7.0 REVIEW OF NRC'S PROGRAM FOR ASSURANCE OF QUALITY

Section 13(b) of the Ford Amendment directs the NRC to analyze the following alternative approach to improving quality assurance (QA) and quality control (QC) in the construction of commercial nuclear power plants:

> Alternative b(4)
>
> Improvement of the Commission's organization, methods, and programs for quality assurance development, review, and inspection.

This chapter presents the analysis and findings of the study for this alternative. In Sections 13(b)(1), (b)(2), (b)(3), and (b)(5) of the Ford Amendment, Congress was specific in identifying the alternative concepts for NRC to analyze. Specific improvements to NRC's organization, methods, and programs were not specified in 13(b)(4), although several improvements are suggested by the other alternatives and by the debate during Congress' consideration of the Ford Amendment. However, a review of the legislative history of the Ford Amendment did not indicate that the sponsors had any specific NRC program improvements in mind other than those already described in Section 13(b).

Because there is no specific direction of possible improvements to pursue in analyzing this alternative and because events have shown that NRC's approach to the assurance of quality in the design and construction of nuclear power plants needs improvement, this study interpreted alternative b(4) as a broad mandate to determine shortcomings in NRC's approach to QA and to recommend improvements. While the charter of alternative b(4) was interpreted as being limited to assurance of quality in design and construction, some of the results have implications for more than just the NRC's QA program. In devising a study approach to address alternative b(4), the NRC used the following question introduced in Chapter 1 as a study focus:

> What changes should be made to the current policies, practices, and procedures governing commercial nuclear power plant design, construction, and regulation to prevent major quality problems in the future or to provide more timely detection and correction of problems that have occurred?

This question directly addresses the issues of prevention and detection and, as a corollary, assurance. These objectives of the NRC QA program were introduced in Section 2.2.

7.1 TECHNICAL APPROACH

To determine how to prevent major quality-related problems in the future and to provide more timely detection and correction of developing problems, the study first tried to determine why these problems occurred and why they were not discovered and corrected earlier. A series of case studies, which are described in Chapter 3 and Appendix A, was the primary means for answering "why." (See in particular Sections 3.2, 3.3 and 3.4.)

This analysis (see Chapters 2 and 3) showed that in prevention the NRC's underlying shortcoming was in its pre- and post-construction permit (CP) licensing reviews and inspections. The NRC had not performed searching analyses of (1) the applicant's capability to manage or provide effective management oversight over a nuclear construction project, or (2) whether project team members have the requisite nuclear construction experience to properly execute their various project roles. Several improvements to the NRC program were identified to address this prevention problem: enhancing pre-CP review by NRC staff; establishing a special advisory committee to help screen new applicants; conditioning the CP on a licensee's satisfactory post-CP demonstration that it can effectively manage all quality-related aspects of the project; and directing more NRC attention in general to the issues of management capability and prior applicable experience of members of the project team and their project staffs. These improvements are addressed in more detail in Chapters 2 and 4 and in the remainder of this chapter.

The NRC was also slow to detect and/or take strong action for significant quality problems that developed at each of the five projects cited as experiencing major quality problems. Reasons for this slowness included the following: (1) sporadic, NRC inspection presence at construction sites (before the NRC resident inspector program was implemented), (2) inability of the NRC inspection program to coalesce scattered quality program-related inspection findings coming in over a period of time into a comprehensive picture of a project-wide breakdown, (3) a prioritization of limited NRC inspection resources to address operations first, construction second, and design last, which resulted in an almost total neglect of design and the design process, (4) setting the threshold for reacting to construction-related problems higher than for operational problems because of the lack of an immediate threat to health and safety, because of an attitude that construction problems would be found during an intensive period of startup testing before an operating license was issued, and because of an attitude that required the demonstration of a project-wide breakdown before enforcement action would be taken for construction quality problems, (5) an orientation of the inspection program to focus heavily on programmatic matters and paperwork at the expense of examining actual work in progress and program implementation, and (6) the NRC's reluctance to address the issue of capability of utility management until problems grew so large that a remedial program became necessary.

Several improvements to the NRC program were identified to address these detection problems: expanding the resident inspector program; increasing team inspections; training inspectors and supervisors to better relate individual inspection findings to programmatic weaknesses; increasing inspection attention to construction and design; reorienting the inspection program to emphasize paper less and hardware quality more; and increasing inspection attention to management issues. These improvements are discussed in more detail in Chapter 2 and later in this chapter.

Although the case studies were useful in identifying why the prevention and detection problems occurred and in suggesting possible fixes, the overall study plan called for a broader analysis by an outside organization of the NRC's organization, methods, and programs for QA. This outside analysis was purposely lagged behind the first several case studies so that information from

the case studies would be available as input to the outside analysis. The desirability of such an analysis was emphasized by the comments of the individual review group members at the June 1983 review group meeting. The next section discusses the results of that analysis.

The firm selected to perform the management analysis of the NRC's QA program was N. C. Kist and Associates, a management consulting firm experienced in performing QA audits and program reviews for industry but which had not done work for the NRC prior to the Ford Amendment Study. Senior members of Kist Associates participated as team members in each case study. This experience enhanced their understanding of the problem under study and helped them to focus on weaknesses in NRC's approach to QA. Although the NRC staff provided logistical support to Kist in their analysis of NRC's QA activities and participated in some of the interviews, the Kist Report is entirely the product of N. C. Kist and Associates. The Kist Report further confirms and supports many of this study's findings and identifies several areas for improvements not identified in the case studies or other project activities. The major recommendations of the Kist Report are summarized in the next section, along with planned NRC actions or responses. The Kist Report is included in its entirety as Appendix B to this report. The findings upon which the Kist Report recommendations are based are found on pages 5-11 of Appendix B.

7.2 ABSTRACT OF APPENDIX B, THE KIST REPORT

Appendix B reports the results of Kist's review of the NRC's QA organization, methods, policies and programs. Kist's management analysis of NRC's QA program was based on (1) review of literature pertaining to past and present Atomic Energy Commission (AEC)/NRC programs for assurance of quality in design and construction of commercial nuclear power plants, including previous studies of those programs, (2) participation in the NRC case studies, and (3) interviews with the staff of the Office of Inspection and Enforcement (IE) in Bethesda, Maryland; Region II offices in Atlanta, Georgia; Region III offices in Glen Ellyn, Illinois; Region IV offices in Arlington, Texas; and Region V offices in Walnut Creek, California. The management analysis was limited to NRC programs for assurance of quality in design and construction of commercial nuclear power plants and did not include other NRC programs. The analysis included the perceptions of licensees, contractors, and NRC inspection staff and management regarding problems with the NRC and QA program. It also included suggestions for improvements obtained during the NRC case studies described in Chapter 3 and Appendix A.

Based on this review, several items were identified as candidate areas for revision, deletion and/or development to improve the NRC's policies and programs for the assurance of quality in the design and construction of nuclear power plants. These areas are summarized in the following section.

7.2.1 Recommendations of the Kist Report for Improvements in NRC's Organization, Methods, and Programs for Quality Assurance Development, Review, and Inspection

N. C. Kist and Associates' analysis of (1) NRC's implementation of management programs and practices for QA, past and present, and (2) the root causes of the NRC's inability to prevent problems and slowness to identify and act on problems resulted in the following Kist recommendations:

(1) Stabilize the regulatory process through more preventive action and planning.

(2) Streamline regulations and guidance documents and make them more prescriptive and definitive in terms of required elements of control without specifying how the elements of control must be implemented. Regulations that can stand on their own would eliminate the need for many guidance documents. Clearly define the applicability of quality program requirements, safety-related items and items important to safety.

(3) Make the quality assurance program and licensee commitments a condition of authorizations and permits.

(4) Replace the licensing review of the quality assurance program described in the Preliminary Safety Analysis Report (PSAR) with a licensing or IE review of the licensee's quality assurance manual and require the manual to detail how the quality assurance program shall be implemented. Require licensing or IE approval of quality assurance manual changes. Establish definitive acceptance criteria for manual reviews, specifying required elements of control but not methods for accomplishing them. Do not permit work to be performed until the quality assurance manual is approved.

(5) Evaluate licensee and contractor experience, attitude and management capability before authorizations and permits are issued. Establish parameters of acceptance criteria.

(6) Require demonstration of the licensee's capability to implement the quality assurance program before authorizations or permits are issued.

(7) Devote greater attention to design activities.

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

(9) Establish mandatory requirements in inspection programs and reduce dependency upon individual engineering judgment.

