

AUG 10 1982

MEMORANDUM FOR: William J. Dircks
Executive Director for Operations

FROM: Richard C. DeYoung, Director
Office of Inspection and Enforcement

SUBJECT: QUALITY ASSURANCE

Our proposed paper recommending measures to improve quality assurance at reactors is provided as Enclosure 1.

Substantial changes have been made from the previous version which was forwarded by my memorandum of July 6, 1982. The changes are highlighted below.

1. The problem statement has been revised.
2. An initiative for revising the construction inspection program has been added.
3. An initiative concerning designated representatives (FAA approach) has been added.
4. An initiative concerning qualification/certification of QA/QC personnel has been added.
5. An initiative concerning the QA planning and evaluation function (consolidation) has been added.
6. Management seminars have been recast to indicate that NRC will cooperate with industry in sponsoring the seminars.
7. The role and importance of followup of allegations in the inspection program has been emphasized in the SECY paper.

In other respects the recommendations, initiatives and information are substantially the same. The previous version had concurrence from NRR and RES. However, we have not provided the paper to those offices for concurrence.

We have reviewed the proposed paper against the Commission's statements to Congress on quality assurance and found the paper to be consistent with the Commission's statements. Enclosure 2 summarizes the review.

The long-term review, as contemplated, would be consistent with the Ford Amendment as it has been approved in conference, including the trial programs.

*Original Signed By
R. C. DeYoung*

Richard C. DeYoung, Director
Office of Inspection and Enforcement

Enclosures:

1. Proposed QA Paper
2. Written Statements to Congress

DEQA:IE *DA*
DP Allison
8/9/82 k1e

D-DEQA:IE
EL Jordan
8/9/82

DDIVE
JH Shiezek
8/9/82

D:IE *RC*
RC DeYoung
8/9/82

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

For: The Commission

From: William J. Dircks
Executive Director for Operations

Subject: ASSURANCE OF QUALITY

Purpose: To obtain Commission approval of recommendations to improve the assurance of quality in the design and construction of nuclear projects.

Discussion: The complexity and extent of problems that have been identified in the past few years at 5 of the 32 units now under active construction have caused concern regarding the quality of the design and construction of nuclear projects. These problems include nonconforming structural steel welds at Zimmer, seismic design errors at Diablo Canyon, inadequate soil compaction at Midland, voids in concrete structures at Marble Hill and design deficiencies at South Texas. Enclosure 3 summarizes recent experience at each of these 5 projects.

Analysis of the experience at problem sites has resulted in the classification of three primary problem areas: 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 appropriate corrective action; and failure of the NRC's programs to recognize the true extent and nature of the problems.

The first two 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.

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The third problem area is two-fold in derivation. 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. Second, previous NRC programs have not addressed design quality as specifically and extensively as other areas.

In response to the breakdowns in quality and quality assurance, the Chairman in a November 27, 1981 memorandum directed the staff to determine various approaches that could be taken to strengthen quality assurance, and to provide the Commission a preliminary evaluation of the approaches that appear most promising. On January 29, 1982 the staff briefed the Commission on initiatives that appeared to merit further consideration. Industry representatives from the Institute for Nuclear Power Operations (INPO) met with the Commission on February 4, 1982 to present their plans for improving the assurance of quality at plants under construction. On July 15, 1982 the staff again briefed the Commission on the actions taken to date and the initiatives under consideration.

The staff has developed recommendations that should lead to effective improvements in quality and quality assurance programs. While many of these recommendations require NRC actions, the underlying principle in their development has been that the ultimate responsibility for quality and safety remains with the nuclear industry, and none of the recommendations are intended to transfer this responsibility to the NRC. The recommendations are designed to establish additional confidence in the quality of design and construction activities and improve the management control of quality. The recommendations also are designed to improve the NRC capability to evaluate the implementation of licensee programs. Compliance with NRC requirements for the quality assurance program and its implementation is a major consideration in establishing this confidence.

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. The staff recommends implementation of a system of designated NRC representatives (analogous to the FAA system) to extend its inspection resources.

During the development of the recommendations presented in this paper, several additional actions were considered. Although an adequate basis to recommend additional actions could not be established at this time, further study is warranted. The staff recommends a long-term review, utilizing knowledge within and outside NRC to evaluate the merits of additional actions, monitor the outcome of ongoing industry and NRC initiatives and recommend changes in program direction as appropriate. This review would satisfy the direction provided the NRC in an amendment accepted by the House and Senate conferees in their joint consideration of the NRC's FY 82-83 authorization bill.

Some of the actions considered and endorsed by the staff are associated with existing agency programs. The followup of allegations is an essential part of the NRC's inspection program, and is an effective extension of inspection resources. Allegations provide an opportunity for non-NRC personnel to enter potential problems into the NRC's problem correction chain. The principal objective of the resultant NRC inspection effort is to obtain sufficient information through independent in-depth examinations to establish the significance of the particular allegation and to effect corrective action commensurate with its significance. To encourage and provide personnel an opportunity to make an allegation, NRC inspectors wear hard hats that uniquely identify them. The resident inspector's office has a telephone answering device for 24-hour response to callers, and the telephone numbers of the resident inspector and NRC regional office are listed in the local telephone directory. Effective October 12, 1982 NRC postings at the site will identify the legal protection afforded people who provide allegations.

With respect to enforcement, the NRC has sufficient authority to take appropriate enforcement action for inadequate quality assurance. The options extend over a broad range from meeting with a licensee, notices of violation and civil penalties to issuance of orders for modification, suspension or revocation of licenses. The staff intends to continue to take strong actions in response to significant quality assurance breakdowns and has expressed this intention in the enforcement policy.

Actions have been initiated at near-term operating license facilities to improve staff confidence in the quality of design and construction activities. These actions include self evaluations by licensees, and in most cases, an independent design review. The limited experience to date with the independent design reviews (Enclosure 4) includes the

identification of numerous deficiencies (nonconformances with the original specifications), which have required reanalysis. Relatively few of the deficiencies have required hardware changes, and to date, none of the deficiencies identified would have prevented safety-related components, systems, or structures from performing their intended function.

The initiatives recommended in this paper are directed toward reactor facilities not yet licensed for operation. At this time, the staff believes a reasonable basis for not backfitting these initiatives to operating reactors is provided by previous reviews of the facilities, their operating history, extensive startup test programs, and the reviews and upgrades in response to TMI and Bulletin actions. The staff believes that further consideration should be given to operating reactors as part of the long-term review.

The staff recommendations are summarized below. The staff recommends continuing those actions that are already underway and implementing the remainder of the recommendations as soon as practicable. Each initiative is described further in Enclosure 1.

° Measures at Near-Term Operating License Facilities

The NRC should continue to employ the measures currently in use to establish confidence in the quality and effectiveness of utility quality assurance programs at near-term operating license facilities until other NRC or industry programs are capable of providing this confidence. These measures include applicant self evaluation, independent design review and regional evaluations.

° Industry Initiatives

The NRC should continue to interact with INPO in its development of industry initiatives, measure their effectiveness and adjust the corresponding NRC actions to provide for effective use of both industry and NRC resources.

° Construction Programs

The NRC should complete development and implement planned revisions to enhance the effectiveness of its construction inspection procedures.

The NRC should complete development and implement its program for construction assessment team inspections at selected facilities to provide a basis for evaluation of the management performance essential to quality construction.

The NRC should complete development and implement the integrated design inspection process to assess the quality of design activities including examination of as-built configuration at near-term operating licensee facilities.

The NRC should expand its capability to identify generic design and construction deficiencies by computerized analysis of information reported by vendors, construction permit holders and NRC inspectors.

The NRC should pursue revision of its statutory authority to allow implementation of a system of designated representation analogous to the system employed by the Federal Aviation Administration.

Management

Quality management seminars for top level managers with facilities under design and construction should be sponsored by industry. The seminars would focus recent experience of selected managers and recognized experts in the design and construction of nuclear projects.

The NRC will request that each utility with a facility under construction reevaluate its quality assurance program and implement improvements in areas where the evaluations identify a need.

The NRC should take actions to improve the enforcement of existing standards for qualification of quality assurance and quality control personnel and pursue establishment of a system of third party qualification and certification for such personnel.

The NRC should continue to explore with labor and other organizations, potential methods and incentives to assure quality in design and construction related production activities.

° Long-Term Review

The NRC should commence a long-term review for continuing evaluation of quality and quality assurance problems related to design, construction, testing and operations, and potential solutions to those problems and their impact on the adequacy of NRC quality assurance policies and programs. Expertise outside NRC should be utilized by establishing an advisory panel to the NRC staff.

° Quality Assurance Planning and Evaluation

The NRC should make organizational realignments to combine within a single organization the functions of research, standards development and inspection program development for quality assurance at reactors. The licensing function should remain in NRR until regionalized. Upon regionalization the program direction and assessment will be combined with the rest of the QA overview function.

The staff has developed resource estimates and implementation schedules for the new initiatives. The resource estimates, implementation schedules, and staff responsibilities for implementation are discussed in Enclosure 2. The staff responsibilities are assigned consistent with the recommended organizational realignment. The resource estimates to implement the recommended initiatives are summarized below.

1. Estimated Industry Resources

280 man years new effort recommended in FY 83
310 man years new effort recommended in FY 84

2. Estimated NRC Staff Resources

15 staff years new effort recommended in FY 83
11 staff years new effort recommended in FY 84

3. Estimated NRC Contractor Resources

\$2.2 million new effort recommended in FY 83
\$1.4 million new effort recommended in FY 84

Recommendation: That the Commission approve the staff proposals as summarized above.

William J. Dircks
Executive Director for Operations

Enclosures:

1. Initiatives
2. Resources, Schedules and Staff Responsibilities
3. Examples of Recent Quality Assurance Problems
4. Independent Design Review for Near-Term Operating License Facilities

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INITIATIVES

I. Introduction

The Commission has considered quality assurance to be a key factor in the design, construction and operation of nuclear power plants for many years. Proposed versions of the General Design Criteria used in 1967 recognize the interest in quality assurance. Appendix B to 10 CFR 50, published in June 1970, described mandatory criteria for acceptable quality assurance programs for safety-related features.* Subsequently, a number of national standards and regulatory guides providing additional guidance have been issued to upgrade quality assurance programs. In the 1973 time frame, the Atomic Energy Commission expended major effort to communicate to industry the framework, e.g., plans, procedures, organization, of a quality assurance program that would be acceptable to AEC. This framework is reflected in current quality assurance programs that have been approved by NRC.

II. Problem Statement

Examination of the problems that have been identified recently indicates that the fundamental cause of most design and construction deficiencies is the lack of total management commitment to quality. This lack of commitment has been intensified by the lack of understanding of the role of quality assurance in project management and the lack of total understanding of what is required of personnel at all levels of the process.

The owner's project management team is responsible for the overall planning and management of the design, construction, and testing of the nuclear power plant. If the senior management has a strong commitment to quality, and if that commitment is imbued in a capable project management team, then the subsequent actions of this team will communicate that commitment to all involved parties. The project management team communicates and

*As used in this paper and defined in Appendix B, quality assurance comprises all those planned and systematic actions necessary to provide adequate confidence that a structure, system, or component will perform satisfactorily in service. Quality assurance includes quality control, which comprises those quality assurance actions related to the physical characteristics of a material, structure, component, or system which provide a means to control the quality of the material, structure, component, or system to predetermined requirements.

obtains through contractual and procedural arrangements with the designers, fabricators, and constructors a level of quality commensurate with the owner's commitment. The commitment to cost and schedule must be properly balanced with quality through these contractual and procedural arrangements. For example, if the constructor earns contractual credit strictly with the schedule of physical installation, the message from project management is production. On the other hand, if earned credit is commensurate with the schedule of owner accepted, adequately documented installation, the message is quality production. The latter case provides the proper incentive for getting work accomplished right the first time. This is then reflected in the policy and procedural direction to the various organization sub-tiers.

Similarly, the role of quality assurance in the project management team is determined by the senior management's commitment to quality. Proper implementation of the quality assurance criteria is an important element in successful project management. However, quality assurance programs cannot substitute for poor project management or a lack of commitment to quality. Quality assurance must be an integral part of all of the project planning and management activities from the projects inception, and its role must be communicated and fully understood by all participants in the design and construction process (from senior management to the craftsman). For example, if the inspection function is planned and conducted as an integral part of physical installation activities, then early detection and correction of procedural or other inadequacies will result in enhancing quality, cost, and schedule. All participants must be adequately trained to understand and obtain these benefits.

Weaknesses in the existing approach to assuring quality are apparent. They are evidenced by the frequency and severity of design and construction deficiencies, and by the failure or delay of industry and NRC recognition of the extent and nature of the breakdowns.

Previous efforts by the NRC to assure program content and structure have not been balanced with comparable efforts to assure successful program implementation. The NRC's licensing and inspection programs have not sufficiently examined the project management controls at sites under construction, but have been oriented towards assuring the adequacy within major technical and functional areas, e.g., concrete, electrical, etc. The systematic assessment of management performance and evaluation of all available information at construction facilities did not receive the same level of effort as operating sites. Previous NRC programs have not addressed design quality as specifically and extensively as other areas.

In sum the fundamental issues can best be characterized as the lack of total management commitment to quality and the uncertainty in industry's and NRC's ability to detect and correct the resulting deficiencies. The need to resolve these issues is the basis for the following recommendations.

III. Initiatives

A. Measures at Near-Term Operating License Facilities

For those plants in the Near-Term Operating License (NTOL) status, the NRC has implemented three interim measures to provide additional confidence that required quality assurance programs have been successfully implemented and completed during the design and construction of the nuclear facility. These measures will be continued until replaced by adequate industry programs or permanent changes in the present NRC program.

1. Self Evaluation

An applicant for an operating license will perform a comprehensive self evaluation of the effectiveness of the quality assurance program for design and construction. This requires an overall description of the project's quality assurance program for design and construction. The self evaluation is a survey of the overall quality assurance program. The survey will describe the development and history of the program, management involvement, audits, reviews, significant problems and corrective actions. The NRC staff reviews the self evaluation and provides the results of its review to the licensee. Additional work, such as corrective actions or further audits, may be required in particular areas. In addition, the Chief Executive Officer or his designee is required to certify that the facility has been designed, constructed, and tested in accordance with the Final Safety Analysis Report and other licensing commitments.

2. Regional Evaluation

On each new operating license, the NRC staff considers whether there is a need for additional inspections of selected areas based on an evaluation of the project's inspection and enforcement history. This assures consideration of the need for a better assessment of performance in potentially weak areas. The project's inspection and enforcement history is evaluated with particular attention to the significant problems that have been noted at other construction sites. Other information considered includes known problem areas, results of NRC inspections and the Systematic Assessment of Licensee Performance program, and problems noted elsewhere with the same contractors. Additional inspections are performed as warranted in potentially weak areas.

