utilities which fail to implement the requirements of Appendix B. Regulatory's efforts to upgrade utility QA programs have relied on "jawboning" sessions with utility executives and routine enforcement letters, while the utilities have been permitted to continue construction or operation of their facilities notwithstanding QA deficiencies."

In the 1970's, guidance was provided for enforcement action which permitted issuance of Notices of Violation, civil penalties and orders and provided for escalation of enforcement action if the licensee was nonresponsive or if responses were not acceptable. However, the AEC and NRC did not aggressively implement enforcement action and the emphasis of enforcement action was in the area of operating plants.

3.8.2.2 Chapter 0800

The categorizing of each noncompliance required judgment of each inspector and was more difficult in design and construction than in operations. To categorize a nonconformance as a violation required determining that the safety function or integrity of a Seismic Class I system or structure was lost as a result of the noncompliance. To categorize a nonconformance as an infraction required determining that the safety function or integrity of a Seismic Class I system or structure was impaired as a result of the noncompliance. To categorize a nonconformance as a deficiency required determining that the threat to the health, safety, or interest of the public on the common defense or security was remote and no undue expenditure of time or resources to implement corrective action was necessary. Since the plant was under construction and not being operated, there was no immediate threat to the health

and safety of the public or interest of the public on the common defense or security. In most cases, the safety function or integrity could not be clearly shown to be impaired or lost. For these reasons, nonconformances in design and construction tended to be categorized as deficiencies or deviations with some infractions and few violations.

Inspections at construction sites during the 1970's were performed by regional inspectors on a periodic basis of about six inspections a year at each site. Inspections were planned and scheduled with the licensee in accordance with construction schedules. It was not uncommon for an activity to be inspected during one site visit and not to be inspected again for a year or longer if at all. A relatively long period of time could elapse before a history on noncompliances to the same basic requirement developed. The AEC and NRC have tended to accept a fix to specific problems without requiring a review for identifying the magnitude of the problem to other areas of activity or action to prevent the problem from recurring.

The categorizing of noncompliances to lower action levels and the infrequency of inspections contributed to action point totals that were below the level for issuance of civil penalties or orders. If the action point totals did reach the levels for civil penalties or orders, AEC and NRC management tended to hold enforcement conferences instead of issuing the civil penalty or order.

The enforcement program did not encourage licensee conformance to commitments. Failure to conform to commitments such as the PSAR and provisions of applicable guides, codes and standards, when such lack of conformance did not constitute an item of noncompliance, was considered a deviation, the lowest level of enforcement action.

The AEC and NRC had difficulty in recognizing breakdowns in quality assurance programs and were hesitant to take permitted enforcement action. A breakdown was to be determined based upon the significance and number of items of noncompliance resulting in construction of discrepant Seismic Category I structures, systems, and/or components and several significant items of noncompliance with several criteria of Appendix B of 10 CFR 50 were required. A civil penalty or an order could be issued for a quality assurance program breakdown but neither were mandatory. The periodic nature of inspections, categorizing of noncompliances, and low level of attention afforded nonconformances with licensee commitments resulted in difficulty in recognizing quality assurance program breakdowns. The attitude that since the plant was not operating there was no immediate danger to the health and safety of the public and it was the licensee's responsibility to correct problems before an operating license would be issued resulted in hesitancy of NRC management to take permitted enforcement action. The fact that the Atomic Energy Act specified a maximum civil penalty of $5,000 and limited the total civil penalties payable in any 30 day period to $25,000 may have further influenced management reluctance to issue a civil penalty. Further, investigation into civil penalties and orders issued during the 1970's may be warranted.

Inadequate significance was attached to procedural matters. Procedural matters were not generally considered to be of prime significance. Failure of a system or failure to implement a program due to failure to develop, review and approve procedures was considered a manifestation of a QA breakdown. The failure to follow prescribed procedures is an indicator of potential problems.

Although primary concern is the adequacy of the end item, adherence to good procedures enhances the attainment of the desired adequacy.

3.8.2.3 General Statement of Policy and Procedure for Enforcement Actions

Following Three Mile Island, Public Law 96-295 was issued raising the maximum civil penalty from $5,000 to $100,000 and eliminating the limiting provision of total civil penalties payable in any 30 day period. The raising of civil penalties that could be issued put more strength into the enforcement program.