(10) Require an Inspection Plan of licensees and contractors and establish NRC hold points.

(11) Re-evaluate NRC personnel practices, including salaries.

(12) Change regulations to permit industry organizations rather than individual licensees to evaluate vendors and monitor their activities or establish licensing or certification programs for vendors. Extend the program to include material manufacturers and suppliers.

(13) Take stronger enforcement action. Require expeditious handling of corrective action, including determining the magnitude of problems and correcting their root causes.

(14) Perform detailed annual audits of the licensee's implementation of the quality assurance program.

(15) Review functions to be performed by the Quality Assurance Branch and Construction Programs Branches of IE to assure that efforts are not duplicated.

(16) Eliminate differences in basic regional office structures and job titles to assure uniformity of functional responsibilities.

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

(18) Establish an audit program of NRC activities, using qualified personnel not having responsibility in the areas audited.

(19) Establish a quality assurance program within the NRC.

These areas for improvement of NRC's QA policies and programs were extracted from pages 11 to 13 of Appendix B. The findings that form the bases for these recommendations are discussed in detail in Appendix B and are summarized on pages 5 to 11. The findings cover the following areas: organization; management practices; the QA standards program; the QA licensing program; the QA inspection program; the licensee, contractor and vendor inspection program; the QA enforcement program; and NRC's inability to prevent problems and slowness to identify and act on problems.

Many of Kist's recommendations are consistent with results from the NRC case study reviews (Chapter 3 and Appendix A) and the review of the quality and quality assurance programs of other government agencies and industries (Chapter 9 and Appendix D). For example, recommendations 1, 5, 6, 7, 13 and 14 corroborate case study findings and have been carried forward into Chapter 2 as major recommendations of the report. Recommendations 1, 2, 3, 4, 10, 12, and 17 are consistent with results of the study of outside programs (Chapter 9), and further action and/or analysis is planned in each area.

Recent NRC actions also address several of Kist's findings. For example, as discussed earlier, the Committee to Review Generic Requirements was established in 1981 to, among other purposes, stabilize the flow of new and/or revised NRC regulatory requirements and to ensure that the impact and resultant benefits of regulatory changes are fully assessed (recommendation 1). Also, in recent years, the NRC enforcement program has been bolstered by Congressional legislation that permits stronger enforcement and penalties for licensees' failure to comply with NRC requirements (recommendation 13). Another example of recent improvements is two new training courses developed in 1983 in the area of QA for operations, construction, and modification (recommendation 17).

Not all of Kist's findings were considered of sufficient importance to be carried forward into Chapter 2. In some cases, the recommendations and their feasibility need to be further evaluated. Each of the above findings will be evaluated and pursued, collectively, with the findings of other QA study reviews

(the pilot program, the case studies, analyses of Alternatives b(1) - b(5) and review of outside programs), to identify the most effective areas for improving NRC's policies and programs for assurance of quality.

Section 7.3 identifies actions that the study recommends to improve NRC's programs for assurance of quality and Sections 7.4 and 7.5 identify additional improvements to NRC's QA policies and programs that have recently been implemented or are under development, respectively. Several of the actions discussed in those sections address Kist's recommendations; those that are not addressed will be analyzed by the NRC staff and may result in subsequent action.

7.3 ACTIONS RECOMMENDED TO IMPROVE NRC PROGRAMS

This section discusses two groups of actions recommended to improve NRC programs. The first group discusses the recommendations resulting from the NRC case studies, the review of NRC QA policies and programs, and a review of outside programs. The second group discusses additional areas identified in the study and needing further consideration.

7.3.1 Recommendations of NRC Case Studies, Review of NRC QA Policies and Programs, and Review of Outside Programs

The findings from the NRC case studies (Chapter 3), review of NRC QA policies and programs (the Kist Report), and the review of outside programs (Chapter 9) form the basis for the following recommended changes to NRC's program for the assurance of quality. Recommended changes (1) to (6) address the prevention issue, changes (7) to (9) address the detection issue, and change (10) addresses the assurance issue (see Chapter 2 for a discussion of prevention, detection, and assurance). Because much of the rest of this report addresses improvements to NRC's program, this section will reference other parts of the report in which certain improvements are more fully discussed.

(1) Enhanced Pre-Construction Permit Reviews

The study recommends that NRC improve its pre-CP review of an applicant's capability for managing or overseeing the management of a commercial nuclear reactor construction project. In particular, future NRC reviews of CP applicants should focus much more heavily on the project team's prior nuclear construction experience and on management capability. The pre-CP review should also cover planning, design, design control and planned construction control processes. This recommendation is described in more detail in Chapter 4 (Pilot Programs) and in Section 2.4.1.

(2) Post-CP Demonstrations of Ability to Manage an Effective Program.

As a condition of their CP, new applicants should be required to successfully demonstrate their ability to manage the implementation of an effective quality assurance and quality control program. This capability should be demonstrated and verified in the first periodic independent audit, approximately 12 to 20 months after the CP is issued. This recommended action is also described in more detail in Chapter 4 (Pilot Programs) and in Section 2.4.1.

(3) Performance Objectives for QA Programs

NRC currently establishes prescriptive review requirements for a "QA program" in Chapter 17 of the Standard Review Plan (SRP). Once NRC has approved a licensee's QA program description of how 10 CFR 50 Appendix B will be met, the licensee develops a set of detailed implementation procedures that the licensee's employees use in performing their jobs.

A licensee is inspected against the requirements of Appendix B to 10 CFR 50 and against the commitments made by that licensee in its approved QA program description. The QA program must address each of the elements described in the SRP. If licensees elect to describe a QA program that has elements going beyond the SRP requirements, the NRC regards those additional elements as commitments that are also subject to enforcement. Because of this, licensees have tended to maintain their QA programs at a level designed to satisfy NRC requirements only, i.e., the minimum required to protect public health and safety. It is inevitable that human endeavor will sometimes fall short of targeted performance. If the target is NRC's requirements, licensees will inevitably fail to meet these requirements on occasion. NRC's current QA licensing practices can thus be counter-productive to 100% attainment of NRC objectives.

The NRC should consider revising current practices by developing a set of inspectable performance objectives and criteria that would meet NRC's requirements for a QA program. These inspectable performance objectives would describe what NRC wants the licensee's QA activities to actually accomplish. The licensee would then develop detailed procedures designed to meet or exceed NRC's performance objectives. NRC's intermediate step of reviewing and accepting an applicant's QA program description would therefore be eliminated. The performance objectives would replace the current Chapter 17 of the SRP. A licensee could elect to establish procedures that exceed NRC's performance objectives. However, inspection and enforcement of a licensee's actual performance would be against NRC's performance criteria rather than the procedures, which could exceed NRC's performance objectives.

If the NRC evaluates a licensee's actions against a nationally uniform set of inspectable performance criteria rather than against the licensee's commitments (which are different for each licensee and sometimes for each plant), there is a greater likelihood that licensees will set their targets (i.e., the detailed procedures) higher than NRC's minimums. There would then be a greater likelihood of licensees consistently exceeding NRC's minimums, even when their actual performance sometimes falls short of their targets. This practice would also indicate to licensees that the NRC is more concerned with what a QA program accomplishes rather than with how it is described, as some believe.

A reform of NRC's current practice for quality assurance becomes even more important if current legislative initiatives are enacted to revise the licensing process by limiting the operating license hearing essentially to operator qualifications and quality assurance matters. The effectiveness of the licensee's quality assurance activities will be vitally important to that kind of process. This recommendation is also discussed in Section 2.4.1.

(4) Management Appraisals by NRC

The study recommends that NRC address the issue of management competence more directly. The NRC should incorporate management lessons learned from the case studies, remedial program experience and other sources into the NRC inspection program to improve NRC's capability to assess the capability and effectiveness of utility and project management. In particular, NRC should (1) develop an inspection module to evaluate the capability, effectiveness, understanding and qualifications of utility management, and (2) implement this management inspection approach by applying it to plants currently under construction.

This recommendation would address a shortcoming in the NRC inspection program. Although this study and years of NRC inspection experience suggest that a primary cause of problems in construction and operation is shortcomings in some utility management, the NRC inspection programs' focus on compliance with requirements addresses the management issue, at best, indirectly and generally after the fact. Developing an inspection approach that looks primarily at the sources of problems rather than the effects should lead to earlier detection and possibly prevention. This recommendation is discussed in more detail in Section 2.4.1.