3. Independent Design Review

Based upon results of the self evaluation and regional evaluation, an applicant for an operating license may be requested to have an independent design review conducted. The criteria for determining which facility, and the scope and extent of the design review also include the combined nuclear experience of the licensee, architect-engineer, and contractors. The review provides an evaluation of the quality of design based on a detailed examination of a small sample. The staff specifies a sample area appropriate to the particular project. For LaSalle, the mechanical and structural loads on the residual heat removal system under blowdown and operating basis earthquake conditions were specified. The independent review addresses programmatic areas, e.g., classification of systems and components, design and verification records, interface control and interdisciplinary review, consistency with FSAR, nonconformances and corrective actions, and audit findings and resolutions. The review includes verification of specific design features by independent calculations and comparison of installations against as-built drawings. The NRC staff reviews the selection of the independent review organization and the plan before implementation, audits the work in progress, and reviews the results.

B. Industry Initiative

The industry initiative is not an NRC staff proposal, but a program that the industry is presently developing. The NRC staff is monitoring this program in order to take best advantage of the industry efforts.

The Institute for Nuclear Power Operations (INPO) is developing criteria which will be used to evaluate quality assurance for design and construction. As with the existing INPO criteria for plant operation, they will be based on "best practice," rather than minimum standards of acceptability. Licensees will use the criteria for self-initiated evaluations (which can be performed either by an independent group within the utility or a contractor). The self-initiated evaluations will be submitted to INPO by the end of 1982. During this trial process, the NRC staff will be involved by reviewing the criteria and observing some of the evaluations. Details of the staff involvement have not yet been developed.

The industry will decide, by early 1983, on the direction of a continuing program. At present, the primary alternatives appear to be: INPO will either begin conducting quality assurance evaluations at individual construction facilities, or a form of self-initiated evaluation will continue.

INPO is also conducting management workshops (May 1980, September 1981 and October 1982) with utility chief executive officers and plant managers in an effort to strengthen the utility commitment to safe operation. NRC will coordinate its quality management seminars (Enclosure 1, Section D.1) with the industry efforts.

C. Construction Inspection Program

1. Procedure Changes

The staff is presently revising the individual inspection procedures for the various technical disciplines. The main purposes of the procedure revision are: (1) to facilitate performance of the procedures by resident inspectors with reduced input from regional-specialist inspectors; (2) eliminate redundancies in the procedures; (3) reexamine scope or frequency of some inspections based on limitations on inspector resources; and (4) shift emphasis of inspection from record review to observation of work. This staff effort is continuing. The first series of revised procedures which cover inspection of mechanical systems are in the final stages of issuance.

2. Construction Assessment Team Inspections

This initiative will extend the concept of the NRC's Performance Appraisal Team (PAT) inspection program for operating reactors to about four selected plants under construction per year. This initiative was directed by the Commission in response to SECY 82-150 dated April 8, 1982, "The Performance Appraisal Team (PAT) Inspection Program."

The procedures for performing management control inspections at nuclear construction sites were revised by the staff in 1981. The procedures covered licensee management performance in the following construction areas: Quality Assurance, Design Controls, Project Management, Construction Controls, and Procurement Controls. During 1981, eight trial inspections were performed by regional-based inspectors using the revised procedures. These inspections were effective in identifying management control problems not identified by the routine inspection program. The manpower demand in these eight inspections caused the Regional Administrators to defer further performance of this type of inspection.

The Construction Assessment Team inspections to be initiated by the IE staff would be similar to the construction inspections performed previously by the Regional Offices. A team of approximately six individuals with skills in the various areas to be inspected, including contractor personnel with appropriate backgrounds, will visit the selected construction site for two to three weeks. Additional site visits will be scheduled if necessary to collect additional information or clarify initial observations. The first site inspection has been tentatively scheduled for Bellefonte in September/October 1982.

The construction assessment will complement the integrated design inspection. The latter is focused on a narrow area of technical inspection, while the construction assessment is designed to assess the broader programmatic controls. Like the integrated design inspection, the scope of construction assessments will be modified to be responsive to unique conditions at a particular facility.

3. Integrated Design Inspections

The objective of this initiative is to expand NRC examination of quality assurance into the design process. The staff is developing an inspection approach which provides a comprehensive examination of the design development and implementation for a selected system and structure on a given project. This evaluation will encompass the total design process from the formulation of principal design and architectural criteria through the development and translation of the design and its revisions. It will conclude with onsite verification on a sampling basis, of the design of the installed system and structure. This inspection will integrate and augment selected activities of NRR, IE, the vendor inspection program, and the regional office. Following development of the evaluation methodology, the staff will conduct a trial inspection with contractor assistance. Subsequent inspections will be performed with a substantial amount of contractor assistance. The results will be provided to the appropriate regional and headquarters offices to be used as input to the overall NRC assessment prior to issuance of the operating license.

The evaluation will be a multi-disciplined review that will address areas such as mechanical, electrical, structural, instrumentation and control. The evaluation will include checking sample calculations, however, the emphasis will be on the systematic management of the total design process. The procedures to implement this approach are presently under development. A discussion of the conceptual logic necessary to evaluate the design process follows.

The evaluation will start with development of a logic or flow network of the design process. Each functional entity within the design organization will be identified. For each of these entities, internal and external design interfaces which involve transmittal of design information will be specified. From this network, critical design areas or areas with the least tolerance for error will be identified. Within each of the design entities, the specific procedures for the verification and transmittal of design information will be reviewed for conformance with the overall quality assurance program, and to identify specific weaknesses in the design process. Based on the results of the procedure review and the identification of critical design areas, a specific sample of the system and structure will be audited. Criteria will be preestablished for expanding or terminating the audit when problem areas are identified.

In examining a system or structure and its specifications, the review will focus on topics such as:

- (a) Validity of design inputs and assumptions.
- (b) Validity of design specifications.
- (c) Validity of analyses.
- (d) Identification of system interface requirements.
- (e) Potential synergistic effects of changes.
- (f) Proper component classification.
- (g) Revision control.
- (h) Documentation control.
- (i) Verification of as-built condition.

The scope of the evaluation can be modified to be responsive to unique conditions for a particular facility, or known or suspected generic problems. This approach will examine all facets of the design management process for a limited sample.

4. Evaluation of Reported Information

Improvements are planned in the current program for systematic review of information pertaining to design and construction quality that is now reported pursuant to 10 CFR 21, "Reporting of Defects and Noncompliances," and 10 CFR 50.55(e), "Construction Deficiency Reports." This program would have objectives similar to those of the Office for Analysis and Evaluation of Operational Data (AEOD) for nuclear power plant operations. Computerized diagnosis would be used to enhance identification of relationships that may not be evident in the manual screening that is done now. No expansion of reporting requirements is currently planned but revisions are expected to facilitate computer input of key information.

5. Designated Representatives

Federal Aviation Regulations (14 CFR 183) prescribe the requirements for the issuance of designations to private persons to act in the capacity of FAA representatives in the examination, inspection and testing necessary for the issuance of aircraft certificates by the Administrator. Nominees meeting the requirements for appointment are authorized to represent the FAA in determining the compliance of aircraft, aircraft components, and their repair or alterations with the requirements of the Federal Aviation Regulations. They serve as direct representatives of the FAA in the performance of duties and are guided by the same requirements, instructions, procedures and interpretations as FAA employees in the performance of those duties. These programs include the Designated Manufacturing Inspection Representative (DMIR) and the Designated Engineering Representative (DER). The DER represents the FAA in helping to determine that the aircraft design complies with the relevant requirements of the regulations and the DMIR represents the FAA in certifying certain product and manufacturing functions. These designations are effective for one year but may be renewed for additional periods of one year.

A similar technique of using the designated representatives would be useful to the NRC inspection effort. It would increase the number of inspectors available to implement the inspection program by providing an immediate source of qualified experienced personnel. Using designated NRC representatives to check key aspects of the design, fabrication and construction of a plant at the specific time increased inspection effort is warranted; would significantly raise the NRC's confidence level of quality assurance in nuclear power plants. For example, during the preoperational and startup testing phases of a plant, designated representatives could provide the additional inspection effort so that all tests are monitored rather than a selected few. Increased inspection effort could also be applied at problem construction sites without having to reduce the routine level of inspection effort at other construction sites.

The aviation industry uses holdpoints in the manufacturing process that require inspection and certification by an FAA inspector before the process can continue. The designated representative, provided by the aviation industry and acting for FAA, can provide that certification when required, which allows the process to continue without delays. It is therefore an advantage to the aviation industry to provide designated representatives and prevent costly delays in their manufacturing process. There is no analogous situation to that process at

nuclear plants. There are no preestablished holdpoints (other than CP and OL issuance) in the construction or operation of a nuclear plant that require NRC approval before the process can continue. Therefore, for the designated representative program to be successful for the NRC, program incentives would have to be developed to encourage the utilities to support the program.

Under the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974, as amended, as well as other pieces of legislation, the Commission does not have the authority to designate licensee personnel as inspectors in a manner similar to the Federal Aviation Administration's authority under its legislation and regulations (see 49 U.S.C. 1355, 31 U.S.C. 483a, and 14 CFR 183). The FAA has the authority to issue designations to provide persons to act in the capacity of FAA representatives while remaining in their original employee status as far as receiving pay. To act in a similar way the NRC would have to have the Atomic Energy Act amended and would have to promulgate regulations based on this amendment.

The staff proposes to pursue the statutory changes necessary to implement a designated representative program and to continue development of program specifics.

D. Management

1. Management and Quality Improvement Programs

The objective of this initiative is to improve attitude and performance throughout all levels of licensee and contractor organizations. The problems that have arisen at construction sites are closely associated with management attitudes and practices. Quality in design and construction is invariably associated with the highest level of management being totally committed to quality. Senior managers are personally committed and are unrelenting in their demands on their staffs and contractors for a similar commitment.

The NRC will cooperate with industry in sponsoring a continuing series of seminars in which top level nuclear managers can communicate the advantages that can be gained through strong management involvement in their own QA programs. The seminars will be conducted with assistance from independent quality professional, utility and contractor representatives and the NRC. The seminars will be highlighted by the participation of managers from utilities which have experienced serious quality

assurance problems and those which have managed highly successful programs. The independent quality professionals will convey the improvement principles and techniques of implementation. The utility and contractor representatives will identify incentives for defect prevention based on direct experiences. The expected outcomes of these seminars will be recognition on the part of licensee and contractor management that positive incentives and benefits are achievable through enthusiastic implementation of aggressive quality assurance programs. While this initiative is directed to facilities under construction, participation by facilities in testing and operation will be strongly encouraged.

10 CFR 50, Appendix B, Criterion 11 requires each utility to regularly review the status and adequacy of its quality assurance program. The extent and nature of the recent breakdowns in quality assurance programs have indicated that this review has not been effective in maintaining an adequate quality assurance program at several facilities under construction.

Each utility with a facility under construction will be requested to reevaluate its quality assurance program, and to implement improvements in areas where the evaluations identify a need. Each utility should identify a senior executive with overall responsibility for the evaluation and implementation of the necessary improvements. The NRC will monitor the evaluation and implementation of the necessary improvements. It is expected that improvements in the quality assurance program will incorporate actions such as those listed below.

- (a) Conduct training sessions for its personnel involved in design and construction. These sessions should emphasize the importance of each individual's contribution to ensuring quality and the enhancement to the cost and schedule goals which can be achieved with a positive program. The result of these sessions would be to get supervisors and employees in the habit of talking positively about quality.
- (b) Provide better evaluation on a routine basis of status reports to detect both trends and current nonconformance problems. Based on this information, meaningful corrective actions can be promptly taken to prevent recurrence of both the specific problems and the root cause. The result would be defect prevention as a routine part of the operation.

- (c) Provide feedback on the achievements of the quality assurance program, emphasizing the improvements from all involved in the program to maintain the concern and enthusiasm on the project toward ensuring quality.
- (d) Establish a system through which all parties are encouraged to communicate to management the situations that make it difficult for the employee to perform quality work. This information will be included in the system for taking corrective actions. The result of this system would be that employees know that their problems can be heard and addressed.

2. Certification of QA/QC Personnel

A significant and prevalent problem in the construction of nuclear power plants is the qualification status of personnel working in the quality control and quality assurance areas. Some utilities have waived, without suitable bases, the education and experience requirements for these people. The NRC has not sufficiently enforced these requirements through its inspection efforts.

Currently, various standards exist for the qualification of QA/QC personnel, for example:

- (a) ANSI N45.2.6, Qualification of Testing & Inspection Personnel
- (b) ANSI N45.2.23, Qualification of QA Audit Personnel
- (c) ANSI N626.3 (Draft), Qualification & Duties of Personnel Engaged in ASME Boiler & Pressure Vessel Code, Section III, Division 1 & 2 Certifying Activities
- (d) ASME Section III, Division 2, Appendix VII Qualification of Concrete Inspection Personnel
- (e) ASNT, Certification of Level III Nondestructive Testing Personnel
- (f) AWS QCI-82, Qualification & Certification of Welding Inspectors

The staff believes that significant improvements can be made in the assurance of quality at nuclear projects through the certification of QA/QC personnel. To achieve these improvements the NRC will direct more attention to the enforcement of the existing standards for the qualification of QA/QC personnel.

Certification of personnel engaged in QA/QC inspections would provide a cadre of industry personnel that have been certified to meet minimum levels of demonstrated inspection capabilities.

Long-term consideration of formal certification of various levels of QA/QC personnel is being given using the following alternatives.

- (a) Third party certification of personnel engaged in QA/QC inspection functions.
- (b) NRC Licensing of personnel engaged in QA/QC inspection functions.

A program for third party certification of Nondestructive Testing (NDT) personnel is currently underway with coordination between the Electric Power Research Institute (EPRI), member utilities, American Society of Nondestructive Testing (ASNT) and NRC. The program includes developing a standard written practice for the qualifications of the level III NDT inspectors as well as administering basic and method examinations and specific and practical examinations in the respective areas of nondestructive testing. A registry of personnel holding the required qualification and certification would be maintained by the third party organization. Unsatisfactory performance would result in removal from the registry through an established procedure. Programs similar to this could be established in other areas such as welding, inspectors QA auditing, concrete inspectors, and laboratory testing personnel.

3. Craftsmanship

The staff has initiated discussions with labor unions involved in nuclear construction in an effort to explore the potential methods and incentives to enhance the crafts role in assuring the quality of construction activities.

Feedback from the labor unions included the following points:

- (a) Craftsmen are not well informed of their role in the QA/QC process.
- (b) Continuous rework as a result of changes has a demoralizing effect on craftsmen and effects the quality of the final work.