The 1980 and 1982 NRC General Statements of Policy and Procedure for Enforcement Actions also put more strength into the enforcement program. The policies more clearly defined severity categories, eliminated the action point system, and recognized quality assurance as an important aspect of construction activities by mentioning it in three of five severity categories. The intent of the new policies was that noncompliance should be more expensive than compliance. Severity levels of noncompliances could be increased for careless disregard or requirements, deception, or other indications of willfulness.

Notices of Violation are to require the licensee to provide a written statement describing corrective action taken, results achieved, steps taken to prevent recurrence and the date full compliance will be attained. During this study, regional personnel indicated that the AEC and NRC should have been more aggressive in requiring licensee determination of the extent of problems and correction of the cause of the problems and in following up of licensee open action items. The Notice of Violation, if properly used, and prompt follow up on all open action items can be strong points of the enforcement program.

Licensees are encouraged to report safety-related problems and the NRC may decrease civil penalties by as much as 50% for prompt identification and reporting of problems and for prompt and extensive corrective action. During the NRC Case Studies, licensees indicated there was little incentive to identify problems. The licensee would identify a problem, take corrective action to eliminate the problem, promptly report the problem to the NRC and then receive a fine from the NRC and publicity in the public media inferring poor quality of construction. Licensees also indicated there was lack of uniformity in application of civil penalties and orders.

Past enforcement programs of the AEC and NRC were not as effective as they could have been as a result of inconsistency in requiring licensees to determine the extent of problems and to correct the causes of the problems, inability to recognize that the problems detected were but symptoms of larger problems, and inability to raise problems to the threshold of action. New enforcement programs tend to correct these deficiencies. However, the new programs do not appear to encourage licensee conformance to commitments or attach greater significance to procedural matters. The NRC should consider making commitments a condition of a permit and placing greater emphasis on procedural matters.

3.9 NRC Inability To Prevent Problems And Slowness To Identify And Act On Problems

An analysis of the root causes of the inability of the NRC to prevent problems and slowness to identify and act on problems at Diablo Canyon, Marble Hill, Midland, South Texas and Zimmer nuclear plants follows.

3.9.1 Diablo Canyon

The major problem was identified as ineffective design control.

The licensee received its Construction permit in 1968. The NRC issued an Operating License in 1981 and then revoked the license two months later following identification by the licensee of an error in seismic response spectra for some piping and equipment restraints. NRC investigation determined that the cause of the problem was informality in the procedures used for design document control and lack of independent review of data by the licensee prior to submittal to its seismic consultant. Prior to reinstatement of its operating license, the licensee is required to complete an extensive design verification program.

Appendix B of 10 CFR 50 was issued in 1970, some 2 years after the construction permit date and as a result there were no quality assurance program requirements at the time much of the design work was performed.

The inspection program concentrated on construction activities and did not focus attention in the area of design. Since PG&E was their own AE, the Licensee Contractor and Vendor Inspection Program started in 1975 did not apply to them.

Although the licensee had no commitment to implement an Appendix B type of quality assurance program on Unit 1, he agreed to implement such a program, as applicable.

Since the work had progressed beyond design and emphasis was on inspection of construction activities, design control activities were not reviewed when Appendix B became applicable.

The root cause of NRC inability to prevent the problem and slowness to identify and act on the problem is:

- Insufficient attention in the design area.

3.9.2 Marble Hill

The major problems were identified as concrete consolidation, improper repair of the imperfections, inadequate or nonexistent records traceable to the repairs, inadequate training and supervision of personnel responsible for the repairs, welding, and insufficient awareness of the problems and control by the licensee. The NRC Case Study identified licensee inexperience to be a root cause of the problems. The licensee had not built a nuclear power plant.

The licensee received its Construction Permit in 1978. In 1979, the NRC shut down all safety-related construction activities.

The NRC had detected nonconformances in concrete work from the outset of the project. About one year after CP issuance, the NRC requested the licensee to upgrade its quality assurance program. The licensee agreed to upgrade the program and determine if previously poured concrete was adequate.

About a month later, a former employee of the Civil Construction contractor alleged that surface defects in concrete had been improperly patched.

Concurrently, the National Board of Boiler and Pressure Vessel Inspectors confirmed problems with piping installation identified by a mechanical subcontractor.