(5) Retrospective Look/Inspection Prioritization of Plants Currently Under Construction

Besides applying management lessons, the NRC should apply the Ford study lessons to analyze plants currently under construction to improve NRC's and licensee's diagnostic capability and to better prioritize the NRC inspection effort. In particular, the NRC should examine the current population of plants under construction to determine which seem to most exhibit the characteristics of plants that had major quality problems in the past and use this information to help prioritize its inspection program for those plants. Although at the beginning this prioritization would be based upon Ford study lessons, it should be sharpened over time by feedback from the inspection program and the development of a trend analysis capability (discussed below). This recommendation is discussed in Section 2.4.1.

(6) Perform Trend Analysis of Construction Indicators

The NRC has been slow to detect major quality breakdowns in the past. One cause of this slowness has been its inability to synthesize scattered bits of information into a comprehensive picture of the health of a construction project. To synthesize information and to develop a closer picture of management effectiveness, the NRC should develop a set of construction performance indicators that could be monitored, trended, and evaluated by the licensee and the NRC. Such indicators should be oriented toward measuring the effectiveness of activities that contribute to, control, or verify construction quality.

Efforts in this area are presently under way (1) to analyze inspection program data, including manhours per site per activity vs. inspection findings, and (2) to develop a computerized NRC capability to analyze licensee construction events and vendor events reported to the NRC under

10 CFR 50.55(e) and 10 CFR 21, respectively. This recommended action would combine these efforts with analyses of other indicators, some arising from the case studies and some yet to be determined, into a comprehensive NRC management information capability.

Besides using the system for observing trends, NRC inspection groups will be able to use data in the system as followup for determining whether plants acceptably resolve outstanding reports and whether deficiencies reported by one plant may potentially apply to other plants. The quality of licensee management of safety deficiency reporting in design and construction may be used as one measure of its commitment to quality and the effectiveness of its QA program.

Some NRC resources need to be redirected to this area, including training, to ensure close attention to detecting problems. QA problems at any site should be clearly and accurately identified, including root causes, and that information should be provided to all sites immediately. Competent and prompt followup to ensure that proper actions are taken is mandatory. Knowledge of the problems by NRC managers is vital and should be stressed. Success of this program will be enhanced by selecting results-oriented NRC managers to lead this activity. See Section 2.4.1 for more discussion of this recommendation.

(7) Independent Audits

Periodic independent audits should be required of all commercial nuclear power plants under construction. This requirement should be imposed on both all current construction permittees and all future applicants by conditioning the CP on the applicant's agreement to employ periodic independent audits. See Chapter 4 and Section 2.4.2 for a complete discussion of the third-party audit recommendations.

(8) Regional Inspections

The regional inspection program should be supplemented with additional contractor support for its regular inspection program. Such support would allow more NRC staff time for reactive inspections such as allegation followup, remedial program inspections, and special regional construction team inspections. Increased use of regional team inspections is being tested in one NRC regional office. Pending results of this trial program, the NRC inspection program in all regions may be reoriented to greater emphasize team inspections. This recommendation is discussed in more detail in Section 2.4.2.

(9) Resident Inspectors

The study found that for new applicants or for the restart of construction at projects presently delayed, resident inspectors should be assigned to the site as early as possible, preferably before the CP is issued and before safety-related construction activities are started. This study finding will be considered for NRC's future policy on placing residents at construction sites. The NRC is also in the process of establishing a pilot program in one of its regional offices. That program would place

more resident inspectors at plant sites and correspondingly reduce the size of the regional inspection staff. Pending the outcome of this trial program, the NRC inspection program may be reoriented to more heavily emphasize resident inspectors. See Section 2.4.2 for more discussion of this recommendation.

(10) Audits of Implementation of NRC Programs

The NRC should strengthen its programs for conducting audits of NRC Program and Regional Offices to assure that NRC programs are being implemented consistently, adequately, and uniformly. Besides providing information to NRC management on the status of that implementation, the audits could be an evaluation tool for feedback on appropriate areas for program revision and as an aid for prioritizing programs. NRC should also arrange for periodic independent management audits of the NRC program relating to QA. See Section 2.4.3 for a discussion of this recommendation.

7.3.2 Additional Areas Requiring Further Evaluation

In the review of NRC programs, some additional areas were identified which the NRC should further consider and evaluate as potential methods for improving NRC's program for the assurance of quality in the design and construction of nuclear power plants. These areas include the following:

(1) Inspection Planning

Better methods of planning quality assurance inspections should be pursued to plan and use the limited inspection resources in these most important areas. Possible methods include applicability of probabilistic risk analysis and qualitative and deterministic risk assessments and development of an overall "inspection plan" that would bring coherence to NRC headquarter's inspections, regional inspections, resident inspections, independent audits and the licensee's regular inspection program.

(2) Readiness Reviews

The NRC should consider requiring formal "readiness reviews" during nuclear power plant construction. Plant designers, construction managers, owner/operators, and possibly the NRC could participate in the reviews, which would be required at key points in the project, beginning with "design ready for construction". The reviews' purpose would be to ensure the coordination of all parties involved and the readiness of the project team to proceed with each new construction phase. This recommendation is also discussed in Chapter 9 and Section 2.4.5.

(3) Training

The NRC should consider additional training for the NRC staff in quality assurance, auditing, conduct of inspections, and analysis of inspection findings to determine programmatic weaknesses. These training programs would help the staff to implement the inspection program more effectively and to develop the ability to detect more readily causes of problems that go beyond surface symptoms. This recommendation is also discussed in Chapter 9, Appendixes B and D, and Section 2.4.1 (item 6).

(4) Control Over Vendors

The NRC holds the licensee responsible for all aspects of the nuclear power plant, including all parts and equipment furnished from vendors and suppliers. The NRC's current vendor program and near-term focus are discussed in Chapter 2. The longer-term implications of the changing supplier-vendor-contractor-utility infrastructure is changing with unknown implications for the future. The NRC should be aware of these changes and their implications so that it can take prudent action to prevent future problems rather than react to them. Assurance of the quality of vendor and supplier activities could be improved by the NRC's stricter enforcement against deficiencies in the licensee's required vendor control and inspection programs and by more NRC inspection of the licensee's control of vendors and suppliers. The NRC should explore different institutional arrangements for oversight of component suppliers, such as changing regulations to permit industry organizations to be responsible for evaluating component suppliers (see the Kist Report). The NRC should support continued development of a data bank on performance of and problems with vendor-supplied components, as suggested by the Battelle report on outside QA programs (Chapter 9 and Appendix D).

(5) Design Completion

NRC should consider requiring that plant designs be well advanced before construction activities begin. Besides permitting better construction planning and scheduling, the more completed design should result in fewer design changes and better design interfaces. See Chapter 6 and Sections 2.2 and 2.4.5 for more discussion of this recommendation.

7.4 RECENT IMPROVEMENTS TO NRC'S QA PROGRAM

After a series of quality-related problems were identified in the design or construction of several nuclear power plants, the NRC staff initiated a series of QA improvements to the NRC QA program designed to improve the assurance of quality in the design and construction of nuclear power plants. The following paragraphs discuss recent improvements to NRC's QA programs stemming from these initiatives as well as some improvements that were already in place, such as the resident inspector program and the Systematic Assessment of Licensee Performance (SALP) Program. As noted earlier, many of these improvements specifically address some of Kist's findings.

(1) Resident Inspector Program

In the 1960s and early to mid-1970s, the reactor inspection program was carried out by inspectors assigned to NRC Regional Offices. In 1974, a two-year trial resident inspection program was initiated to test the concept of placing NRC inspectors at a nuclear power plant site. The program's purpose was to derive benefits accruing from increased onsite inspection time, to improve NRC's awareness of site activities and status, and to increase inspector efficiency. The program demonstrated that the resident inspector concept was viable, and in 1977 the NRC adopted the program as a central feature of the inspection program. At first, resident inspectors were placed at operating reactors, and in 1979 they began to be stationed at nuclear power plants under construction.

The resident inspector program currently includes one inspector for each reactor site at which plant construction is more than 15% complete and one for each operating reactor. The resident inspector performs a significant part of the total inspection effort. As a "generalist" (as opposed to a "specialist"), the resident inspector monitors day-to-day activities and performs the parts of the inspection program in which he is knowledgeable. Specialists from the regional office conduct inspections in specific technical areas to complement the resident inspector's activities.

This study found the resident inspector program to be the backbone of the current NRC inspection program. The resident's constant presence at a site enables him to more comprehensively understand the project's health and status and better enables NRC to analyze individual inspection findings to determine if they represent only isolated deficiencies, a programmatic problem, or a quality assurance breakdown.