- (c) Utilities and contractors have not provided adequate training to craftsmen regarding quality.
- (d) Utilities are not convinced that quality assurance is a cost effective approach to construction. Labor perceived the utilities to think QA/QC was a "high cost" item rather than a "cost saving" tool.
- (e) Improved front-end engineering and procurement would reduce the amount of change and rework.
- (f) A Nuclear Stabilization Committee has been established with representatives from labor, utilities and contractors to improve relations between labor and management.

The staff proposes to continue these discussions as part of the long-term review.

E. Long-Term Review

Long-term NRC quality assurance policies and programs will be based on a review which assesses existing agency and industry quality assurance activities in a broad manner and then recommends an integrated long-term agency plan for quality assurance. Additionally, the review will focus the viewpoints of various sectors of the public and the regulated community.

The primary function of the long-term effort will be to conduct a thorough review of continuing quality and quality assurance problems, and to propose solutions to improve the quality assurance programs for design, construction, testing and operation. This review will include a detailed assessment of the problems that developed at facilities such as Diablo Canyon, South Texas, Midland, Marble Hill, and Zimmer. The object of this assessment will be to identify, as concisely as possible, specific problems that have occurred and their root causes, particularly in the area of programmatic deficiencies. Additionally, the review will evaluate existing programs at facilities which have programs that are functioning properly in order to identify the positive aspects of those programs that should be applied generically. Both this review and the review of programs at problem facilities will involve site visits by the personnel performing the review.

Proposed solutions to generic and plant-specific quality and quality assurance problems will be reviewed critically to determine whether the recommended actions would actually resolve the identified problems. The review will develop estimates of the qualitative and quantitative value/benefit and impact/cost of proposed solutions, and ways in which they should be implemented for operating plants, plants presently under construction, or for plants to be constructed in the future.

The review will be conducted by the NRC staff and will include representatives from headquarters, the regional offices, and consultants to the NRC. An advisory panel will be established to provide recommendation on the scope and direction of the review and to provide a peer review service. The members of the panel would be selected from government, industry and special interest groups. Their function would be to provide a broad spectrum of insights and viewpoints to the NRC review group. The panel will assure a proper balance of considerations in the findings and recommendations of the review.

The House and Senate in their current joint consideration of the NRC's FY 82-83 authorization bill have accepted in conference an amendment which directs the NRC to study ways to improve quality assurance programs. Implementation of this review is consistent with that direction. The review will commence shortly after Commission approval of this proposal. It is expected that findings and recommendations from the review will be available for Commission consideration within one year of Commission approval.

F. Quality Assurance Planning and Evaluation

The recommendation to form a single organizational unit dedicated to the various aspects of quality assurance was made in a report prepared for the NRC by Sandia Labs in August 1977, entitled "A Study of the Nuclear Regulatory Commission Quality Assurance Program."*

*Page 60, "A Study of the Nuclear Regulatory Commission Quality Assurance Program," NUREG-0321

The centralization of quality assurance functions has been one of continual interest and now more than ever needs to be achieved.

The NRC presently views responsibility for quality assurance as threefold: first, to determine the adequacy of the licensee's quality assurance program description contained in the safety analysis report; second, to ascertain that the licensee has established and adequately implemented the approved quality assurance program and to verify compliance with NRC regulations; and third, to develop the regulations, standards and guides addressing QA in the design, construction and operation of nuclear facilities.

The responsibility for these three functions is currently divided among three separate offices, NRR, IE and RES, with execution of the inspection function from five regional offices. These three functional areas are not separate and discrete areas but are highly interrelated, requiring continual interface. For example, the inspection experience needs to be continually factored into the licensing effort, inspection program development and development of regulations and standards. In addition, recent quality assurance issues (e.g., Diablo Canyon, Marble Hill, South Texas) have been highly reactive and have required rapid NRC management attention and response from the three separate offices for their various quality assurance functional areas.

The functional quality assurance areas need to be realigned for the following reasons:

- (a) To more effectively utilize the limited staff resources and expertise in quality assurance engineering.
- (b) To establish a more discernible policy and position on quality assurance issues.
- (c) To establish unity of control and to provide both information and coordination with industry.
- (d) To bring together the licensing, inspection and standards functions on interrelated issues.
- (e) To provide industry a signal that NRC management considers quality a leading part of the NRC operation and of sufficient importance to depart from the existing organizational structure.

It is recognized that most NRC activities are quality assurance related. The NRC review process is an interdisciplinary function involving many organizational components. Only those NRC headquarters activities which directly relate to the review and evaluation of the implementation of licensee's QA programs and development of NRC rules, standards and guides are recommended to be consolidated at this time. Such consolidation will occur in the Office of Inspection and Enforcement. At a later point in time, after phasing out the NTOL reviews, the licensing function will be regionalized. Upon regionalization, the program direction and assessment will be combined with the rest of the QA overview function.

Resources, Schedules and Staff Responsibilities

The nuclear industry currently expends substantial resources for quality assurance at power reactors. For example, about 7500 positions are currently devoted to quality control and quality assurance on construction projects.

The NRC Regional Offices devote about 130 positions to inspection of power reactors under construction and vendors. These inspections are concerned, to a great degree, with the effectiveness of the quality assurance programs in the various areas that are being inspected. This effort, which provides a measure of the overall effectiveness of the quality assurance programs, is the largest segment of the NRC's efforts related to quality assurance at construction projects. A smaller part of this inspection effort (about 28 positions) is narrowly directed towards inspecting the quality assurance programs.

In a broad sense, the headquarters offices also devote considerable efforts to quality assurance. In the narrow sense, they devote about 16 positions to direct professional work on quality assurance programs as follows: 4 positions licensing; 7 positions inspection program (QA related) development and development of QA initiatives; 5 positions research and standards development. Much of this effort can be considered applicable to construction projects.

NRC contractor work has previously been at a level of about \$400,000 per year for research/standards development in quality assurance.

The estimated resources for the initiatives discussed in this paper are provided in Tables 1 and 2. They can be summarized as follows:

1. Estimated Industry Resources

- (a) In FY 83
 - (i) 280 man years new effort recommended
 - (ii) 420 man years altogether
- (b) In FY 84
 - (i) 310 man years new effort recommended
 - (ii) 390 man years altogether

2. Estimated NRC Staff Resources

- (a) In FY 83
 - (i) 15 staff years new effort recommended
 - (ii) 36 staff years altogether
- (b) In FY 84
 - (i) 11 staff years new effort recommended
 - (ii) 21 staff years altogether

3. Estimated NRC Contractor Resources

- (a) In FY 83
 - (i) \$2.2 million new effort recommended
 - (ii) \$2.2 million altogether
- (b) In FY 84
 - (i) \$1.4 million new effort recommended
 - (ii) \$1.4 million altogether

New efforts correspond to the new initiatives recommended by the staff, i.e., those that are not already underway and well established.

Generally, additional efforts are not large in comparison to the resources already devoted to QA. The improvements will come mostly from redirection of existing resources. NRC staff and contractor resources can be redirected as necessary to accomplish the initiatives without dropping any planned accomplishments although the depth and schedule of some planned accomplishments will necessarily be affected. NRC staff responsibilities with respect to development and implementation of the initiatives are indicated in Table 3. The schedules for accomplishing the initiatives are provided in Figure 1.

Table 1 - Estimated Resources for QA Initiatives (New Efforts)

QA INITIATIVES	FY 83 (1)			FY 84 (1)		
	INDUSTRY (MAN YR)	NRC STAFF (STAFF YR)	NRC CONTRACT (\$ THOU.)	INDUSTRY (MAN YR)	NRC STAFF (STAFF YR)	NRC CONTRACT (\$ THOU.)
NRC - Self Evaluation ⁽²⁾						
NRC - Regional Evaluation ⁽²⁾						
NRC - Independent Design Review ⁽²⁾						
Industry Initiative						
Inspection Procedure Changes						
Construction Assessment ... Inspections	0.6	5.0	300	0.6	6.0	600
Integrated Design Inspections	0.3	3.5	800	0.9	1.4	320
Evaluation of Reported Information		0.2	250		0.2	350
Designated Representatives		0.5		84	2.0	
Management ... Programs	270	1.4	100	200	0.8	
Certification ... Personnel	2.7	3.8		20	0.8	
Craftsmanship		3.4				
Long Term Review		1.8	750		0.1	100
Quality Assurance ... Evaluation						
TOTALS: (3)	280	15	2200	310	11	1400

NOTES:

- (1) Resource estimates for initiatives related to licensing peak sharply in FY 83 and drop sharply in FY 84. Construction delays may reduce this variation.
- (2) NRC programs may be reduced beginning in mid FY 83 as other NRC and industry activities take effect.
- (3) Totals are rounded to two significant figures.

Table 2 - Estimated Resources for QA Initiatives (Altogether)

QA INITIATIVES	FY 83 ⁽¹⁾			FY 84 ⁽¹⁾		
	INDUSTRY (MAN YR)	NRC STAFF (STAFF YR)	NRC CONTRACT (\$ THOU.)	INDUSTRY (MAN YR)	NRC STAFF (STAFF YR)	NRC CONTRACT (\$ THOU.)
NIOI - Self Evaluation ⁽²⁾	10	2.5		3.6	0.9	
NIOI - Regional Evaluation ⁽²⁾	0.8	8.5		0.3	3.9	
NIOI - Independent Design Review ⁽²⁾	63	5.0		23	1.8	
Industry Initiative	74	2.6		54	1.3	
Inspection Procedure Changes		3.0			3.0	
Construction Assessment ... Inspections	0.6	6.0	300	0.6	6.0	600
Integrated Design Inspections	2.3	3.5	800	0.9	1.4	120
Evaluation of Reported Information		0.2	250		0.2	350
Designated Representatives		0.5		84	2.0	
Management ... Programs	270	1.4	100	200	0.8	
Certification ... Personnel	2.7	0.2		20	0.8	
Craftsmanship		0.4				
Long Term Review		1.2	750		0.1	190
Quality Assurance ... Evaluation						
TOTALS: ⁽³⁾	420	36	2200	390	21	1400

NOTES:

- (1) Resource estimates for initiatives related to licensing peak sharply in FY 83 and drop sharply in FY 84. Construction delays may reduce this variation.
- (2) NIOI programs may be reduced beginning in mid FY 83 as other NRC and Industry initiatives take effect.
- (3) Totals are rounded to two significant figures.

Table 3 - Staff Responsibilities for QA Initiatives

QA INITIATIVES	STAFF RESPONSIBILITIES			
	REGION	OTL	MMR	ALOD
MMR - Self Evaluation	ASSIST		LEAD-REVIEW	
MMR - Regional Evaluation	LEAD-PERFORM	PROCESSES		
MMR - Independent Design Review	ASSIST		LEAD-REVIEW	
Industry Initiative	MONITOR	LEAD-QUALITY	REVIEW	
Inspection Procedure Changes		DEVELOP-ASSIST		
Construction Assessment ... Inspections		PERFORM		
Integrated Design Inspections	ASSIST	LEAD-DEVELOP	ASSIST	
Evaluation of Reported Information		LEAD-DEVELOP		
Designated Representatives	IMPLEMENT	LEAD-DEVELOP		
Management ... Programs	MONITOR	LEAD-DEVELOP		
Certification ... Personnel	INSPECT	LEAD-DEVELOP		
Craftsmanship		PERFORM		
Long Term Review	ADVISE	LEAD-PERFORM	ASSIST	
Quality Assurance ... Evaluation		LEAD-IMPLEMENT		

Figure 1 - Schedule for Quality Assurance Initiatives

HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES

Self Evaluation

Regional Evaluation

Independent Design Review

INDUSTRY INITIATIVE

CONSTRUCTION INSPECTION PROGRAM

Procedure Changes

Construction Assessment Team Inspections

Integrated Design Inspections

Evaluation of Reported Information

Designated Representatives

MANAGEMENT

Management and Quality Improvement Programs

Certification of QA/QC Personnel

Craftsmanship

LONG-TERM REVIEW

QUALITY ASSURANCE PLANNING AND EVALUATION

Projected Licensing Schedule



Dashed Lines Indicate development

Solid Lines Indicate Implementation

1982

1983

1984

1985

1986

1987

1988

1989

1990

1991

1992

1993

1994

1995

1996

1997

1998

1999

2000

2001

2002

2003

2004

2005

Examples of Recent Quality Assurance Problems

During the past few years, there have been serious quality assurance problems at nuclear power plants. Some examples are listed below:

1. Marble Hill

In June and July 1979, NRC confirmed allegations of improperly repaired concrete imperfections at Marble Hill. The imperfections were generally identified as concrete consolidation problems (honeycomb and voids), and improper repair (patching) of these imperfections.

NRC inspections confirmed that:

- a. An excessive amount of honeycomb and air voids had occurred. Approximately 4000 concrete patches existed.
- b. In many instances these imperfections were improperly repaired, and/or unacceptable materials were used for the repair.
- c. Quality control records traceable to the repairs were either non-existent or inadequate.
- d. Personnel responsible for such repairs were inadequately trained and supervised.
- e. The licensee was not in control nor sufficiently aware of the above circumstances.

These events led to a halting of all safety-related work at the site in August 1979. Work was not permitted by NRC to resume until December 1980, when the utility's quality assurance program and that of its contractors, had been substantially upgraded and the adequacy of completed construction work had been verified.

2. Midland

Excessive settlement of the diesel generator building was observed in 1978. The unexpected settling was subsequently attributed to inadequate and poorly compacted soil under the building. Other safety-related systems and structures were affected. NRC's investigation determined that design and construction specifications had not been followed during placement of the soil fill materials and that there was a lack of control and supervision of the soil placement activities by the utility and its contractors. Extensive rework has begun, and the operating license application is currently being litigated before an NRC Hearing Board.

3. Zimmer

Allegations received in January 1981 prompted an NRC investigation of quality assurance problems at the Zimmer site. The investigation has identified a large number of quality assurance related problems. The majority of the problems identified focus on the ineffectiveness of controls implemented by the licensee and its contractors for assuring the quality of work performed. In that regard, numerous deficiencies have been found concerning traceability of materials, handling of nonconformance, interface between construction and quality control, quality records, and the licensee's overview of ongoing work.

An extensive review of the as-built plant is being performed. Limited independent measurements were performed by the NRC in selected areas of concern in an attempt to characterize the actual safety significance of these deficiencies. Although a few problems requiring corrective action were identified, the majority of the tests and examinations disclosed no hardware problems. The licensee will perform a comprehensive quality confirmation program and resolve identified problems before an operating license is issued.

4. South Texas

In response to allegations that QC inspectors were being threatened if they reported unacceptable items during concrete placements, the NRC initiated an investigation through its Region IV Office in July 1977. Ten investigations of allegations were performed during the period July 1977 to November 1979.