These events led to an NRC team inspection which confirmed concrete consolidation problems and improper repair of the imperfections and resulted in the shut down of safety-related construction activities. Work was not permitted to resume until the licensee upgraded its QA program and that of its contractors and the adequacy of completed construction work was verified.

The root causes of NRC inability to prevent problems and slowness to identify and act on the problems are:

- Inadequate review of the licensee and contractor experience and ability to manage construction of a nuclear power plant.
- Irregular non-constant presence.
- Inability to recognize the significance and magnitude of the problems.

3.9.3 Midland

The major problem was identified as settlement of the diesel generating building in 1978 as a result of inadequate and poorly compacted soil. Licensee investigation revealed that other safety-related systems and structures were affected. NRC investigation determined specifications had not been followed for soil fill activities and there was insufficient control and supervision of the activities by the utility and its contractors.

The licensee received its construction permit in 1972. The NRC issued a Show Cause Order regarding the soils problem in 1978. Rework is in progress and the application for an operating License is in litigation before a hearing board.

NRC personnel were aware of problems at Midland. Between 1973 and 1978, problems were reported with cadwelds, omitted rebar, tendon installation and bulgeing of the containment liner. Problems were identified on multiple occasions separated by about one year. There were meetings at the Region to determine if action should be taken and meetings were held with Midland management. Regional requests to stop work at Midland were not supported by NRC headquarters until 1978. In response to the Show Cause Order, Midland requested a hearing. The hearing process is still going on and Midland has been permitted to continue soils work.

Since 1978, additional problems have been identified in HVAC welding, reactor vessel anchor bolts, pipe supports and hangers, electrical cable separation and in the diesel generator building inspection performed by the licensee. Mechanical equipment, piping and electrical systems were poorly installed and supervisors had ordered QC inspectors to suspend inspections if they found too many deficiencies.. A civil penalty of $38,000 was issued in 1979 for the HVAC problem and a $120,000 civil penalty was issued in 1982 for breakdown of the Quality Assurance Program. Reinspection and finishing of the plant is to be performed in accordance with an NRC approved plan under the oversight of an independent contractor.

The root causes of NRC inability to prevent problems and slowness to identify and act on the problems are:

- Irregular non-constant presence until 1980.
- Reluctance to take enforcement action.
- Mindset that it is the licensee's responsibility to properly construct the plant and it would not be licensed until ready for operation as determined by pre-operational and startup tests.

3.9.4 South Texas

The major problems were identified as concrete placement, welding activities, procedural violations, records falsification and personnel qualification. Additional problems were identified as harassment and intimidation of inspectors and insufficient design work to support construction. The NRC Case Study identified licensee and AE/Constructor inexperience to be a root cause of the problems. Neither the licensee nor the AE/Constructor had built a nuclear power plant.

The licensee received its Construction permit in 1975. The NRC issued the licensee a $100,000 fine and show cause order in 1980. Work was allowed to restart only after upgrading of QA for that area and verification by the NRC.

In 1977, the NRC received reports of intimidation of QC inspectors at the construction site. Between July of 1977 and November of 1979, the NRC performed 10 investigations of allegations. In 1978, the NRC held a meeting with licensee management to discuss morale problems. An FBI probe into allegations of forged documentation in 1979 reported widespread problems. A NRC special investigation was performed which determined shortcomings in management and implementation of the QA/QC Program.

A summary report (Gower 1981), prepared after reviewing headquarters files of inspections performed from 1974 through 1979, stated there was good inspections procedure coverage of the major problem areas but the degree to which the procedures would have turned up similar problems is strongly influenced by the experience, practical knowledge ad technical depth of the inspectors. In an analysis of 72 allegation relating to problems at the site, the report indicated 34 were substantiated, 28 were refuted and 10 were neither substantiated nor refuted. NRC inspections had detected problems concerning procedures, records, personnel qualifications, audits, and concrete and welding activities.

The root causes of NRC inability to prevent problems and slowness to identify and act on the problems are:

- Inadequate review of the licensee and contractor ability to manage construction of a nuclear power plant.
- Irregular non-constant presence.
- Inability of the NRC to recognize the significance and magnitude of the problems.
- Mindset that it was the licensee's responsibility to properly construct the plant and it would not be licensed until ready for operation as determined by pre-operational and startup tests.