The resident program is one aspect of NRC's approach to improving its detection (and prevention) capabilities. The study recommends that for future CP applicants, experienced NRC residents should be assigned to the site before the CP is issued, as soon as preliminary site work begins. The resident inspector program and recommendations above are discussed further in Section 2.4.2.

(2) Construction Appraisal Teams

In 1980, on a trial basis the NRC initiated Construction Appraisal Team (CAT) inspections to provide in-depth inspections of the quality of the implementation of management and quality controls at a nuclear construction project. In a CAT inspection, a multi-disciplinary team of specialists assess program implementation by examining safety-related hardware after it is installed and after the licensee's QA/QC inspection is completed. The principal objective of the CAT program is to evaluate the effectiveness of design controls, construction practices, and other management controls used to ensure that as-built conditions are according to the plant's design.

During 1980-1981, eight trial CAT inspections were performed by 5-man teams from Regional Offices. Each inspection included about 2 weeks of onsite inspection time. In 1982-1983, the CAT program was revised and CAT inspections are now performed by NRC headquarters using teams of NRC personnel and consultants. A team generally consists of a team leader and 10 engineers and spends approximately 4 weeks at the site. Each inspection entails approximately 1,600 to 2,000 manhours of direct inspection time onsite. In 1982-83 NRC performed about 4 CAT inspections per year.

The CAT inspection program is another aspect of NRC's effort to improve its detection capabilities and to address the "threshold" problem for taking action for quality problems in construction. The headquarters-based CAT inspection partially, but not completely, addresses Kist recommendations 18 and 19, serving as both an audit of the performance of the licensee inspected and as an overcheck of the implementation of the NRC resident and regional-based inspection program. The CAT program is further discussed in Section 2.4.2.

(3) Systematic Assessment of Licensee Performance

Following the Three Mile Island accident, the NRC initiated a program for the Systematic Assessment of Licensee Performance (SALP). The SALP program consists of periodic reviews of regulatory performance of nuclear power plants (both under construction and in operation) by a team of inspectors, licensing staff and regional supervisors and management. The SALP assessment is intended to be sufficiently diagnostic to provide a rational basis for assessing licensee performance, for allocating NRC inspection resources, and for providing meaningful guidance to licensee management. The SALP assessment is based on a review of inspection data, licensing staff input, licensee performance in areas such as deficiency reports (Licensee Event Reports and reports submitted pursuant to 10 CFR 21 and 10 CFR 50.55e reporting requirements), and licensee responsiveness to Inspection and Enforcement Bulletins and other suggestions for improvement. Each of nine or ten functional areas is evaluated and is assigned to one of three categories to indicate whether more, less, or about the same level of NRC inspection attention and licensee attention is appropriate for the coming period. The SALP program represents an effort by the NRC inspection program to better address management capability and competence. The SALP program is also discussed in Section 2.4.1.

(4) Integrated Design Inspection (IDI)

NRC has recently developed a special design inspection program to assess the quality of design activities. The design area has received little inspection attention in the past, and recent experience has suggested that it should receive greater attention. This design inspection program also uses the team approach and encompasses the total design process on a selected system, from formulating design and A&E criteria through developing and translating the design to actually performing site construction. While the NRC staff evaluates a great deal of basic design information in the licensing reviews, it has not previously verified that this basic information has been properly incorporated in the actual design drawings. This new design inspection program examines the adequacy and consistency of the integration of all the design details within a selected sample area. The focus of the inspection is on the completed drawings and includes such things as independent calculations to verify piping and tank sizes, seismic support strengths and failure modes. Where errors are found in designs, the design process is examined to determine if there are generic problems. It is believed that conclusions about the adequacy of the overall design process can be drawn from this very detailed audit of a selected sample. Each IDI requires about twelve persons and four months to complete. Current plans are to conduct three IDIs per year.

The IDI program is the main NRC initiative aimed at addressing the problem of insufficient past NRC inspection attention to design. The IDI program is another aspect of NRC's effort to improve its detection capability. The IDI program is also discussed in Section 2.4.2.

(5) Revised Construction Inspection Program

The construction inspection program was recently revised for two reasons: (1) a recognition that inspection requirements exceeded inspection resources; and (2) programmatic review was being emphasized at the expense of observing work and inspecting hardware. In 1982 the NRC staff began revising the individual inspection procedures in the construction inspection program to better match the budgeted resources. The main goals of the revision program, which is to be an ongoing program of review with the first cycle of review to be completed in the spring of 1984, are as follows: (1) to shift emphasis of inspection from reviewing records to observing work; (2) to facilitate performance of certain procedures by resident inspectors; (3) to re-examine the scope and frequency of some inspections based on limitations of inspector resources; and (4) to eliminate redundancies in the procedures. With current plans, the first review cycle will consolidate 115 inspection procedures to 61 procedures. The revised inspection program is also discussed in Section 2.4.2.

(6) Quality Assurance Staff Consolidation

In the fall of 1982, the quality assurance responsibility and functions of the NRC Office of Research were assigned to the Office of Inspection and Enforcement (IE). These responsibilities included regulatory development, standards development, liaison with code and standards making organizations, and research. In January of 1983, the quality assurance licensing functions for power reactors were also assigned from NRC's Office of Nuclear Reactor Regulation to IE. These re-assignments of personnel and functions are intended to consolidate responsibility for all NRC quality assurance matters in one NRC line office. Consolidating NRC QA functions and responsibilities has been a long-standing issue within the AEC and the NRC. Programmatic weaknesses in the AEC's QA program resulting from diffusion of QA responsibilities among several AEC program offices was first identified as an issue in a 1973 assessment of QA regulatory programs.*

(7) Independent Design Verification Program (IDVP)

On a case-by-case basis, the NRC staff has requested that an applicant for an operating license provide additional assurance that the design process used in constructing the plant has fully complied with NRC regulations and licensing commitments. Many licensees have responded by initiating a design review through an independent third-party contractor. This review program has been termed the Independent Design Verification Program (IDVP). The independent review evaluates the quality of design based on a detailed examination of a small sample. The independent review has also addressed programmatic areas, for example, classification of systems and components, design and verification records, interface control and interdisciplinary review, consistency with the Final Safety Analysis Report (FSAR), nonconformances and corrective actions, and audit findings and

*Davis, J. G. and H. H. Brown. 1973. "Quality Assurance and the Utilities: Is Regulatory Doing Enough?" Prepared for the Director of Regulation.

resolutions. The review includes verifying specific design features by independent calculations and by comparing installations against as-built drawings. The NRC staff reviews the selection of the independent review organization and the audit plan before they are implemented, reviews the completed report, and assesses the applicant's response to the audit findings. In all cases to date, the NRC staff has concluded that the applicant has complied with NRC regulations and licensing commitments.

Some licensees have expanded their IDVP to cover construction quality as well as design, and these are referred to as Independent Design and Construction Verification Programs (IDCVP). THE IDCVP conducted at Palo Verde and the one in process at Midland were selected for special review by the NRC staff in conjunction with the Ford Amendment Pilot Program (see Chapter 4). The scope of the IDVPs (IDCVPs) has varied from plant to plant. THE IDCVP at Palo Verde was of greater scope than the average and involved about 120 manmonths of review.

The third parties selected to perform the IDVPs or IDCVPs must meet strict NRC-established criteria to ensure they are independent of the licensee. In particular, the organization selected and each individual participating in the review must not have had any responsibility for or involvement in the project's design or construction, and safeguards are established around the review of draft inspection reports. Plants that have received an IDI or that are replicates of plants that have already been subjected to an independent design review have generally been able to provide sufficient assurance that the design process has complied with NRC requirements without performing a second design review.

The usefulness of these audits has varied from site to site because of the variability among each audit's scope and methodology. With the transfer of IDVP responsibility to the same NRC program office (IE) responsible for the IDI program, future IDVPs will be patterned more like IDIs and the variability should decrease.

This study concluded that a series of comprehensive third-party audits, using a clearly established set of audit criteria, will better enable the NRC to meet its responsibilities than the current IDVP practice. Until this regulation has been established, however, the NRC should continue to encourage licensees to perform voluntary independent design reviews. This recommendation is discussed in more detail in Chapter 4 and Sections 2.2 and 2.4.2. The IDVP program is also discussed in Sections 2.4.2 and 2.4.3.

(8) Quality Assurance Surveys on Computer Code Development and Use

Since 1978, the NRC has been developing and implementing a program to assure that vendors, national laboratories and utilities that develop or use thermal-hydraulic computer codes apply quality assurance programs that provide traceability and independent review of calculations used for the design of plant systems.