The results of these investigations established that the allegations of harassment, intimidation and lack of support of QC inspectors were substantiated. The investigation demonstrated shortcomings in the management and that the implementation of the QA/QC program at the South Texas Project did not meet the standards required to assure that the facility will be constructed to NRC requirements. Safety-related work was stopped in 1980. NRC allowed restart in designated areas only after QA for that area was upgraded and verified by the NRC.

In January 1981, the licensee initiated a design review of those portions of the engineering design work performed by Brown and Root, Inc. The Quadrex Corporation assisted the licensee in this review. Briefly, the Quadrex report found that Brown and Root failed to properly implement an overall design consistent with the needs of a nuclear power plant. The licensee replaced Brown and Root with Bechtel Power Corporation as architect-engineer in September 1981. NRC is monitoring the performance of Bechtel as they resolve the problems identified in the Quadrex report.

5. Diablo Canyon

At Diablo Canyon, the Pacific Gas & Electric Company (PG&E) provided incorrect information to an expert consultant, who used the information in developing the seismic response spectra for the design of certain seismic piping and equipment restraints. NRC investigators have found that there was a lack of rigor and formality in the procedures used for verifying the accuracy of information transferred by PG&E to its consultants. These procedures did not comply with NRC requirements calling for verification of design information at each stage of the process by an independent person qualified in the pertinent disciplines. Proper quality assurance controls were not employed in technical and procurement communications with service-type contractors. Nor were document controls adequate to assure that those involved in design had ready access to the most recent information available.

Following discovery of these errors in seismic design, the recently issued operating license for Unit 1 was suspended in late 1981. Prior to the NRC's reinstatement of the operating license the licensee will be required to complete an extensive design reverification program for those areas in question.

Independent Design Review For
Near-Term Operating License Facilities

In order to provide further staff confidence in the quality of design and construction at near-term operating license applicants, licensees have been requested to conduct an independent verification of selected design and construction activities. The independent verification would be performed by an independent contractor with qualifications acceptable to the NRC. Independent verification efforts have been completed at LaSalle Unit 1 and 2 and San Onofre Unit 2 and 3. Reviews are presently in process at Grand Gulf, Susquehanna, Shoreham, Watts Bar, Palo Verde, Summer and St. Lucie.

At LaSalle, the licensee hired an independent contractor, approved by NRC, to perform a review of the mechanical and structural design of loop C residual heat removal system excluding all branch piping less than 3 inches, in the functioning mode of the low pressure injection system using loads resulting from the actuation of the automatic depressurization system in conjunction with the operating basis earthquake to verify that this system has been designed and constructed in accordance with the application and that the NRC requirements have been satisfied. Commonwealth Edison contracted the Teledyne Engineering Services (Teledyne) to perform this review with NRC approval.

The preliminary findings by Teledyne resulted in 21 Error/Deviation and 31 open-items reports which were transmitted to the licensee and the NRC staff. Upon submittal of all Teledyne's preliminary findings, the licensee transmitted its responses to Teledyne and the NRC staff and, in addition, the licensee received permission from the NRC staff to establish a dialogue between Teledyne and its Architect-Engineer (Sargent & Lundy) to discuss the potential errors found in the Teledyne review. Of these 52 reports which involved various problems in the design area and none in quality assurance, 39 were closed by Teledyne based on the acquisition of additional information and/or clarification of existing information. The 13 remaining reports were reviewed by Teledyne's Project Review Internal Committee. This committee, composed of three senior level Teledyne engineers who together had the expertise to resolve the technical issues, and the Teledyne Project Manager concurred that none of these reports have the potential for significant safety impact.

The NRC staff reviewed those open-items and error-deviations reports submitted to the Project Review Committee and concluded that these reports can be categorized as not having a significant safety impact on LaSalle. In addition, the NRC staff feels that Teledyne has performed an in-depth review of the analytical procedures and design calculations used in the piping, equipment, and component support design to assure the adequacy of the design bases, the adequacy of the design implementation, and the consistency between the design documents and the Final Safety Analysis Report commitments.

The independent design verification program conducted by Teledyne on the loop C residual heat removal system indicated that the quality assurance control and implementation, design process, procedures and Final Safety Analysis Report commitments are acceptable except in the area of response spectra, which was reviewed by NRC staff. The results of the limited review provide increased assurance that the quality assurance program established and implemented by the licensee and its principal contractors did effectively control the overall program and construction activities for the LaSalle County Station. While several design deficiencies were identified, the overall design and construction activities were adequately performed so that no adverse impact on safety was found.

At San Onofre the licensee contracted with Torrey Pines Technology, a subsidiary of the General Atomic Company (GA), to perform an independent evaluation of the seismic design and quality assurance program for San Onofre 2 and 3.

The design verification encompassed a review of the seismic design of San Onofre 2 and 3 to:

- a. verify that the design process converted the seismic design basis specified in the San Onofre 2 and 3 Final Safety Analysis Report (FSAR) into the design documents that are transmitted to the constructor or fabricator, and
- b. evaluate the SCE quality assurance (QA) audit plan and its implementation at the construction site and the fabricator's shops.

The design process performed by the equipment fabricators was not part of this review program.

The work was divided into eight major tasks:

- Task A. Design Procedure Review
- Task B. Design Procedure Implementation Review
- Task C. Seismic Design Technical Review
- Task D. Audit Plan Review
- Task E. Processing of Findings
- Task F. Reports
- Task G. Pipe Segment Walkdown
- Task H. Independent Calculations

The review was conducted by individual GA reviewers investigating each area covered by Tasks A through D, G, and H. When a reviewer found a deficiency that might have safety significance, it was documented in a "Potential Finding Report."

After the Potential Finding Report (PFR) was written, it was sent to the "original design organization" that was responsible for the area covered by the PFR. The original design organization (ODO) then investigated the PFR and responded in writing. The PFR and the ODO response was then reviewed by a GA committee, and the PFR was classified as (1) Out of scope, (2) Invalid, (3) Observation, or (4) Finding.

Out of scope items are those which are beyond the original scope of the review. For example, the review was oriented towards design verification. Procurement items are considered out of scope. Invalid Findings are the result of apparent deviations, uncovered in the course of the independent verification, that are resolved to the satisfaction of project personnel, usually during the Potential Finding review by the Original Design Organizations. Observations are valid deviations that are judged not to have the potential for significant impact on the seismic design adequacy of San Onofre Units 2 and 3. Findings are valid deviations that could have potential for significant impact on the seismic design adequacy.

Of the total of 170 PFRs that were initiated, 77 were determined to be invalid after additional information was reviewed. Of the 93 PFRs that were determined to be valid, 7 were classified as findings and 86 as observations. The numbers of findings and observations for each of the various tasks are as follows:

<u>Task</u>	<u>Findings</u>	<u>Observations</u>
A	3	2
B	1	35
C	1	41
D	2	5
G	0	2
H	<u>0</u>	<u>1</u>
Total	7	86

The staff has concluded, based on its review of the results of the design verification program, that the GA design verification program has not discovered anything that would cause the staff to change their previous conclusions that the San Onofre 2 and 3 quality assurance and seismic design programs are acceptable, and provides additional assurance that plant design and construction have been appropriately accomplished.

Enclosure 2
Statements to Congress

A. Hearing, Udall Subcommittee, 11/19/81

1. Chairman's opening statement, 11/19/81

- a. Statement - QA should be used as a formal management tool. It needs management support to be effective.

Paper - The problem descriptions are consistent with this view.

2. EDO's opening statement, 11/19/81

- a. Statement - Problems found at five plants are described.

Paper - Enclosure 3 provides generally consistent descriptions for the same 5 plants. The primary difference is for South Texas. The paper emphasizes QA/QC breakdowns, concrete, harrassment, etc., and only mentions the Quadrex report. On the other hand, the EDO's prepared remarks focus almost entirely on the Quadrex report.

- b. Statement - NRC is placing residents at all construction sites more than 15% complete.

Paper - Page 2 of the SECY paper states this has been done.

- c. Statement - NRC enforcement posture has been toughened.

Paper - Page 3 of the SECY paper states that the tougher posture will continue.

- d. Statement - Construction Assessment Team inspections are discussed.

Paper - These inspections are recommended as an initiative.

- e. Statement - Construction Inspection Program is being revised.

Paper - These revisions are discussed as an initiative.

- f. Statement - Systematic Assessment of Licensee Performance is being conducted.

Paper - SALP itself is not discussed as an initiative. It is an ongoing program.

- g. Statement - The mobile van is being used.

Paper - The van is not discussed as an initiative. It is already being used during routine inspections.

3. Discussions, 11/19/81

- a. Statement - In Commissioner Gilinsky's opinion we should design plants before building them.

Paper - This point is not explicitly discussed. It would be an appropriate subject for the long-term review.

E. Hearing, Moffett Subcommittee, 12/14/81

1. Chairman's opening statement, 12/14/81

- a. Statement - A new inspection program has been instituted for FY 82.

Paper - Changes are in progress and continuing. Program revisions in FY 83 are recommended as an initiative.

2. Discussions, 12/14/82

- a. Statement - The five example plants are named.

Paper - The paper discusses the same five plants as examples.

- b. Statement - In the Chairman's opinion standardization is one of the ideas with the most promise.

Paper - This subject is not discussed. It would be an appropriate subject for the long-term review.

C. Hearing, Simpson Subcommittee, 2/22/82

1. Hearings, 2/22/82

2. Kammerer letter to Stafford, 4/1/82, followup.

- a. Statement - The NRC is evaluating the initiatives in the EDO's memo of 1/21/82 to the Chairman.

Paper - Specific actions are now recommended.

- b. Statement - NRC is encouraging licensees to perform third party audits. NRC views INPO program as supplementing but not supplanting NRC efforts.

Paper - NRC and industry initiatives and descriptions are consistent with this view.

D. Hearing, Ottinger Subcommittee, 3/3/82

1. Kammerer letter to Ottinger, 3/1/82, responses to questions

- a. Statement - FY 83 budget request includes about 40 professional staff and \$200k for quality assurance. Additional resource estimates would be premature while assessing options for improvement.

Paper - Enclosure 2 states that the NRC currently devotes 16 positions in HQ to QA and 28 positions in the regions to QA for construction reactors. These are the FY 83 numbers from the Chairman's recent budget crosscut. The paper also states that, in the past, funding has been about \$400k per year. This corresponds roughly to what was expended in FY 82 and what is intended in FY 83 (aside from initiatives).

- b. Statement - The NRC is evaluating the initiatives in the EDO's memo of 1/21/82 to the Chairman.

Paper - Specific actions are now recommended.

- c. Statement - Specific evaluation criteria for initiatives have not been established. Initiatives are being evaluated for cost effective impact.

Paper - No criteria are stated in the paper. It can be said that the staff generally considered cost-effective impact in developing initiatives.

- d. Statement - Organizational changes are being considered.

Paper - Such changes are now recommended as an initiative.

- e. Statement - QA paper is scheduled for 3/31/82.

Paper - Timing of paper is not discussed.

2. Hearings, 3/3/82

- a. Statement - An important lesson from Diablo Canyon is that NRC had a gap in its treatment of design.

Paper - Several initiatives address this gap.

- b. Statement - There was a general discussion of independent audits. They are not necessarily required for all plants.

Paper - The initiative discussions are consistent with the views presented.

3. Chairman letter to Moorhead, 4/19/82, followup.

- a. Statement - Standardized design helps QA and lack of it makes QA more difficult.

Paper - This subject is not discussed. It would be an appropriate subject for the long-term review.

- b. Statement - Criteria for independent auditors are described.

Paper - No criteria are discussed. The paper is not that detailed in this area.

- c. Statement - Applicants are responsible for the safety of their plants. However, the NRC staff determines if that responsibility has been met.

Paper - Page 2 of the SECY paper states that none of the initiatives is intended to detract from licensee responsibility.

- d. Statement - Over reliance by applicants on third parties to manage QA is not as effective as strong applicant involvement.

Paper - This point is not explicitly discussed. It can be considered implicit in the problem statements where the importance of management commitment and integration of QA into effective project management teams are discussed.

E. Hearings, Bevill Subcommittee, 3/22/82

1. Hearings, 3/22/82

- a. Statement - Responsibility remains with plants' owners.

Paper - Page 2 of the SECY paper states that none of the initiatives is intended to detract from licensee responsibility.

2. Kammerer letter to Bevill, 3/26/82, followup

- a. Statement - The NRC is evaluating the initiatives in the EDO's memo of 1/21/82 to the Chairman.

Paper - Specific actions are now recommended.

- b. Statement - The QA paper is scheduled for 3/31/82.

Paper - Timing of the paper is not discussed.

- c. Statement - Independent audits strengthen utility QA and supplement NRC inspections. No pitfalls have been identified.

Paper - The initiatives reflect this view.

- d. Statement - Independent audits do not detract from licensee responsibility.

Paper - Page 2 of the SECY paper states that none of the initiatives is intended to detract from licensee responsibility.

- e. Statement - NRC supports the INPO program and will monitor and review it. NRC will design new efforts to minimize duplication and overlap, to take advantage of INPO while still providing adequate independent review. If the INPO program appears effective and vigorous, it may substitute for some NRC initiatives.

Paper - These views are reflected in the initiatives.

- f. Statement - INPO criteria could be used by third party auditors.

Paper - This is stated in the industry initiative description.

- g. Statement - The staff will review INPO criteria and results to achieve coordination.

Paper - The industry initiative description states that during the trial program the staff will review the criteria and observe some evaluations.

Enclosure 2
Statements to Congress

A. Hearing, Udall Subcommittee, 11/19/81

1. Chairman's opening statement, 11/19/81

- a. Statement - QA should be used as a formal management tool. It needs management support to be effective.

Paper - The problem descriptions are consistent with this view.

2. EDO's opening statement, 11/19/81

- a. Statement - Problems found at five plants are described.

Paper - Enclosure 3 provides generally consistent descriptions for the same 5 plants. The primary difference is for South Texas. The paper emphasizes QA/QC breakdowns, concrete, harrassment, etc., and only mentions the Quadrex report. On the other hand, the EDO's prepared remarks focus almost entirely on the Quadrex report.

- b. Statement - NRC is placing residents at all construction sites more than 15% complete.

Paper - Page 2 of the SECY paper states this has been done.

- c. Statement - NRC enforcement posture has been toughened.

Paper - Page 3 of the SECY paper states that the tougher posture will continue.

- d. Statement - Construction Assessment Team inspections are discussed.

Paper - These inspections are recommended as an initiative.

- e. Statement - Construction Inspection Program is being revised.

Paper - These revisions are discussed as an initiative.

- f. Statement - Systematic Assessment of Licensee Performance is being conducted.

Paper - SALP itself is not discussed as an initiative. It is an ongoing program.