3.9.5 Zimmer

The major problems were identified as Q.C. documentation, procedure violations, inadequate nonconformance reporting system, deficiencies in drawings, specifications, instructions and procedures, material control and licensee audits and corrective action.

The licensee received its Construction Permit in late 1972. In November of 1981, the NRC issued a $200,000 fine for Quality Assurance breakdowns following investigation of allegations of shoddy construction practices. In November of 1982, the NRC suspended all safety-related work in response to concerns about the quality of construction and management controls. The licensee has been required to complete a Quality Confirmation Program of the as-built condition and to correct any problems before additional consideration for an Operating License.

A summary report (Gower 1981), prepared as a result of reviewing headquarters inspection files and the draft report on investigation of Zimmer, revealed inspection coverage appeared to be extensive and comprehensive, inspections up through 1976 appeared to have been in line with the inspection program, and that during 1977, 1978 and 1979, inspection-hours per year (600 to 1200) exceeded planned hours (400-500) and 12 to 16 different inspectors contributed to the inspection effort during one year. Three to six different inspectors were thought to be sufficient for adequate coverage. There were signs of problems with the licensee/constructor audit programs in 1973, 1975, 1977 and 1979. Up to 1981, there were 13 investigations performed addressing allegations in depth and dealing primarily with QA/QC problems. There were numerous instances of enforcement citations in QC documentation, procedure violations, materials control, and deficiencies in instructions, procedures and specifications. The notices of violation were limited to the item of noncompliance with little, if any, inference that the concern may be indicative of a larger more pervasive problem that should be looked into and corrective action taken.

Another study (Torrey Pines 1983), reported inadequate management controls of the project citing GC&E and H.V. Kaiser inexperience in building nuclear plants as a cause of problems at Zimmer. The study reported inadequate staffing, procedures, and control systems and an ineffective audit program. Problems remained uncorrected partly through a lack of attention and follow through on corrective action by the NRC. CG&E was allowed to continue construction while being lulled into a false sense of satisfactory performance until the late 1970's.

An NRC report (NET 1983, NUREG-1969) indicated inspections and investigations revealed inadequacies in administration of the Quality Assurance Program and that the quality of plant systems, structures and components was indeterminate.

During this study, Region III personnel indicated lots of the problems were noted but they didn't reach a threshold of action. Reviews of the Action Item Tracking List revealed every criteria of Appendix B of 10 CFR 50 was cited in the first and last years of construction. They indicated that the NRC failed to follow-up on open action items (approximately 12,000) and failed to require reviews for determining the extent of problems and determination and correction action regarding the cause of the problem. They also indicated

that until 1974, teams of four or five cross-discipline inspectors performed quarterly inspections. In 1974 and 1975, six experienced inspectors with accumulated experience of about 120 years left the Region for other assignments and were replaced by less experienced, more specialized inspectors.

The root causes of the NRC inability to prevent problems and slowness to identify and act on problems were:

- Inadequate review of the licensee and its contractor's ability to manage construction of a nuclear power plant.
- Failure of the NRC to require licensee reviews of problems to determine their extent and to take corrective action regarding the cause of the problem.
- Inability to recognize the significance and magnitude of the problems.
- Loss of inspection experience in the Region.
- Problems didn't reach the threshold for enforcement action.
- Mindset that it was the licensee's responsibility to properly construct the plant and it would not be licensed until ready for operation as determined by pre-operational and startup tests.

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5.0 LIST OF ACRONYMS

AE	Architect Engineer
AEC	Atomic Energy Commission
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
CAT	Construction Assessment Team
EDO	Executive Director of Operations
ERDA	Energy Research and Development Administration
HVAC	Heating, Ventilating, and Air Conditioning
I&E	Office of Inspection and Enforcement
IEEE	Institute of Electrical and Electronic Engineers
IDI	Integrated Design Inspection
IDVP	Independent Design Verification Program
INPO	Institute of Nuclear Power Operations
LCVIP	Licensee Contractor and Vendor Inspection Program
NMSS	Office of Nuclear Material Safety and Safeguards
NRC	Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
NSSS	Nuclear Steam System Supplier
PAT	Performance Appraisal Team
PSAR	Preliminary Safety Analysis Report
RES	Office of Nuclear Regulatory Research
SALP	Systematic Assessment of Licensee Performance
SAR	Safety Analysis Report

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