The licensing staff, with the assistance of Region IV, has conducted inspections at vendor facilities, national laboratories, and selected utilities. These inspections have not revealed any major deficiencies in the quality of the work performed with various codes. However, QA practices applied in developing and using codes varied significantly among national laboratories, while the practices of vendors and utilities were consistent with staff and industry guidelines. As a result of work done to date, the staff is in the process of proposing a uniform QA program for the national laboratories and will continue the inspection of vendors and utilities with an expanded scope that will include other types of codes (e.g., seismic, radiological).

7.5 PROGRAMS UNDER DEVELOPMENT

The previous section identified NRC initiatives that the staff has implemented as methods to improve NRC's assurance of the quality in the design and construction of nuclear power plants. The initiatives presented in this section are additional efforts that the staff has under preparation, in varying stages of development and implementation. These efforts are in addition to the areas identified in Section 7.3.2.

(1) Regional Administrator's Evaluation

To provide additional confidence in the quality of design and construction to the regions, the NRC staff has taken steps to improve its guidance in the NRC program of pre-operating license review. In this program the NRC Regional Administrator comprehensively evaluates the licensee's performance and plant construction status shortly before an operating license is issued. Based on inspection and enforcement history and other licensee performance information, the new evaluation guidance helps identify areas requiring additional inspections. A report of this evaluation is forwarded from the cognizant Regional Administrator to the Director of the Office of Nuclear Reactor Regulation (NRR) to provide information relevant to NRR's considerations in plant licensing. This procedure is currently being revised to incorporate the results of the periodic SALP evaluations.

(2) Qualification and Certification of QA/QC Personnel

Inadequate qualifications of some personnel working in quality assurance areas have been noted as a contributing factor to quality-related problems in NRC investigations or inspections of quality problems at Marble Hill, South Texas, Zimmer, and Midland. To better understand and characterize the significance of this issue, the NRC is conducting a study to determine the extent and magnitude of the problem, the underlying causes for it, and the extent and quality of existing standards for QA/QC personnel qualifications to develop recommended actions for NRC program improvement. The staff also has efforts under way to direct more NRC attention to enforcing the existing standards for qualifications of quality assurance personnel, to work with the industry in developing improved qualification standards, and to further consider the benefits and feasibility of requiring formal qualification and certification of QA/QC personnel.

(3) Craftsmanship and the Importance of Feeling Personally Responsible for Quality

The NRC recognizes the important role that craftsmanship plays in putting quality into a product. Improving craftsmanship in nuclear construction is a high priority. The study concluded that improving management will improve craftsmanship more than any other single factor. The University of Texas study of craft productivity in power plant construction cited in Chapter 3 strongly supports this conclusion.

Clearly, ultimate responsibility for performing high-quality work rests with the actual doer. However, management must provide the directions and supporting conditions that allow and encourage the individual to attain quality. The individual must feel personally responsible for attaining quality. If management does not carry out its responsibilities such as, for construction, giving a qualified craftsman a complete and accurate set of drawings, the proper tools and materials, valid acceptance criteria and confidence that enough time is available to do the job correctly, the craftsman is unlikely to feel the degree of personal responsibility that has the greatest probability of yielding quality work. The primary role of the quality control inspector then shifts from providing assurance that the work has been done properly to screening out improperly performed work. While it has been established that many nuclear power plant construction projects suffer from poor craftsmanship, this report concludes that improving management in nuclear construction is a necessary precursor to significantly improving the job done by the craftsman.

The importance of feeling responsible for quality extends from the craftsman upward to all levels of management, including first-line supervisors. First-line and higher supervisors should be held accountable for the quality of work under their direction. These supervisors should be appropriately trained to provide instruction on how to achieve quality work and to recognize project activities or practices that may degrade quality.

The feeling of personal responsibility for the successful outcome of a project, whether it is large or small, applies equally to the NRC. NRC management is also required to establish a framework for its inspectors in which those inspectors feel a sense of personal responsibility for determining the effectiveness of the QA programs of their assigned plants.

During this study, some labor unions involved in nuclear construction were contacted to explore potential methods and incentives to enhance the crafts role in assuring the quality of construction activities. Meetings with union officials and discussion with union training officials highlighted the following points:

(1) Craftsmen are generally not well informed of their role in the QA/QC process.

(2) Continuous rework because of changes has a demoralizing effect on craftsmen and affects the quality of the final work.

(3) Utilities and contractors have not provided adequate training on quality for craftsmen.

(4) Utilities are not convinced that quality assurance is a cost-effective approach to construction. Labor perceived that utilities think QA/QC is a "high-cost" item rather than a "cost-saving" tool.

(5) Improved front-end engineering and procurement would reduce the amount of change and rework.

The staff has used this input from the unions and crafts in preparing the changes to NRC programs discussed in this report. The NRC will further study improving the management of crafts.

(4) Improved NRC Management Reviews

The case studies identified management experience, competence, and commitment to quality as fundamental for assuring an effective quality assurance program on a nuclear project. CPs have been issued to licensees who, in retrospect, experienced difficulty in managing their projects, including the quality program, because of inexperienced personnel in major project organizations and lack of understanding of the complexity of designing, constructing, and licensing a nuclear plant. Moreover, the NRC has been slow to determine the extent and magnitude of the results of inadequate management.

The SALP program discussed above performs periodic appraisals of the quality of licensee and licensee management performance, based on inspection findings and other indicators. CAT inspections and Performance Appraisal Team (PAT) inspections for operating plants also measure management effectiveness. The NRC staff is currently examining how to incorporate lessons learned from the case studies into the inspection program to improve NRC's capability to assess the quality and effectiveness of utility and project management. See Section 2.4.1.

Chapters 2 and 4 discuss some of the improvements being considered (enhanced pre-CP reviews, post-CP demonstrations, and third-party audits), to improve (1) the focus of the NRC review of management capabilities before a CP is issued, (2) confirmation of management capabilities shortly after site construction is begun, and (3) management effectiveness throughout the project.

(5) Prioritization of QA Efforts and Integration of QA

The NRC has three QA research projects planned or under way to address the applicability of QA requirements to various structures, systems, and components in a nuclear power plant. One project is attempting to develop a methodology to prioritize QA coverage commensurate with the relative importance of equipment and components to prevent or mitigate postulated accidents. The second project is a test application to a nuclear power plant of the National Aeronautics and Space Administration's (NASA) approach to analyzing system safety and reliability. The NASA approach

requires establishing safety and reliability goals and objectives, analyzing the system's capability to meet those goals and objectives, and developing a quality plan to specify the QA requirements necessary to obtain the safety and reliability goals and objectives. A third project planned for this area is an NRC survey of existing utility practices for applying QA to nonsafety-related items. The goals of the project are (1) to increase NRC staff understanding of current industry practice, (2) to identify strengths of existing programs, and (3) to establish a practical basis for considering any generic actions in this area.

It is hoped that the three projects will help NRC identify the optimum areas for applying QA requirements, the extent to which QA should be applied, and a more quantified basis for applying QA. The end objective is for the nuclear industry to have definitive guidance on practical ways to prioritize QA measures. Prioritization of QA efforts is discussed also in Section 2.4.5.

(6) Designated Representatives

The Federal Aviation Administration (FAA) uses a system of designated representatives (DR) to achieve extensive oversight of the design and manufacture of commercial aircraft. These representatives, who are employees of the manufacturer but are certified by the FAA, perform examinations, inspections, and tests on behalf of the FAA and report results of such activities to the manufacturer and the FAA. The NRC is considering variations of a DR program to increase NRC inspection capabilities. Several legal, technical, and programmatic issues remain to be addressed before NRC decides whether an FAA-like DR program or some variant of it is feasible.

8.0 CONTRACTUAL, ORGANIZATIONAL, AND INSTITUTIONAL ISSUES

In the course of conducting the quality assurance study mandated by the Ford Amendment, it became clear that a study of some of the indirect factors that shape the environment in which utility management must operate during the design and construction of nuclear power plants would be desirable. Such a study would contribute to a better understanding of the management capability issue and would provide a broader base of information from which to develop approaches to improve the achievement of quality. Battelle Memorial Institute's Human Affairs Research Center (HARC) was selected as the lead contractor to conduct this study, and their interim report constitutes Appendix C to this report. This chapter summarizes the study approach of this special review and its preliminary findings and conclusions. Where appropriate, these findings and conclusions have been incorporated into the findings and conclusions of Chapter 2. From this special review, some issues that merit futher study were also identified in Chapter 2.