- g. Statement - The mobile van is being used.

Paper - The van is not discussed as an initiative. It is already being used during routine inspections.

3. Discussions, 11/19/81

- a. Statement - In Commissioner Gilinsky's opinion we should design plants before building them.

Paper - This point is not explicitly discussed. It would be an appropriate subject for the long-term review.

B. Hearing, Moffett Subcommittee, 12/14/81

1. Chairman's opening statement, 12/14/81

- a. Statement - A new inspection program has been instituted for FY 82.

Paper - Changes are in progress and continuing. Program revisions in FY 83 are recommended as an initiative.

2. Discussions, 12/14/82

- a. Statement - The five example plants are named.

Paper - The paper discusses the same five plants as examples.

- b. Statement - In the Chairman's opinion standardization is one of the ideas with the most promise.

Paper - This subject is not discussed. It would be an appropriate subject for the long-term review.

C. Hearing, Simpson Subcommittee, 2/22/82

1. Hearings, 2/22/82

2. Kammerer letter to Stafford, 4/1/82, followup.

- a. Statement - The NRC is evaluating the initiatives in the EDO's memo of 1/21/82 to the Chairman.

Paper - Specific actions are now recommended.

- b. Statement - NRC is encouraging licensees to perform third party audits. NRC views INPO program as supplementing but not supplanting NRC efforts.

Paper - NRC and industry initiatives and descriptions are consistent with this view.

D. Hearing, Ottinger Subcommittee, 3/3/82

1. Kammerer letter to Ottinger, 3/1/82, responses to questions

- a. Statement - FY 83 budget request includes about 40 professional staff and \$200k for quality assurance. Additional resource estimates would be premature while assessing options for improvement.

Paper - Enclosure 2 states that the NRC currently devotes 16 positions in HQ to QA and 28 positions in the regions to QA for construction reactors. These are the FY 83 numbers from the Chairman's recent budget crosscut. The paper also states that, in the past, funding has been about \$400k per year. This corresponds roughly to what was expended in FY 82 and what is intended in FY 83 (aside from initiatives).

- b. Statement - The NRC is evaluating the initiatives in the EDO's memo of 1/21/82 to the Chairman.

Paper - Specific actions are now recommended.

- c. Statement - Specific evaluation criteria for initiatives have not been established. Initiatives are being evaluated for cost effective impact.

Paper - No criteria are stated in the paper. It can be said that the staff generally considered cost-effective impact in developing initiatives.

- d. Statement - Organizational changes are being considered.

Paper - Such changes are now recommended as an initiative.

- e. Statement - QA paper is scheduled for 3/31/82.

Paper - Timing of paper is not discussed.

2. Hearings, 3/3/82

- a. Statement - An important lesson from Diablo Canyon is that NRC had a gap in its treatment of design.

Paper - Several initiatives address this gap.

- b. Statement - There was a general discussion of independent audits. They are not necessarily required for all plants.

Paper - The initiative discussions are consistent with the views presented.

3. Chairman letter to Moorhead, 4/19/82, followup.

- a. Statement - Standardized design helps QA and lack of it makes QA more difficult.

Paper - This subject is not discussed. It would be an appropriate subject for the long-term review.

- b. Statement - Criteria for independent auditors are described.

Paper - No criteria are discussed. The paper is not that detailed in this area.

- c. Statement - Applicants are responsible for the safety of their plants. However, the NRC staff determines if that responsibility has been met.

Paper - Page 2 of the SECY paper states that none of the initiatives is intended to detract from licensee responsibility.

- d. Statement - Over reliance by applicants on third parties to manage QA is not as effective as strong applicant involvement.

Paper - This point is not explicitly discussed. It can be considered implicit in the problem statements where the importance of management commitment and integration of QA into effective project management teams are discussed.

E. Hearings, Bevill Subcommittee, 3/22/82

1. Hearings, 3/22/82

- a. Statement - Responsibility remains with plants' owners.

Paper - Page 2 of the SECY paper states that none of the initiatives is intended to detract from licensee responsibility.

2. Kammerer letter to Bevill, 3/26/82, followup

- a. Statement - The NRC is evaluating the initiatives in the EDO's memo of 1/21/82 to the Chairman.

Paper - Specific actions are now recommended.

- b. Statement - The QA paper is scheduled for 3/31/82.

Paper - Timing of the paper is not discussed.

- c. Statement - Independent audits strengthen utility QA and supplement NRC inspections: No pitfalls have been identified.

Paper - The initiatives reflect this view.

- d. Statement - Independent audits do not detract from licensee responsibility.

Paper - Page 2 of the SECY paper states that none of the initiatives is intended to detract from licensee responsibility.

- e. Statement - NRC supports the INPO program and will monitor and review it. NRC will design new efforts to minimize duplication and overlap, to take advantage of INPO while still providing adequate independent review. If the INPO program appears effective and vigorous, it may substitute for some NRC initiatives.

Paper - These views are reflected in the initiatives.

- f. Statement - INPO criteria could be used by third party auditors.

Paper - This is stated in the industry initiative description.

- g. Statement - The staff will review INPO criteria and results to achieve coordination.

Paper - The industry initiative description states that during the trial program the staff will review the criteria and observe some evaluations.

August 20, 1982



App A #1
SECY-82-352

POLICY ISSUE

For: The Commission (Notation Vote)
From: William J. Dircks
Executive Director for Operations
Subject: ASSURANCE OF QUALITY

Purpose: To inform the Commission of staff initiatives approved within the authority of the Executive Director for Operations, to improve the assurance of quality in the design and construction of nuclear projects; and to obtain Commission approval to pursue revision of the NRC's statutory authority to allow implementation of a system of designated representatives analogous to the system employed by the Federal Aviation Administration.

Discussion: The complexity and extent of problems that have been identified in the past few years at 5 of the 32 units now under active construction have caused concern regarding the quality of the design and construction of nuclear projects. These problems include nonconforming structural steel welds at Zimmer, seismic design errors at Diablo Canyon, inadequate soil compaction at Midland, voids in concrete structures at Marble Hill and design deficiencies at South Texas. Enclosure 3 summarizes recent experience at each of these 5 projects.

Analysis of the experience at problem sites has resulted in the classification of three primary problem areas: 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 appropriate corrective action; and failure of the NRC's programs to recognize the true extent and nature of the problems.

The first two 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.

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The third problem area is two-fold in derivation. 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. Second, previous NRC programs have not addressed design quality as specifically and extensively as other areas.

In response to the breakdowns in quality and quality assurance, the Chairman in a November 27, 1981 memorandum directed the staff to determine various approaches that could be taken to strengthen quality assurance, and to provide the Commission a preliminary evaluation of the approaches that appear most promising. On January 29, 1982 the staff briefed the Commission on initiatives that appeared to merit further consideration. Industry representatives from the Institute for Nuclear Power Operations (INPO) met with the Commission on February 4, 1982 to present their plans for improving the assurance of quality at plants under construction. On July 15, 1982 the staff again briefed the Commission on the actions taken to date and the initiatives under consideration.

The staff has developed initiatives that should lead to effective improvements in quality and quality assurance programs. While many of these initiatives require NRC actions, the underlying principle in their development has been that the ultimate responsibility for quality and safety remains with the nuclear industry, and none of the initiatives are intended to transfer this responsibility to the NRC. The initiatives are designed to establish additional confidence in the quality of design and construction activities and improve the management control of quality. The initiatives are also designed to improve the NRC capability to evaluate the implementation of licensee programs. Compliance with NRC requirements for the quality assurance program and its implementation is a major consideration in establishing this confidence.

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. The staff recommends implementation of a system of designated NRC representatives (analogous to the FAA system) to extend its inspection resources.

During the development of the initiatives presented in this paper, several additional actions were considered. Where we were not able to establish an adequate basis to initiate additional actions at this time, further study is warranted. A long-term review will be conducted, utilizing knowledge within and outside NRC to evaluate the merits of additional actions, monitor the outcome of ongoing industry and NRC initiatives and initiate changes in program direction as appropriate. This review will satisfy the direction provided the NRC in an amendment accepted by the House and Senate conferees in their joint consideration of the NRC's FY 82-83 authorization bill.

Some of the actions considered and endorsed by the staff are associated with existing agency programs. The followup of allegations is an essential part of the NRC's inspection program, and is an effective extension of inspection resources. Allegations provide an opportunity for non-NRC personnel to enter potential problems into the NRC's problem correction chain. The principal objective of the resultant NRC inspection effort is to obtain sufficient information through independent in-depth examinations to establish the significance of the particular allegation and to effect corrective action commensurate with its significance. To encourage and provide personnel an opportunity to make an allegation, NRC inspectors wear hard hats that uniquely identify them. The resident inspector's office has a telephone answering device for 24-hour response to callers, and the telephone numbers of the resident inspector and NRC regional office are listed in the local telephone directory. Effective October 12, 1982 NRC postings at the site will identify the legal protection afforded people who provide allegations.

With respect to enforcement, the NRC has sufficient authority to take appropriate enforcement action for inadequate quality assurance. The options extend over a broad range from meeting with a licensee, notices of violation and civil penalties to issuance of orders for modification, suspension or revocation of licenses. The staff intends to continue to take strong actions in response to significant quality assurance breakdowns and has expressed this intention in the enforcement policy.

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.

Actions have been initiated at near-term operating license facilities to improve staff confidence in the quality of design and construction activities. These actions include self evaluations by licensees, and in most cases, an independent design review. The limited experience to date with the independent design reviews conducted at LaSalle and San Onofre (Enclosure 4) includes the identification of numerous deficiencies (nonconformances with the original specifications), which have required reanalysis. Relatively few of these deficiencies have required hardware changes, and to date, none of the deficiencies identified would have prevented safety-related components, systems, or structures from performing their intended function.

The initiatives in this paper are directed toward reactor facilities not yet licensed for operation. At this time, the staff concludes a reasonable basis for not backfitting these initiatives to operating reactors is provided by previous reviews of the facilities, their operating history, extensive startup test programs, and the reviews and upgrades in response to TMI and Bulletin actions. Further consideration will be given to operating reactors as part of the long-term review.

The initiatives summarized below have been approved within the authority of the Executive Director for Operations. The staff will continue those actions that are already underway and implement the remainder of the initiatives as soon as practicable. Each initiative is described further in Enclosure 1.

• Measures at Near-Term Operating License Facilities

The NRC will continue to employ the measures currently in use to establish confidence in the quality and effectiveness of utility quality assurance programs at near-term operating license facilities until other NRC or industry programs are capable of providing this confidence. These measures include applicant self evaluation, independent design review and regional evaluations.

• Industry Initiatives

The NRC will continue to interact with INPO in its development of industry initiatives, measure their effectiveness and adjust the corresponding NRC actions to provide for effective use of both industry and NRC resources.

• Construction Programs

The NRC will increase the resources allocated to the inspection of reactors under construction by an additional 0.3 (FY 83) and 0.5 (FY 84) staff years per unit under construction.

The NRC will complete development and implement planned revisions to enhance the effectiveness of its construction inspection procedures.

The NRC will complete development and implement its program for construction assessment team inspections at selected facilities to provide a basis for evaluation of the management performance essential to quality construction.

The NRC will complete development and implement the integrated design inspection process to assess the quality of design activities including examination of as-built configuration at near-term operating licensee facilities.

The NRC will expand its capability to identify generic design and construction deficiencies by computerized analysis of information reported by vendors, construction permit holders and NRC inspectors.

• Management

Quality management seminars for top level managers with facilities under design and construction should be sponsored by industry. The seminars would focus recent experience of selected managers and recognized experts in the design and construction of nuclear projects.

The NRC will request that each utility with a facility under construction reevaluate its quality assurance program and implement improvements in areas where the evaluations identify a need.

The NRC will take actions to improve the enforcement of existing standards for qualification of quality assurance and quality control personnel and pursue establishment of a system of third party qualification and certification for such personnel.

The NRC will continue to explore with labor and other organizations, potential methods and incentives to assure quality in design and construction related production activities.

- Long-Term Review

The NRC will commence a long-term review for continuing evaluation of quality and quality assurance problems related to design, construction, testing and operations, and potential solutions to those problems and their impact on the adequacy of NRC quality assurance policies and programs.

- Quality Assurance Planning and Evaluation

The NRC will make organizational realignments to combine within a single organization the functions of research, standards development and inspection program development for quality assurance at reactors. The licensing function will remain in NRR until the current backlog of licensing actions is completed.

The Office of Inspection and Enforcement is designated lead office with responsibility for development of NRC policies and programs for quality assurance and for implementation of the quality assurance initiatives.

The following staff recommendation is provided for Commission consideration and approval.

- Designated Representatives

The NRC should pursue revision of its statutory authority to allow implementation of a system of designated representatives analogous to the system employed by the Federal Aviation Administration.

The staff has developed resource estimates and implementation schedules for the new initiatives. The resource estimates, implementation schedules, and staff responsibilities for implementation are discussed in Enclosure 2. The staff responsibilities are assigned consistent with the organizational realignment. The resource estimates to implement the initiatives are consistent with the NRC FY 83-84 budget. The NRC resource estimates are summarized below.

1. Estimated NRC Staff Resources

25 staff years new effort in FY 83

24 staff years new effort in FY 84

2. Estimated NRC Contractor Resources

\$2.2 million new effort in FY 83

\$1.4 million new effort in FY 84

Recommendation:

That the Commission approve the staff proposal as summarized above.



William J. Dircks

Executive Director for Operations

Enclosures:

1. Initiatives
2. Resources, Schedules and Staff Responsibilities
3. Examples of Recent Quality Assurance Problems
4. Independent Design Review for Near-Term Operating License Facilities

Commissioners' comments should be provided directly to the Office of the Secretary by c.o.b. Wednesday, September 8, 1982.

Commission staff office comments, if any, should be submitted to the Commissioners NLT Tuesday, August 31, 1982, with an information copy to the Office of the Secretary. If the paper is of such a nature that it requires additional time for analytical review and comment, the Commissioners and the Secretariat should be apprised of when comments may be expected.

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ENCLOSURE 1

INITIATIVES

I. Introduction

The Commission has considered quality assurance to be a key factor in the design, construction and operation of nuclear power plants for many years. Proposed versions of the General Design Criteria used in 1967 recognized the interest in quality assurance. Appendix B to 10 CFR 50, published in June 1970, described mandatory criteria for acceptable quality assurance programs for safety-related features.* Subsequently, a number of national standards and regulatory guides providing additional guidance have been issued to upgrade quality assurance programs. In the 1973 time frame, the Atomic Energy Commission expended major effort to communicate to industry the framework, e.g., plans, procedures, organization, of a quality assurance program that would be acceptable to AEC. This framework is reflected in current quality assurance programs that have been approved by NRC.