8.1 ABSTRACT OF APPENDIX C

Appendix C presents preliminary findings, analyses, and conclusions of a study of the contracting and procurement process used in constructing nuclear power plants and selected organizational and institutional issues associated with nuclear construction. The objectives of the study were as follows:

(1) to characterize the aspects of contracts and procurement that appear to affect the quality during construction of a nuclear power plant

(2) to determine the types of contract and procurement provisions and arrangements that could contribute most to enhanced quality

(3) to develop guidelines for construction contracts and procurement that could assist in achieving overall quality objectives

(4) to examine the contributions of selected organizational and institutional arrangements to nuclear construction projects.

To accomplish these objectives, a series of site visits to utilities constructing nuclear power plants, architectural-engineering (A/E) firms, constructors, and subtier contractors was planned and partially implemented. (The study is still in process.) Specific contractual, organizational, and institutional factors were investigated at each site. The findings and conclusions contained in Appendix C and summarized here are based upon four such visits (three to nuclear construction projects and one to an A/E firm). Also, much information used in the analyses was obtained from secondary source materials and from telephone and personal contacts with informed sources, including 16 state Public Utility Commissions (PUCs).

8.2 PRELIMINARY FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

From the Appendix C study by HARC, the following preliminary findings and conclusions were reached:

(1) Previous nuclear experience appears to provide a significant advantage in a nuclear construction effort. Utilities that do not possess such experience internally should consider hiring either a project staff or contractors who can provide such expertise.

(2) A nuclear construction project appears to benefit when its procurement entity is large enough and experienced enough to exert "marketplace presence". A large procurement entity offers the advantages of market familiarity and commercial power (based upon frequency and continuity of purchasing) as well as the expertise needed to secure satisfactory performance on procurements.

(3) Bid evaluation and selection processes should be based upon functional criteria related to the work to be performed.

(4) To achieve quality objectives in contracting and procurement, clearly defined requirements, program implementation and oversight are important.

- The level of detail in QA/QC requirements in procurement documents is extremely important.
- A contractors' ability to perform to these requirements must be evaluated before issuing a contract.
- Followup is essential to evaluate contractors' and subcontractors' performance against these requirements.

(5) Because designs are usually not complete before construction is begun and nuclear construction projects are subject to unanticipated changes due to changes in the state of the art and regulatory requirements, fixed-price contracting for most aspects of nuclear power plant construction projects is not appropriate. Instead, cost-reimbursable contracts with fixed fees are recommended most frequently by those involved in nuclear construction projects, particularly for assuring quality performance. Except in special cases where the work scope can be clearly specified in advance and will not be impacted by change, fixed-price contracting for nuclear construction work tends to be a disincentive to achieving high quality because under a fixed-price contract, the contractor has to pay for rework out of his profits.

(6) Along with the NRC, state PUCs provide a major source of regulatory oversight for nuclear construction projects. Regulatory influence in this case is exercised through the rate base treatment of such projects. Historically, state PUCs do not appear to have been active in disallowing construction costs that may have resulted from lapses in quality assurance or project management. This position results in shifting the risks of quality lapses from the utility to its ratepayers. Recent actions by several PUCs suggest that this position is changing with unknown implications for the course of nuclear projects under construction.

Possible recommendations resulting from these preliminary findings and the Appendix C study by HARC are given below. This study has adopted several of these recommendations and the more important ones appear, in the same or in a similar form, in Chapter 2.

(1) As part of its management review, the NRC should consider requiring applicants for construction permits to explain their proposed contracting methods, their bid evaluation and selection procedures, and their reasons for choosing them.

Given the overwhelming consensus about contractor selection processes and cost-reimbursement contracting, this item clearly seems to warrant NRC attention. The contracts study found that utilities would be well advised to require bidders to demonstrate their approach and commitment to a project, and that NRC should require the same of licensees. This would force the potential licensee to think through the contracting process with all its implications for risk sharing, cost control, and quality performance requirements.

(2) The NRC should examine methods to focus more attention on the way a licensee proposes to ensure that quality work is being performed rather than on the documents that describe general QA and QC programs.

An overemphasis on what is written about quality assurance and quality control appears to contribute little to the actual assurance of quality and may be detrimental. This is particularly true if such an emphasis diverts attention from how the elements of QA and QC programs will be implemented. The issue here is the difference between examining a utility's written QA program description and examining the number and qualifications of the staff it assigns to QA functions. The former audits writing ability; the latter contributes to an assessment of the capacity to carry out a QA objective.

(3) The NRC should examine the implications for its own mission of state PUC scrutiny of and policies toward nuclear construction project costs and management.

State PUCs appear to be taking more action in examining and disallowing what they view as unnecessary and unwarranted expenses. How this new posture affects execution of the NRC's safety mission, PUCs expectations of the NRC, and the assurance of quality in nuclear construction projects is not yet clear. This shift represents what may be a major change in the institutional environment of nuclear power plant construction; thus, the NRC should carefully examine its implications.

(4) Nuclear construction projects appear to benefit significantly when the owners and members of the project team possess strong management capabilities, seasoned by prior nuclear construction experience. The advantages to a project under these circumstances appear great enough to warrant NRC's examination of how such beneficial ownership and management arrangements can be stimulated and fostered.

One suggestion frequently made is to encourage greater consolidation within the nuclear industry (along the lines of the more centralized nuclear industries in foreign countries, for example). However, before any course is adopted, the specific advantages/disadvantages of various ownership and management arrangements for assuring safe and successful nuclear projects need careful study.

9.0 REVIEW OF OTHER EXISTING AND ALTERNATIVE PROGRAMS FOR THE ASSURANCE OF QUALITY

In conducting the quality assurance study mandated by the Ford Amendment to the NRC Authorization Act, it became clear that a review of the programs for assurance of quality of other government agencies, other industries, and foreign countries would provide a broader base of information from which to develop approaches to improving NRC's program for assurance of quality. Pacific Northwest Laboratory (PNL) was selected as the lead contractor for this review. A PNL-prepared report on this review constitutes Appendix D to this report. This chapter summarizes the study approach of the outside program review and its findings and conclusions. Where appropriate, these findings and conclusions have been incorporated into the findings and conclusions of this report in Chapter 2. Some issues that merit further study from this special review are also identified in Chapter 2.

9.1 ABSTRACT OF APPENDIX D

Appendix D reports the results of a study of the assurance of quality programs of five other U.S. government agencies and of NRC counterparts in six foreign countries. Based on features found in these outside programs, several items were identified as deserving of further consideration to potentially enhance the program to assure quality in the design and construction of nuclear power plants in the United States.

An important element in the study of outside QA programs is selecting the industries and programs to be examined. One organizational category of interest is nuclear endeavors that are not under NRC jurisdiction. This category includes the Department of Energy (DOE) and the nuclear programs in foreign countries. A second organizational category is non-nuclear endeavors that involve highly complex technology requiring high-quality standards in design and manufacture and that strive for low failure probability because the consequences of failure may be substantial. This category includes aircraft manufacturing regulated by the Federal Aviation Administration (FAA); non-nuclear shipbuilding under both the U.S. Navy (USN) and the Maritime Administration (MarAd); and spacecraft under the National Aeronautics and Space Administration (NASA).

The DOE, NASA and the USN parts of the shipbuilding industry represent examples in which a government agency is the owner and/or operator of products or facilities generally produced by the private sector under government contract. The FAA and the MarAd are examples of private sector endeavors regulated by a government agency. The foreign nuclear programs reviewed include both government and private ownership and operation of nuclear power plants. The foreign nuclear programs examined were those in Canada, the Federal Republic of Germany, France, Japan, Sweden, and the United Kingdom.

The Appendix D study by PNL was conducted by reviewing published information on each of the programs selected for study and supplementing this review with information obtained from interviews with FAA and DOE representatives. Limited interviews were also conducted with the NASA staff in Washington, D.C. Published information and interviews with those in the private sector organizations corresponding with these government agencies were also used.

The reviews of the foreign nuclear programs were based almost entirely on publicly available information. Subcontractors with experience in the countries of interest conducted these reviews. There were also limited contacts with foreign nationals in developing the necessary information. Studies of the shipbuilding programs in the United States, both USN and commercial, were conducted entirely through reviews of publicly available documents.

The Appendix D study was not intended to, nor did it attempt to, evaluate the effectiveness of the other programs studied. Rather, it focused on identifying features in those programs that had the potential to improve and translate to the NRC program. In general, these were features that program administrators viewed as positive factors in their respective programs.

9.2 RESULTS AND RECOMMENDATIONS

There are several significant differences among the programs investigated in Appendix D:

(1) The nature and extent of the interfaces differ between the government sector and the private sector.

(2) The incentive systems for achieving quality vary.

(3) In some cases, the major thrust for quality needs arises from safety considerations; in others, it arises from a need for reliable performance. However, safety and reliability are frequently closely intermixed.

Each of the programs reviewed in Appendix D operates within its own cultural environment and such differences profoundly affect the resulting program for assuring quality. This is particularly evident in the foreign nuclear programs. In spite of such differences, there are also identifiable areas of commonality. For example, all of the programs studied are quite dynamic. Although each program has experienced its own evolutionary process and some are much older than others, changes aimed at improving the effectiveness of the quality assurance programs are ongoing.

One observation from Appendix D is that the FAA, NASA, USN and MarAd shipbuilding regulatory programs are directed towards industries that have evolved as specific entities. These industries are, respectively, the aircraft manufacturing industry, the aerospace industry, and the shipbuilding industry. Design and fabrication are normally performed by industrial sectors that have generally evolved in parallel with the corresponding regulatory programs. In contrast, the NRC program is directed towards regulating the "nuclear industry"--a construct that has never evolved as a specific industrial entity in the traditional sense. Nuclear power plants are designed and constructed as an offshoot activity from several traditionally established industries, i.e., the electrical utilities, the architect-engineers (A/Es), the major power plant equipment suppliers, and the construction industry. Each has its own historical methods of doing business. Implementing the NRC program in these industries has required major changes in traditional practices for what might be a limited segment of total activities. Furthermore, NRC's regulations

are directly applied only to the utility that chooses to build a nuclear power plant with the stipulation that it will be responsible for all other participants' compliance with NRC's regulations.

One result of the complex institutional arrangement for building nuclear power plants has been that major changes in long-established ways of doing business have been imposed across many business-management interfaces. Pursuing such a complex issue to the point of developing recommendations was beyond the scope of the PNL study; however, PNL reported it as an issue deserving further study.

Although significant differences exist between the NRC's assurance of quality program and the other programs reviewed, some elements of the other programs may be applicable to the NRC program. The major results in Appendix D were derived from studies of the various individual programs. It must be emphasized that the scope of these studies was limited to general concepts. Therefore, these findings should be viewed as features deserving NRC consideration for its assurance of quality program, rather than as features that should be immediately adopted.

In formulating these results, consideration was given to the institutional differences that exist between the NRC and the outside programs reviewed. For example, the relationship between the government and the private sector is regulatory in some cases (FAA, NRC, MarAd) and contractual in others (DOE, NASA, USN). Other intrinsic aspects of the various programs studied include cultural differences, as observed in the foreign nuclear programs, and national commitment to developing the product, as observed in the USN shipbuilding, NASA, and foreign nuclear programs.

Results and recommendations for further study arising from Appendix D are categorized below by design and quality engineering, quality programs, program reviews, vendors, inspection programs and making management more responsible for quality. The NRC agreed with many of these recommendations, and the most important appear, in the same or shortened form, in Chapter 2.

9.2.1 Design and Quality Engineering

The NRC should consider requiring that plant design be well advanced before initiating construction activities. Design requirements should include the completion of safety, reliability, and availability analyses including failure mode and effect analyses, fault tree and hazards analyses, and safety analyses. The analyses should be integrated with QA and should be completed before construction begins. This recommendation is based upon findings from the DOE, NASA, FAA, foreign nuclear, and shipbuilding programs.

9.2.2 Quality Programs

The NRC should consider requiring the establishment of a QA system that prioritizes quality efforts, quality measures and QA coverage commensurate with the relative importance of equipment, components and systems. This importance would be determined by the safety, reliability and availability analyses discussed under "Design and Quality Engineering" above. This recommendation derives from findings of the DOE, NASA, and shipbuilding programs.

9.2.3 Program Reviews

The NRC should consider adopting the following recommendations relating to program reviews:

(1) The NRC program should require "readiness reviews" during nuclear power plant construction. In some industries, readiness reviews are conducted before embarking on a major new phase of a project to ensure that appropriate planning, coordination and necessary previous work has been completed and that the project team is "ready" to proceed to the new phase. These reviews might involve plant designers, construction managers, owner-operators, and (possibly) NRC staff and should be required at key points in the project, beginning with "design ready for construction". Additional reviews at selected key milestone points may be useful. This recommendation is based upon findings from the DOE, NASA, and shipbuilding programs.

(2) The NRC should study ways to better integrate NRC inspection functions with system design reviews, test program reviews, and test program evaluations. This recommendation is based upon findings from the USN, FAA, DOE, and NASA programs.

9.2.4 Vendors

Consideration should be given to enhancing the NRC's vendor inspection program. The licensee should continue to be held fully responsible for vendor-supplied items, with necessary enforcement actions relevant to vendors applied to the licensee. The NRC should continue supporting the development of a data bank on performance of and problems with vendor-supplied components. These data should be analyzed and the results published periodically. This recommendation is based on findings from the FAA, the USN, and the foreign nuclear programs.

9.2.5 Inspection Programs

The NRC should consider adopting the following inspection-related suggestions:

(1) The NRC should expand its inspector training program to increase emphasis on "how to inspect". The training program should concentrate on such areas as conducting inspections and use of time, and should include specific guidance on identifying possible indicators of developing problems. This recommendation is based upon findings from the USN program.

(2) The NRC should consider requiring inspections of nuclear power plants by independent inspecting agencies. This recommendation is based on findings from the foreign nuclear programs.

9.2.6 Making Management More Responsible For Quality

The NRC should re-examine its posture on quality assurance to emphasize to the licensee that quality and assurance of quality are responsibilities of overall management rather than responsibilities that can be delegated to the QA/QC organization. This recommendation is based on findings from the DOE and NASA programs.

10.0 PUBLIC COMMENTS

Section 13(b) requires the NRC to obtain comments on the Ford Amendment from the public, licensees of nuclear power plants, the Advisory Committee on Reactor Safeguards (ACRS), and organizations comprised of professionals having expertise in appropriate fields. In response to that requirement, the NRC took the following actions:

(1) on March 3, 1983, published a Federal Register Notice (FRN) that detailed Sections 13(b), (c), and (d) of the Ford Amendment and requested comments by May 1, 1983

(2) issued a public announcement detailing the Ford Amendment requirements and requesting comments by May 1, 1983

(3) sent copies of the FRN to fifteen organizations of professionals as an enclosure to a letter requesting comments by May 1, 1983

(4) on July 18, 1983, briefed an ACRS Subcommittee in a public meeting about the Ford Amendment study plan. On December 6, 1983, briefed an ACRS Subcommittee in a public meeting on progress made toward completing the study. On February 24, 1984, briefed an ACRS subcommittee on the results of the study. On March 15, 1984, briefed the ACRS on the results of the study.

Thirty-four sets of comments were received as a result of these actions--nine from private citizens, five from citizen organizations, seven from licensees, three from professional organizations, nine from other industry groups, and comments from both members of the ACRS and the ACRS. The NRC also established a review group of distinguished professionals having a broad range of expertise in related fields to provide an ongoing peer review of the study while it was in progress. Comments from the public, licensees and associations appear in Section 10.2. ACRS comments appear in Section 10.3, and written comments from the review group appear in Section 10.4. For convenience, the public comments are consolidated and grouped according to each of the alternatives contained in Sections 13(b)(1) through (b)(5) of the Ford Amendment. In addition to comments on Sections 13(b)(1) through 13(b)(5) and 13(c), comments were received on a variety of related and unrelated subjects. These comments are included in Section 10.2.7, General Comments. The NRC response appears below each comment. The source(s) of each comment appears to the right of the comment. The commenters and abbreviations used in the discussions are listed and categorized just before the comments in Section 10.2.

One public comment concerned NRC's failure to provide both a program plan in the Federal Register Notice for the conduct of the Ford Amendment study and an opportunity for comment on that program plan. Such a study plan had not been completed at the time of request for comments. Moreover, the NRC staff wished to use the comments received on the Ford Amendment as part of the study plan development process. Once the plan was developed, it was presented to the ACRS at a public meeting. To provide an ongoing review of the study by persons outside the NRC and the government, the NRC staff established the review group of professionals mentioned earlier to review the study's plans and progress. This review was performed by nine distinguished professionals having expertise

in nuclear power plant quality assurance, project management, engineering, and other relevant areas. The review group represented a broad spectrum of expertise, experience and viewpoints. Section 10.4 provides the names and positions of the reviewers and a summary of their comments on major issues.