II. Problem Statement

Examination of the problems that have been identified recently indicates that the fundamental cause of most design and construction deficiencies is the lack of total management commitment to quality. This lack of commitment has been intensified by the lack of understanding of the role of quality assurance in project management and the lack of total understanding of what is required of personnel at all levels of the process.

The owner's project management team is responsible for the overall planning and management of the design, construction, and testing of the nuclear power plant. If the senior management has a strong commitment to quality, and if that commitment is imbued in a capable project management team, then the subsequent actions of this team will communicate that commitment to all involved parties. The project management team communicates and

*As used in this paper and defined in Appendix B, quality assurance comprises all those planned and systematic actions necessary to provide adequate confidence that a structure, system, or component will perform satisfactorily in service. Quality assurance includes quality control, which comprises those quality assurance actions related to the physical characteristics of a material, structure, component, or system which provide a means to control the quality of the material, structure, component, or system to predetermined requirements.

obtains through contractual and procedural arrangements with the designers, fabricators, and constructors a level of quality commensurate with the owner's commitment. The commitment to cost and schedule must be properly balanced with quality through these contractual and procedural arrangements. For example, if the constructor earns contractual credit strictly with the schedule of physical installation, the message from project management is production. On the other hand, if earned credit is commensurate with the schedule of owner accepted, adequately documented installation, the message is quality production. The latter case provides the proper incentive for getting work accomplished right the first time. This is then reflected in the policy and procedural direction to the various organization sub-tiers.

Similarly, the role of quality assurance in the project management team is determined by the senior management's commitment to quality. Proper implementation of the quality assurance criteria is an important element in successful project management. However, quality assurance programs cannot substitute for poor project management or a lack of commitment to quality. Quality assurance must be an integral part of all of the project planning and management activities from the projects inception, and its role must be communicated and fully understood by all participants in the design and construction process (from senior management to the craftsman). For example, if the inspection function is planned and conducted as an integral part of physical installation activities, then early detection and correction of procedural or other inadequacies will result in enhancing quality, cost, and schedule. All participants must be adequately trained to understand and obtain these benefits.

Weaknesses in the existing approach to assuring quality are apparent. They are evidenced by the frequency and severity of design and construction deficiencies, and by the failure or delay of industry and NRC recognition of the extent and nature of the breakdowns.

Previous efforts by the NRC to assure program content and structure have not been balanced with comparable efforts to assure successful program implementation. The NRC's licensing and inspection programs have not sufficiently examined the project management controls at sites under construction, but have been oriented towards assuring the adequacy within major technical and functional areas, e.g., concrete, electrical, etc. The systematic assessment of management performance and evaluation of all available information at construction facilities did not receive the same level of effort as operating sites. Previous NRC programs have not addressed design quality as specifically and extensively as other areas.

In sum the fundamental issues can best be characterized as the lack of total management commitment to quality and the uncertainty in industry's and NRC's ability to detect and correct the resulting deficiencies. The need to resolve these issues is the basis for the following initiatives.

II. Initiatives

A. Measures at Near-Term Operating License Facilities

For those plants in the Near-Term Operating License (NTOL) status, the NRC has implemented three interim measures to provide additional confidence that required quality assurance programs have been successfully implemented and completed during the design and construction of the nuclear facility. These measures will be continued until replaced by adequate industry programs or permanent changes in the present NRC program.

1. Self Evaluation

An applicant for an operating license will perform a comprehensive self evaluation of the effectiveness of the quality assurance program for design and construction. This requires an overall description of the project's quality assurance program for design and construction. The self evaluation is a survey of the overall quality assurance program. The survey will describe the development and history of the program, management involvement, audits, reviews, significant problems and corrective actions. The NRC staff reviews the self evaluation and provides the results of its review to the licensee. Additional work, such as corrective actions or further audits, may be required in particular areas. In addition, the Chief Executive Officer or his designee is required to certify that the facility has been designed, constructed, and tested in accordance with the Final Safety Analysis Report and other licensing commitments.

2. Regional Evaluation

On each new operating license, the NRC staff considers whether there is a need for additional inspections of selected areas based on an evaluation of the project's inspection and enforcement history. This assures consideration of the need for a better assessment of performance in potentially weak areas. The project's inspection and enforcement history is evaluated with particular attention to the significant problems that have been noted at other construction sites. Other information considered includes known problem areas, results of NRC inspections and the Systematic Assessment of Licensee Performance program, and problems noted elsewhere with the same contractors. Additional inspections are performed as warranted in potentially weak areas.

3. Independent Design Review

Based upon results of the self evaluation and regional evaluation, an applicant for an operating license may be requested to have an independent design review conducted. The criteria for determining which facility, and the scope and extent of the design review also include the combined nuclear experience of the licensee, architect-engineer, and contractors. The review provides an evaluation of the quality of design based on a detailed examination of a small sample. The staff specifies a sample area appropriate to the particular project. For LaSalle, the mechanical and structural loads on the residual heat removal system under blowdown and operating basis earthquake conditions were specified. The independent review addresses programmatic areas, e.g., classification of systems and components, design and verification records, interface control and interdisciplinary review, consistency with FSAR, nonconformances and corrective actions, and audit findings and resolutions. The review includes verification of specific design features by independent calculations and comparison of installations against as-built drawings. The NRC staff reviews the selection of the independent review organization and the plan before implementation, audits the work in progress, and reviews the results.

B. Industry Initiative

The industry initiative is not an NRC staff proposal, but a program that the industry is presently developing. The NRC staff is monitoring this program in order to take best advantage of the industry efforts.

The Institute for Nuclear Power Operations (INPO) is developing criteria which will be used to evaluate quality assurance for design and construction. As with the existing INPO criteria for plant operation, they will be based on "best practice," rather than minimum standards of acceptability. Licensees will use the criteria for self-initiated evaluations (which can be performed either by an independent group within the utility or a contractor). The self-initiated evaluations will be submitted to INPO by the end of 1982. During this trial process, the NRC staff will be involved by reviewing the criteria and observing some of the evaluations. Details of the staff involvement have not yet been developed.

The industry will decide, by early 1983, on the direction of a continuing program. At present, the primary alternatives appear to be: INPO will either begin conducting quality assurance evaluations at individual construction facilities, or a form of self-initiated evaluation will continue.

INPO is also conducting management workshops (May 1980, September 1981 and October 1982) with utility chief executive officers and plant managers in an effort to strengthen the utility commitment to safe operation. NRC will coordinate its quality management seminars (Enclosure 1, Section D.1) with the industry efforts.

C. Construction Inspection Program

1. Procedure Changes

The NRC does not have sufficient inspection resources to fully implement all of the existing procedures in the reactor construction inspection program. The FY 83-84 NRC budget allocates an additional 0.3 (FY 83) and 0.5 (FY 84) staff years per construction project to execute the construction inspection procedures. The staff is presently revising the individual inspection procedures for the various technical disciplines to better match the budgeted resources. The main goals of the procedure revision are: (1) to facilitate performance of the procedures by resident inspectors with reduced input from regional-specialist inspectors; (2) eliminate redundancies in the procedures; (3) reexamine scope or frequency of some inspections based on limitations on inspector resources; and (4) shift emphasis of inspection from record review to observation of work. This staff effort is continuing. The first series of revised procedures which cover inspection of mechanical systems are in the final stages of issuance.

2. Construction Assessment Team Inspections

This initiative will extend the concept of the NRC's Performance Appraisal Team (PAT) inspection program for operating reactors to about four selected plants under construction per year. This initiative was directed by the Commission in response to SECY 82-150 dated April 8, 1982, "The Performance Appraisal Team (PAT) Inspection Program."

The procedures for performing management control inspections at nuclear construction sites were revised by the staff in 1981. The procedures covered licensee management performance in the following construction areas: Quality Assurance, Design Controls, Project Management, Construction Controls, and Procurement Controls. During 1981, eight trial inspections were performed by regional-based inspectors using the revised procedures. These inspections were effective in identifying management control problems not identified by the routine inspection program. The manpower demand in these eight inspections caused the Regional Administrators to defer further performance of this type of inspection.

The Construction Assessment Team inspections to be initiated by the IE staff would be similar to the construction inspections performed previously by the Regional Offices. A team of approximately six individuals with skills in the various areas to be inspected, including contractor personnel with appropriate backgrounds, will visit the selected construction site for two to three weeks. Additional site visits will be scheduled if necessary to collect additional information or clarify initial observations. The first site inspection has been tentatively scheduled for Bellefonte in September/October 1982.

The construction assessment will complement the integrated design inspection. The latter is focused on a narrow area of technical inspection, while the construction assessment is designed to assess the broader programmatic controls. Like the integrated design inspection, the scope of construction assessments will be modified to be responsive to unique conditions at a particular facility.

3. Integrated Design Inspections

The objective of this initiative is to expand NRC examination of quality assurance into the design process. The staff is developing an inspection approach which provides a comprehensive examination of the design development and implementation for a selected system and structure on a given project. This evaluation will encompass the total design process from the formulation of principal design and architectural criteria through the development and translation of the design and its revisions. It will conclude with onsite verification on a sampling basis, of the design of the installed system and structure. This inspection will integrate and augment selected activities of NRR, IE, the vendor inspection program, and the regional office. Following development of the evaluation methodology, the staff will conduct a trial inspection with contractor assistance. Subsequent inspections will be performed with a substantial amount of contractor assistance. The results will be provided to the appropriate regional and headquarters offices to be used as input to the overall NRC assessment prior to issuance of the operating license.

The evaluation will be a multi-disciplined review that will address areas such as mechanical, electrical, structural, instrumentation and control. The evaluation will include checking sample calculations, however, the emphasis will be on the systematic management of the total design process. The procedures to implement this approach are presently under development. A discussion of the conceptual logic necessary to evaluate the design process follows.

The evaluation will start with development of a logic or flow network of the design process. Each functional entity within the design organization will be identified. For each of these entities, internal and external design interfaces which involve transmittal of design information will be specified. From this network, critical design areas or areas with the least tolerance for error will be identified. Within each of the design entities, the specific procedures for the verification and transmittal of design information will be reviewed for conformance with the overall quality assurance program, and to identify specific weaknesses in the design process. Based on the results of the procedure review and the identification of critical design areas, a specific sample of the system and structure will be audited. Criteria will be preestablished for expanding or terminating the audit when problem areas are identified.

In examining a system or structure and its specifications, the review will focus on topics such as:

- (a) Validity of design inputs and assumptions.
- (b) Validity of design specifications.
- (c) Validity of analyses.
- (d) Identification of system interface requirements.
- (e) Potential synergistic effects of changes.
- (f) Proper component classification.
- (g) Revision control.
- (h) Documentation control.
- (i) Verification of as-built condition.

The scope of the evaluation can be modified to be responsive to unique conditions for a particular facility, or known or suspected generic problems. This approach will examine all facets of the design management process for a limited sample.

4. Evaluation of Reported Information

Improvements are planned in the current program for systematic review of information pertaining to design and construction quality that is now reported pursuant to 10 CFR 21, "Reporting of Defects and Noncompliances," and 10 CFR 50.55(e), "Construction Deficiency Reports." This program would have objectives similar to those of the Office for Analysis and Evaluation of Operational Data (AEOD) for nuclear power plant operations. Computerized diagnosis would be used to enhance identification of relationships that may not be evident in the manual screening that is done now. No expansion of reporting requirements is currently planned but revisions are expected to facilitate computer input of key information.

Designated Representatives

Federal Aviation Regulations (14 CFR 183) prescribe the requirements for the issuance of designations to private persons to act in the capacity of FAA representatives in the examination, inspection and testing necessary for the issuance of aircraft certificates by the Administrator. Nominees meeting the requirements for appointment are authorized to represent the FAA in determining the compliance of aircraft, aircraft components, and their repair or alterations with the requirements of the Federal Aviation Regulations. They serve as direct representatives of the FAA in the performance of duties and are guided by the same requirements, instructions, procedures and interpretations as FAA employees in the performance of those duties. These programs include the Designated Manufacturing Inspection Representative (DMIR) and the Designated Engineering Representative (DER). The DER represents the FAA in helping to determine that the aircraft design complies with the relevant requirements of the regulations and the DMIR represents the FAA in certifying certain product and manufacturing functions. These designations are effective for one year but may be renewed for additional periods of one year.

A similar technique of using the designated representatives would be useful to the NRC inspection effort. It would increase the number of inspectors available to implement the inspection program by providing an immediate source of qualified experienced personnel. Using designated NRC representatives to check key aspects of the design, fabrication and construction of a plant at the specific time increased inspection effort is warranted, would significantly raise the NRC's confidence level of quality assurance in nuclear power plants. For example, during the preoperational and startup testing phases of a plant, designated representatives could provide the additional inspection effort so that all tests are monitored rather than a selected few. Increased inspection effort could also be applied at problem construction sites without having to reduce the routine level of inspection effort at other construction sites. Under a statutory regime and regulations like those of the FAA, NRC could ensure that the designated representative would not be subjected to harassment as he would be under the same protection as NRC employees.

The aviation industry uses holdpoints in the manufacturing process that require inspection and certification by an FAA inspector before the process can continue. The designated representative, provided by the aviation industry and acting for FAA, can provide that certification when required, which allows the process to continue without delays. It is therefore an advantage to the aviation industry to provide designated representatives and prevent costly delays in their manufacturing process. There is no analogous situation to that process at nuclear plants. There are no

preestablished holdpoints (other than CP and OL issuance) in the construction or operation of a nuclear plant that require NRC approval before the process can continue. Therefore, for the designated representative program to be successful for the NRC, program incentives would have to be developed to encourage the utilities to support the program.

Under the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974, as amended, as well as other pieces of legislation, the Commission does not have the authority to designate licensee personnel as inspectors in a manner similar to the Federal Aviation Administration's authority under its legislation and regulations (see 49 U.S.C. 1355, 31 U.S.C. 483a, and 14 CFR 183). The FAA has the authority to issue designations to provide persons to act in the capacity of FAA representatives while remaining in their original employee status as far as receiving pay. To act in a similar way the NRC would have to have the Atomic Energy Act amended and would have to promulgate regulations based on this amendment.

The staff proposes to pursue the statutory changes necessary to implement a designated representative program and to continue development of program specifics.

E. Management

1. Management and Quality Improvement Programs

The objective of this initiative is to improve attitude and performance throughout all levels of licensee and contractor organizations. The problems that have arisen at construction sites are closely associated with management attitudes and practices. Quality in design and construction is invariably associated with the highest level of management being totally committed to quality. Senior managers are personally committed and are unrelenting in their demands on their staffs and contractors for a similar commitment.

The NRC will cooperate with industry in sponsoring a continuing series of seminars in which top level nuclear managers can communicate the advantages that can be gained through strong management involvement in their own QA programs. The seminars will be conducted with assistance from independent quality professional, utility and contractor representatives and the NRC. The seminars will be highlighted by the participation of managers from utilities which have experienced serious quality

assurance problems and those which have managed highly successful programs. The independent quality professionals will convey the improvement principles and techniques of implementation. The utility and contractor representatives will identify incentives for defect prevention based on direct experiences. The expected outcomes of these seminars will be recognition on the part of licensee and contractor management that positive incentives and benefits are achievable through enthusiastic implementation of aggressive quality assurance programs. While this initiative is directed to facilities under construction, participation by facilities in testing and operation will be strongly encouraged.

10 CFR 50, Appendix B, Criterion II requires each utility to regularly review the status and adequacy of its quality assurance program. The extent and nature of the recent breakdowns in quality assurance programs have indicated that this review has not been effective in maintaining an adequate quality assurance program at several facilities under construction.

Each utility with a facility under construction will be requested to reevaluate its quality assurance program, and to implement improvements in areas where the evaluations identify a need. Each utility should identify a senior executive with overall responsibility for the evaluation and implementation of the necessary improvements. The NRC will monitor the evaluation and implementation of the necessary improvements. It is expected that improvements in the quality assurance program will incorporate actions such as those listed below.

- (a) Conduct training sessions for its personnel involved in design and construction. These sessions should emphasize the importance of each individual's contribution to ensuring quality and the enhancement to the cost and schedule goals which can be achieved with a positive program. The result of these sessions would be to get supervisors and employees in the habit of talking positively about quality.
- (b) Provide better evaluation on a routine basis of status reports to detect both trends and current nonconformance problems. Based on this information, meaningful corrective actions can be promptly taken to prevent recurrence of both the specific problems and the root cause. The result would be defect prevention as a routine part of the operation.

- (c) Provide feedback on the achievements of the quality assurance program, emphasizing the improvements from all involved in the program to maintain the concern and enthusiasm on the project toward ensuring quality.
- (d) Establish a system through which all parties are encouraged to communicate to management the situations that make it difficult for the employee to perform quality work. This information will be included in the system for taking corrective actions. The result of this system would be that employees know that their problems can be heard and addressed.

2. Qualification and Certification of QA/QC Personnel

A significant and prevalent problem in the construction of nuclear power plants is the qualification status of personnel working in the quality control and quality assurance areas. Some utilities have waived, without suitable bases, the education and experience requirements for these people. The NRC has not sufficiently enforced these requirements through its inspection efforts.

Currently, various standards exist for the qualification of QA/QC personnel, for example:

- (a) ANSI N45.2.6, Qualification of Testing & Inspection Personnel
- (b) ANSI N45.2.23, Qualification of QA Audit Personnel
- (c) ANSI N626.3 (Draft), Qualification & Duties of Personnel Engaged in ASME Boiler & Pressure Vessel Code, Section III, Division 1 & 2 Certifying Activities
- (d) ASME Section III, Division 2, Appendix VII Qualification of Concrete Inspection Personnel
- (e) ASNT, Certification of Level III Nondestructive Testing Personnel
- (f) AWS QCI-82, Qualification & Certification of Welding Inspectors

NRC will direct more attention to the enforcement of the existing standards for the qualification of QA/QC personnel.

Certification of personnel engaged in QA/QC inspections would provide a cadre of industry personnel that have been qualified to minimum standards and certified to have demonstrated inspection capabilities.

A program for third party certification of Nondestructive Testing (NDT) personnel is currently underway with coordination between the Electric Power Research Institute (EPRI), member utilities, American Society of Nondestructive Testing (ASNT) and NRC. The program includes developing a standard written practice for the qualifications of the level III NDT inspectors as well as administering basic and method examinations and specific and practical examinations in the respective areas of nondestructive testing. A registry of personnel holding the required qualifications and certification would be maintained by the third party organization. Unsatisfactory performance would result in removal from the registry through an established procedure. Programs similar to this could be established in other areas such as welding, inspectors, QA auditing, concrete inspectors, and laboratory testing personnel.

Formal certification of various levels of QA/QC personnel will be considered as part of the long-term review (Enclosure 1, Section III.F).

3. Craftsmanship

The staff has initiated discussions with labor unions involved in nuclear construction in an effort to explore the potential methods and incentives to enhance the crafts role in assuring the quality of construction activities.

Feedback from the labor unions included the following points:

- (a) Craftsmen are not well informed of their role in the QA/QC process.
- (b) Continuous rework as a result of changes has a demoralizing effect on craftsmen and effects the quality of the final work.
- (c) Utilities and contractors have not provided adequate training to craftsmen regarding quality.
- (d) Utilities are not convinced that quality assurance is a cost effective approach to construction. Labor perceived the utilities to think QA/QC was a "high cost" item rather than a "cost saving" tool.

- (e) Improved front-end engineering and procurement would reduce the amount of change and rework.
- (f) A Nuclear Stabilization Committee has been established with representatives from labor, utilities and contractors to improve relations between labor and management.

The staff proposes to continue these discussions as part of the long-term review.

F. Long-Term Review

Long-term NRC quality assurance policies and programs will be based on a review which assesses existing agency and industry quality assurance activities in a broad manner and then recommends an integrated long-term agency plan for quality assurance. Additionally, the review will focus the viewpoints of various sectors of the public and the regulated community. The review will be conducted by the NRC staff and will include representatives from headquarters, the regional offices, and consultants to the NRC.

The primary function of the long-term effort will be to conduct a thorough review of continuing quality and quality assurance problems, and to propose solutions to improve the quality assurance programs for design, construction, testing and operation. This review will include a detailed assessment of the problems that developed at facilities such as Diablo Canyon, South Texas, Midland, Marble Hill, and Zimmer. The object of this assessment will be to identify, as concisely as possible, specific problems that have occurred and their root causes, particularly in the area of programmatic deficiencies. Additionally, the review will evaluate existing programs at facilities which have programs that are functioning properly in order to identify the positive aspects of those programs that should be applied generically. Both this review and the review of programs at problem facilities will involve site visits by the personnel performing the review.

Proposed solutions to generic and plant-specific quality and quality assurance problems will be reviewed critically to determine whether the recommended actions would actually resolve the identified problems. The review will develop estimates of the qualitative and quantitative value/benefit and impact/cost of proposed solutions, and ways in which they should be implemented for operating plants, plants presently under construction, or for plants to be constructed in the future.

The House and Senate in their current joint consideration of the NRC's FY 82-83 authorization bill have accepted in conference an amendment which directs the NRC to study ways to improve quality assurance programs. Implementation of this review is consistent with that direction.

G. Quality Assurance Planning and Evaluation

The recommendation to form a single organizational unit dedicated to the various aspects of quality assurance was made in a report prepared for the NRC by Sandia Labs in August 1977, entitled "A Study of the Nuclear Regulatory Commission Quality Assurance Program."* The centralization of quality assurance functions has been one of continual interest and now more than ever needs to be achieved.

The NRC presently views responsibility for quality assurance as threefold: first, to determine the adequacy of the licensee's quality assurance program description contained in the safety analysis report; second, to ascertain that the licensee has established and adequately implemented the approved quality assurance program and to verify compliance with NRC regulations; and third, to develop the regulations, standards and guides addressing QA in the design, construction and operation of nuclear facilities.

The responsibility for these three functions is currently divided among three separate offices, NRR, IE and RES, with execution of the inspection function from five regional offices. These three functional areas are not separate and discrete areas but are highly interrelated, requiring continual interface. For example, the inspection experience needs to be continually factored into the licensing effort, inspection program development and development of regulations and standards. In addition, recent quality assurance issues (e.g., Diablo Canyon, Marble Hill, South Texas) have been highly reactive and have required rapid NRC management attention and response from the three separate offices for their various quality assurance functional areas.

The functional quality assurance areas need to be realigned for the following reasons:

- (a) To more effectively utilize the limited staff resources and expertise in quality assurance engineering.
- (b) To establish a more discernible policy and position on quality assurance issues.
- (c) To establish unity of control and to provide both information and coordination with industry.
- (d) To bring together the licensing, inspection and standards functions on interrelated issues.
- (e) To provide industry a signal that NRC management considers quality a leading part of the NRC operation and of sufficient importance to depart from the existing organizational structure.

It is recognized that most NRC activities are quality assurance related and that the NRC review process is an interdisciplinary function involving many organizational components. NRC headquarters activities which relate to the development of NRC policy, rules, standards and guides, and review and evaluation of the implementation of licensee's QA programs are to be consolidated at this time. The consolidation will occur in the Office of Inspection and Enforcement. The licensing function will remain in NRR until the current backlog of licensing actions is completed.

ENCLOSURE 2

Resources, Schedules and Staff Responsibilities

nuclear industry currently expends substantial resources for quality assurance at power reactors. For example, about 7500 positions are currently devoted to quality control and quality assurance on construction projects.

NRC Regional Offices devote about 130 positions to inspection of power reactors under construction and vendors. These inspections are concerned, to a great degree, with the effectiveness of the quality assurance programs in the various areas that are being inspected. This effort, which provides a measure of the overall effectiveness of the quality assurance programs, is the largest component of the NRC's efforts related to quality assurance at construction projects. A smaller part of this inspection effort (about 28 positions) is now directed towards inspecting the quality assurance programs.

In a broad sense, the headquarters offices also devote considerable efforts to quality assurance. In the narrow sense, they devote about 16 positions to direct professional work on quality assurance programs as follows: 4 positions training; 7 positions inspection program (QA related) development and implementation of QA initiatives; 5 positions research and standards development. None of this effort can be considered applicable to construction projects.

Contractor work has previously been at a level of about \$400,000 per year for research/standards development in quality assurance.

Estimated resources for the initiatives discussed in this paper are provided in Tables 1 and 2. These estimates are consistent with the NRC FY 83-84 budget. They can be summarized as follows:

Estimated Industry Resources

- (a) In FY 83
 - (i) 280 man years new effort
 - (ii) 420 man years altogether
- (b) In FY 84
 - (i) 310 man years new effort
 - (ii) 390 man years altogether

Estimated NRC Staff Resources

- (a) In FY 83
 - (i) 25 staff years new effort
 - (ii) 46 staff years altogether
- (b) In FY 84
 - (i) 24 staff years new effort
 - (ii) 34 staff years altogether

3. Estimated NRC Contractor Resources

- (a) In FY 83
 - (i) \$2.2 million new effort
 - (ii) \$2.2 million altogether
- (b) In FY 84
 - (i) \$1.4 million new effort
 - (ii) \$1.4 million altogether

New efforts correspond to the new initiatives developed by the staff, i.e., those that are not already underway and well established.

Generally, additional efforts are not large in comparison to the resources already devoted to QA. The improvements will come mostly from redirection of existing resources. NRC staff and contractor resources can be redirected as necessary to accomplish the initiatives without dropping any planned accomplishments although the depth and schedule of some planned accomplishments will necessarily be affected. NRC staff responsibilities with respect to development and implementation of the initiatives are indicated in Table 3. The schedules for accomplishing the initiatives are provided in Figure 1.

QA INITIATIVES	FY 83 (1)			FY 84 (1)		
	INDUSTRY (MAN YR)	MHC STAFF (STAFF YR)	MHC CONTRACT (\$ THOU.)	INDUSTRY (MAN YR)	MHC STAFF (STAFF YR)	MHC CONTRACT (\$ THOU.)
NIM - Self Evaluation (2)						
NIM - Regional Evaluation (2)						
NIM - Independent Design Review (2)						
Industry Initiative						
Inspection Program Changes (4)		10.0			13.0	
Construction Assessment ... Inspections	0.6	6.0	300	0.6	6.0	600
Integrated Design Inspections	2.3	3.5	800	0.9	1.4	120
Evaluation of Reported Information		0.2	250		0.2	350
Designated Representatives		0.8		0.4	2.0	
Management ... Programs	2.0	1.4	100	2.0	0.8	
Qualification ... Personnel	2.7	0.8		2.0	0.8	
Craftsmanship		0.4				
Long Term Review		1.0	750		0.1	100
Quality Assurance ... Evaluation						
TOTALS: (3)	280	25	2200	310	24	1400

NOTES:

- (1) Resource estimates for initiatives related to licensing peak sharply in FY 83 and drop sharply in FY 84. Construction delays may reduce this variation.
- (2) NIM programs may be reduced beginning in mid FY 83 as other MHC and Industry initiatives take effect.
- (3) Totals are rounded to two significant figures.
- (4) FY 83-84 MHC budget allocates an additional 0.3 (FY 83) and 0.5 (FY 84) staff years inspection effort per construction unit.

Table 2 - Estimated Resources for QA Initiatives (Altogether)

QA INITIATIVES	FY 83 (1)			FY 84 (1)		
	INDUSTRY (MAN YR)	NRC STAFF (STAFF YR)	NRC CONTRACT (\$ THOU.)	INDUSTRY (MAN YR)	NRC STAFF (STAFF YR)	NRC CONTRACT (\$ THOU.)
NIDOL - Self Evaluation (2)	10	2.5		3.6	0.9	
NIDOL - Regional Evaluation (2)	0.8	8.5		0.3	3.0	
NIDOL - Independent Design Review (2)	63	5.0		23	1.8	
Industry Initiative	74	2.6		54	1.3	
Inspection Program Changes		13.0			16.0	
Construction Assessment ... Inspections	0.6	6.0	300	0.6	6.0	600
Integrated Design Inspections	2.3	3.5	800	0.9	1.4	320
Evaluation of Reported Information		0.2	250		0.2	350
Designated Representatives		0.5			2.0	
Management ... Programs	270	1.4	100	84	0.8	
Qualification ... Personnel	2.7	0.8		200	0.8	
Craftsmanship		0.4		20	0.8	
Long Term Review		1.8	750		0.1	100
Quality Assurance ... Evaluation						
TOTALS: (3)	420	46	2200	390	34	1400

NOTES:

- (1) Resource estimates for initiatives related to licensing peak sharply in FY 83 and drop sharply in FY 84. Construction delays may reduce this variation.
- (2) NIDOL programs may be reduced beginning in mid FY 83 as other NRC and Industry initiatives take effect.
- (3) Totals are rounded to two significant figures.

Table 3 - Staff Responsibilities for QA Initiatives

QA INITIATIVES	REGION	OIE	NR	AFND
MITOL - Self Evaluation	ASSIST		LEAD-REVIEW	
MITOL - Regional Evaluation	LEAD-PERFORM	PROCEDURES		
MITOL - Independent Design Review	ASSIST		LEAD-REVIEW	
Industry Initiative	MONITOR	LEAD-REVIEW	REVIEW	
Inspection Program Changes	IMPLEMENT	DEVELOP-ISSUE		
Construction Assessment ... Inspections		PERFORM		
Integrated Design Inspections	ASSIST	LEAD-DEVELOP	ASSIST	
Evaluation of Reported Information		LEAD-DEVELOP		ASSIST
Designated Representatives	IMPLEMENT	LEAD-DEVELOP		
Management ... Programs	MONITOR	LEAD-DEVELOP		
Qualification ... Personnel	INSPECT	LEAD-DEVELOP		
Craftsmanship		PERFORM		
Long Term Review	ADVISE	LEAD-PERFORM	ASSIST	
Quality Assurance ... Evaluation		LEAD-IMPLEMENT		

Figure 1 - Schedule for Quality Assurance Initiatives

ISSUES AT NEAR-TERM OPERATING LICENSE FACILITIES

Self Evaluation

Regional Evaluation

Independent Design Review

INDUSTRY INITIATIVE

CONSTRUCTION INSPECTION PROGRAM

Procedure Changes

Construction Assessment Team Inspections

Integrated Design Inspections

Evaluation of Reported Information

DESIGNATED REPRESENTATIVES

MANAGEMENT

Management and Quality Improvement Programs

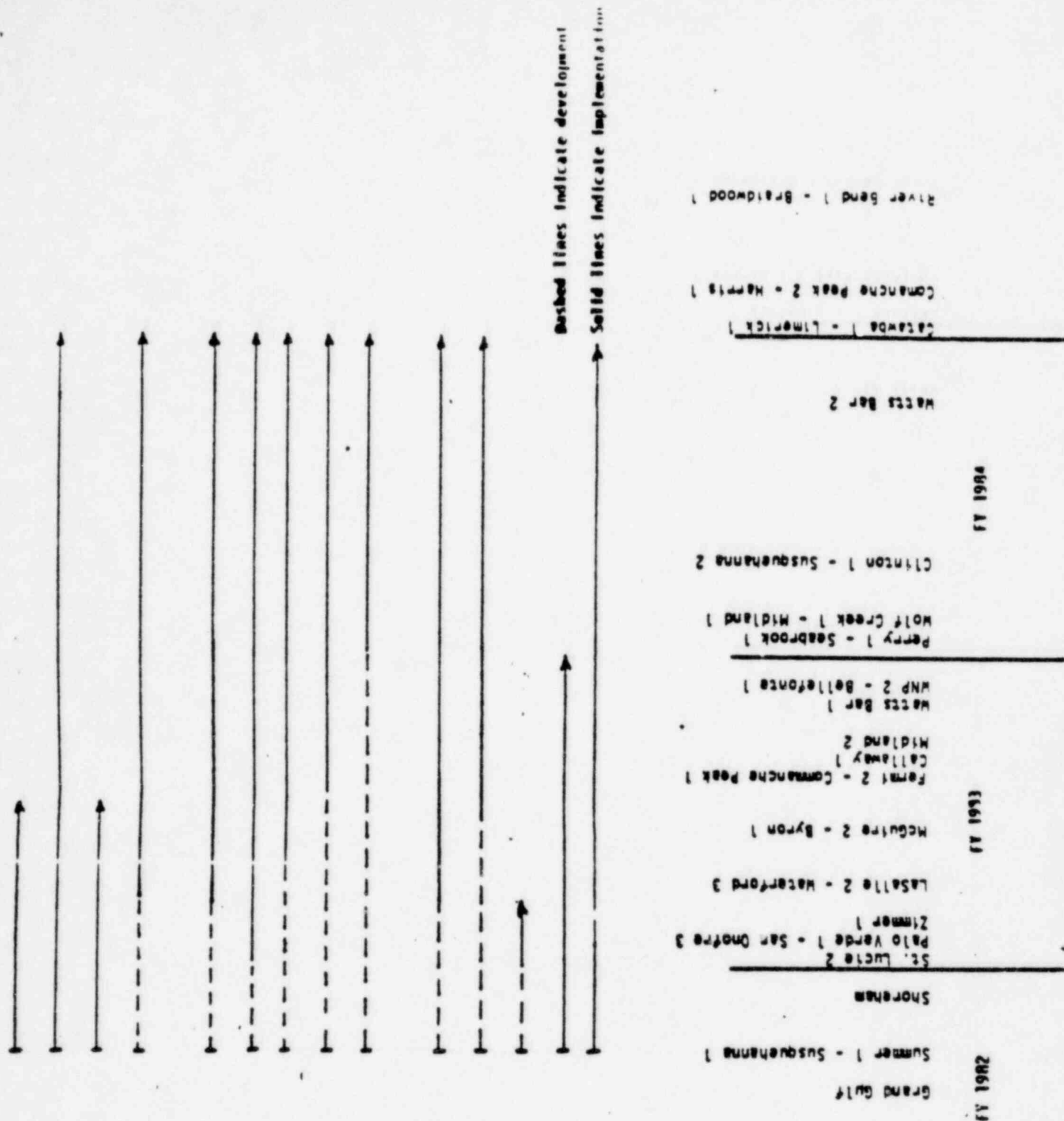
Qualification of QA/QC Personnel

Craftsmanship

ONE-TERM REVIEW

QUALITY ASSURANCE PLANNING AND EVALUATION

Projected Licensing Schedule



ENCLOSURE 3

Examples of Recent Quality Assurance Problems

During the past few years, there have been serious quality assurance problems at nuclear power plants. Some examples are listed below:

1. Marble Hill

In June and July 1979, NRC confirmed allegations of improperly repaired concrete imperfections at Marble Hill. The imperfections were generally identified as concrete consolidation problems (honeycomb and voids), and improper repair (patching) of these imperfections.

NRC inspections confirmed that:

- a. An excessive amount of honeycomb and air voids had occurred. Approximately 4000 concrete patches existed.
- b. In many instances these imperfections were improperly repaired, and/or unacceptable materials were used for the repair.
- c. Quality control records traceable to the repairs were either non-existent or inadequate.
- d. Personnel responsible for such repairs were inadequately trained and supervised.
- e. The licensee was not in control nor sufficiently aware of the above circumstances.

These events led to a halting of all safety-related work at the site in August 1979. Work was not permitted by NRC to resume until December 1980, when the utility's quality assurance program and that of its contractors, had been substantially upgraded and the adequacy of completed construction work had been verified.

2. Midland

Excessive settlement of the diesel generator building was observed in 1978. The unexpected settling was subsequently attributed to inadequate and poorly compacted soil under the building. Other safety-related systems and structures were affected. NRC's investigation determined that design and construction specifications had not been followed during placement of the soil fill materials and that there was a lack of control and supervision of the soil placement activities by the utility and its contractors. Extensive rework has begun, and the operating license application is currently being litigated before an NRC Hearing Board.

3. Zimmer

Allegations received in January 1981 prompted an NRC investigation of quality assurance problems at the Zimmer site. The investigation has identified a large number of quality assurance related problems. The majority of the problems identified focus on the ineffectiveness of controls implemented by the licensee and its contractors for assuring the quality of work performed. In that regard, numerous deficiencies have been found concerning traceability of materials, handling of nonconformance, interface between construction and quality control, quality records, and the licensee's overview of ongoing work.

An extensive review of the as-built plant is being performed. Limited independent measurements were performed by the NRC in selected areas of concern in an attempt to characterize the actual safety significance of these deficiencies. Although a few problems requiring corrective action were identified, the majority of the tests and examinations disclosed no hardware problems. The licensee will perform a comprehensive quality confirmation program and resolve identified problems before an operating license is issued.

4. South Texas

In response to allegations that QC inspectors were being threatened if they reported unacceptable items during concrete placements, the NRC initiated an investigation through its Region IV Office in July 1977. Ten investigations of allegations were performed during the period July 1977 to November 1979.

The results of these investigations established that the allegations of harassment, intimidation and lack of support of QC inspectors were substantiated. The investigation demonstrated shortcomings in the management and that the implementation of the QA/QC program at the South Texas Project did not meet the standards required to assure that the facility will be constructed to NRC requirements. Safety-related work was stopped in 1980. NRC allowed restart in designated areas only after QA for that area was upgraded and verified by the NRC.

In January 1981, the licensee initiated a design review of those portions of the engineering design work performed by Brown and Root, Inc. The Quadrex Corporation assisted the licensee in this review. Briefly, the Quadrex report found that Brown and Root failed to properly implement an overall design consistent with the needs of a nuclear power plant. The licensee replaced Brown and Root with Bechtel Power Corporation as architect-engineer in September 1981. NRC is monitoring the performance of Bechtel as they resolve the problems identified in the Quadrex report.

5. Diablo Canyon

At Diablo Canyon, the Pacific Gas & Electric Company (PG&E) provided incorrect information to an expert consultant, who used the information in developing the seismic response spectra for the design of certain seismic piping and equipment restraints. NRC investigators have found that there was a lack of rigor and formality in the procedures used for verifying the accuracy of information transferred by PG&E to its consultants. These procedures did not comply with NRC requirements calling for verification of design information at each stage of the process by an independent person qualified in the pertinent disciplines. Proper quality assurance controls were not employed in technical and procurement communications with service-type contractors. Nor were document controls adequate to assure that those involved in design had ready access to the most recent information available.

Following discovery of these errors in seismic design, the recently issued operating license for Unit 1 was suspended in late 1981. Prior to the NRC's reinstatement of the operating license the licensee will be required to complete an extensive design reverification program for those areas in question.

ENCLOSURE 4

Independent Design Review For
Near-Term Operating License Facilities

In order to provide further staff confidence in the quality of design and construction at near-term operating license applicants, licensees have been requested to conduct an independent verification of selected design and construction activities. The independent verification would be performed by an independent contractor with qualifications acceptable to the NRC. Independent verification efforts have been completed at LaSalle Unit 1 and 2 and San Onofre Unit 2 and 3. Reviews are presently in process at Grand Gulf, Susquehanna, Shoreham, Watts Bar, Palo Verde, Summer and St. Lucie.

At LaSalle, the licensee hired an independent contractor, approved by NRC, to perform a review of the mechanical and structural design of loop C residual heat removal system excluding all branch piping less than 3 inches, in the functioning mode of the low pressure injection system using loads resulting from the actuation of the automatic depressurization system in conjunction with the operating basis earthquake to verify that this system has been designed and constructed in accordance with the application and that the NRC requirements have been satisfied. Commonwealth Edison contracted the Teledyne Engineering Services (Teledyne) to perform this review with NRC approval.

The preliminary findings by Teledyne resulted in 21 Error/Deviation and 31 open-items reports which were transmitted to the licensee and the NRC staff. Upon submittal of all Teledyne's preliminary findings, the licensee transmitted its responses to Teledyne and the NRC staff and, in addition, the licensee received permission from the NRC staff to establish a dialogue between Teledyne and its Architect-Engineer (Sargent & Lundy) to discuss the potential errors found in the Teledyne review. Of these 52 reports which involved various problems in the design area and none in quality assurance, 39 were closed by Teledyne based on the acquisition of additional information and/or clarification of existing information. The 13 remaining reports were reviewed by Teledyne's Project Review Internal Committee. This committee, composed of three senior level Teledyne engineers who together had the expertise to resolve the technical issues, and the Teledyne Project Manager concurred that none of these reports have the potential for significant safety impact.

The NRC staff reviewed those open-items and error-deviations reports submitted to the Project Review Committee and concluded that these reports can be categorized as not having a significant safety impact on LaSalle. In addition, the NRC staff feels that Teledyne has performed an in-depth review of the analytical procedures and design calculations used in the piping, equipment, and component support design to assure the adequacy of the design bases, the adequacy of the design implementation, and the consistency between the design documents and the Final Safety Analysis Report commitments.

The independent design verification program conducted by Teledyne on the loop C residual heat removal system indicated that the quality assurance control and implementation, design process, procedures and Final Safety Analysis Report commitments are acceptable except in the area of response spectra, which was reviewed by NRC staff. The results of the limited review provide increased assurance that the quality assurance program established and implemented by the licensee and its principal contractors did effectively control the overall program and construction activities for the LaSalle County Station. While several design deficiencies were identified, the overall design and construction activities were adequately performed so that no adverse impact on safety was found.

At San Onofre the licensee contracted with Torrey Pines Technology, a subsidiary of the General Atomic Company (GA), to perform an independent evaluation of the seismic design and quality assurance program for San Onofre 2 and 3.

The design verification encompassed a review of the seismic design of San Onofre 2 and 3 to:

- a. verify that the design process converted the seismic design basis specified in the San Onofre 2 and 3 Final Safety Analysis Report (FSAR) into the design documents that are transmitted to the constructor or fabricator, and
- b. evaluate the SCE quality assurance (QA) audit plan and its implementation at the construction site and the fabricator's shops.

The design process performed by the equipment fabricators was not part of this review program.

The work was divided into eight major tasks:

- Task A. Design Procedure Review
- Task B. Design Procedure Implementation Review
- Task C. Seismic Design Technical Review
- Task D. Audit Plan Review
- Task E. Processing of Findings
- Task F. Reports
- Task G. Pipe Segment Walkdown
- Task H. Independent Calculations

The review was conducted by individual GA reviewers investigating each area covered by Tasks A through D, G, and H. When a reviewer found a deficiency that might have safety significance, it was documented in a "Potential Finding Report."

After the Potential Finding Report (PFR) was written, it was sent to the "original design organization" that was responsible for the area covered by the PFR. The original design organization (ODO) then investigated the PFR and responded in writing. The PFR and the ODO response was then reviewed by a GA committee, and the PFR was classified as (1) Out of scope, (2) Invalid, (3) Observation, or (4) Finding.

Out of scope items are those which are beyond the original scope of the review. For example, the review was oriented towards design verification. Procurement items are considered out of scope. Invalid Findings are the result of apparent deviations, uncovered in the course of the independent verification, that are resolved to the satisfaction of project personnel, usually during the Potential Finding review by the Original Design Organizations. Observations are valid deviations that are judged not to have the potential for significant impact on the seismic design adequacy of San Onofre Units 2 and 3. Findings are valid deviations that could have potential for significant impact on the seismic design adequacy.

Of the total of 170 PFRs that were initiated, 77 were determined to be invalid after additional information was reviewed. Of the 93 PFRs that were determined to be valid, 7 were classified as findings and 86 as observations. The numbers of findings and observations for each of the various tasks are as follows:

<u>Task</u>	<u>Findings</u>	<u>Observations</u>
A	3	2
B	1	35
C	1	41
D	2	5
G	0	2
H	<u>0</u>	<u>1</u>
Total	7	86

The staff has concluded, based on its review of the results of the design verification program, that the GA design verification program has not discovered anything that would cause the staff to change their previous conclusions that the San Onofre 2 and 3 quality assurance and seismic design programs are acceptable, and provides additional assurance that plant design and construction have been appropriately accomplished.