Public and other comments were sought early in the study effort. Several of those comments were used in conducting the study and many of the study conclusions supported comments received. As a result, many of the comments received have been adopted within NRC's planned actions or included in issues slated for further study.

10.1 TEXT OF THE AMENDMENT

The Federal Register Notice contained Sections 13(b), (c), and (d) of the Ford Amendment. The accompanying text of the Federal Register Notice invited the public to provide to the NRC any comments on the quality assurance study by May 1, 1983. For convenience, the text of Sections 13(b), (c), and (d) is reproduced below:

> Sec. 13(b) The Commission shall conduct a study of existing and alternative programs for improving quality assurance and quality control in the construction of commercial nuclear powerplants. In conducting the study, the Commission shall obtain the comments of the public, licensees of nuclear powerplants, the Advisory Committee on Reactor Safeguards, and organizations comprised of professionals having expertise in appropriate fields. The study shall include an analysis of the following:
>
> (1) providing a basis for quality assurance and quality control, inspection, and enforcement actions through the adoption of an approach which is more prescriptive than that currently in practice for defining principal architectural and engineering criteria for the construction of commercial nuclear powerplants;
>
> (2) conditioning the issuance of construction permits for commercial nuclear powerplants on a demonstration by the licensee that the licensee is capable of independently managing the effective performance of all quality assurance and quality control responsibilities for the powerplant;
>
> (3) evaluations, inspections, or audits of commercial nuclear powerplant construction by organizations comprised of professionals having expertise in appropriate fields which evaluations, inspections, or audits are more effective than those under current practice;
>
> (4) improvement of the Commission's organization, methods, and programs for quality assurance development, review, and inspection; and
>
> (5) conditioning the issuance of construction permits for commercial nuclear powerplants on the permittee entering into contracts or other arrangements with an independent inspector to audit the quality assurance program to verify quality assurance performance.

For purposes of paragraph (5), the term "independent inspector" means a person or other entity having no responsibility for the design or construction of the plant involved. The study shall also include an analysis of quality assurance and quality control programs at representative sites at which such programs are operating satisfactorily and an assessment of the reasons therefor.

(c) For purposes of --

(1) determining the best means of assuring that commercial nuclear powerplants are constructed in accordance with the applicable safety requirements in effect pursuant to the Atomic Energy Act of 1954; and

(2) assessing the feasibility and benefits of the various means listed in subsection (b);

the Commission shall undertake a pilot program to review and evaluate programs that include one or more of the alternative concepts identified in subsection (b) for the purposes of assessing the feasibility and benefits of their implementation. The pilot program shall include programs that use independent inspectors for auditing quality assurance responsibilities of the licensee for the construction of commercial nuclear powerplants, as described in paragraph (5) of subsection (b). The pilot program shall include at least three sites at which commercial nuclear powerplants are under construction. The Commission shall select at least one site at which quality assurance and quality control programs have operated satisfactorily, and at least two sites with remedial programs underway at which major construction, quality assurance, or quality control deficiencies (or any combination thereof) have been identified in the past. The Commission may require any changes in existing quality assurance and quality control organizations and relationships that may be necessary at the selected sites to implement the pilot program.

(d) Not later than fifteen months after the date of the enactment of this Act, the Commission shall complete the study required under subsection (b) and submit to the United States Senate and House of Representatives a report setting forth the results of the study. The report shall include a brief summary of the information received from the public and from other persons referred to in subsection (b) and a statement of the Commission's response to the significant comments received. The report shall also set forth an analysis of the results of the pilot program required under subsection (c). The report shall be accompanied by the recommendations of the Commission, including any legislative recommendations, and a description of any administrative actions that the Commission has undertaken or intends to undertake, for improving quality assurance and quality control programs that are applicable during the construction of nuclear powerplants.

10.2 COMMENTS OF THE PUBLIC, LICENSEES OF NUCLEAR POWER PLANTS, ORGANIZATIONS OF PROFESSIONALS AND OTHERS, AND NRC'S RESPONSE TO THESE COMMENTS

The following is a listing of the persons and organizations providing comments to the March 3, 1983, Federal Register Notice:

Private Citizens (P.C.)
Christine Simmers, MD
Marvin Lewis, PA
L. H. Wilkie, Jr., AZ
Daniel Garland, WA
Nancy Compton, TN
L. D. Gustafson, WA
John O'Neill, MI
Wells Eddleman, NC
Scott Bullock, NY

Citizen Organizations (C.O.)
Suffolk Nuclear Study Group (SNSG), NY
Union of Concerned Scientists (UCS), DC
Audubon Society, The Indiana Sassafras (ISAS), IN
Sinnissippi Alliance for the Environment (SAFE), IL
Ohio Citizens for Responsible Energy (OCFRE), OH

Utilities/Licensees
San Diego Gas and Electric (SDG&E), CA
Public Service Electric and Gas (PSG&E), NJ
Houston Lighting and Power (HL&P), TX
Florida Power and Light (FP&L), FL
Duke Power Company, NC
Baltimore Gas and Electric (BG&E), MD
Cleveland Electric Illuminating Co. (CEI), OH

Professional Organizations (P.O.)
The National Board of Boiler and PV Inspectors (NB), OH
American Society of Mechanical Engineers (ASME), NY
Institute of Electrical and Electronics Engineers (IEEE), NY
Nuclear Power Engineering Committee (NPEC)

Other Industry Groups (Other)
Townsend & Bottum, MI
Automatic Switch Co (ASC), NY
Stone and Webster (S&W), MA
Atomic Industrial Forum (AIF), D.C.
Management Analysis Corp. (MAC), CA
Institute of Nuclear Power Operations (INPO), GA
American Nuclear Insurers (ANI), CN
Edison Electric Institute (EEI), D.C.
Commonwealth-Lord J.V.C. (CWL), IN

10.2.1 Section 13(b)(1): More Prescriptive Architectural and Engineering Criteria

	Comment	Commenter *
(1)	The NRC should establish more prescriptive requirements for QC inspections, process control, records, etc.	1 utility 1 other

Response: The NRC is in the process of endorsing an American National Standard (ANSI), ANSI/ASME, NQA-1, "Quality Assurance Program Requirements for Nuclear Power Plants," which includes requirements and guidance for establishing and carrying out quality assurance programs during the design, construction, operation, and decommissioning of nuclear facilities. The NRC intends to continue to work with ANSI to produce needed standards. The NRC also is initiating research efforts to analyze alternative approaches to inspection planning and prioritization. The appropriate level of prescriptiveness in required inspection activities will be one of the issues considered in the research. See the response to Comment 2 on standardizing QA/QC paperwork.

(2) The NRC should standardize all QA/QC paperwork. — 1 other

Response: The NRC has certain minimum reporting and recordkeeping requirements and attempts to standardize its own requirements. Each project is sufficiently different that it would be difficult, if not impossible, to devise a system of standardized QA/QC paperwork that would be appropriate for all projects. Prescribing paperwork at the QA/QC record level would have the effect of putting the NRC into a quasi-management rather than an oversight role. The NRC should set standards and performance objectives for QA/QC systems and their paperwork but should not prescribe how to achieve those objectives. If the NRC were to standardize all QA/QC paperwork, the flexibility of licensees would be limited in recording any additional data for their own needs. This could lead to the licensees developing a second set of records for this additional data. Duplicate records markedly increase the chances for errors and would also increase costs without an increase in safety.

(3) The NRC should require scale models and computer-assisted drawings. — 2 utilities

Response: With the advancement of computer modeling, scale models may find less use. Computer-assisted drawings are currently used at some plants and should be considered for all future plants primarily because of the technique's economics. This study also strongly endorses the use of models and found them to be extremely useful in helping some licensees manage the construction of their projects. The use of models would be considered to be a good project management practice. The NRC's follow-on research to this study will further evaluate this suggestion.

*For abbreviations and codes used to identify commenters, see Section 10.2.

(4) NRC should institute more prescriptive architectural and engineering (A&E) criteria. — 1 P.C., 1 C.O.

Response: The topic of more prescriptive A&E criteria is discussed at length in the report. In particular, see Chapters 2 and 6. The study found that more prescriptive A&E criteria would not have prevented or led to earlier detection of the five major quality-related problems that stimulated this study. The QA study did find that a more complete plant design would help facilitate better planning and scheduling, would minimize design changes and potentially would reduce rework caused by the design not being far enough ahead of construction. This study suggests further efforts to improve the management of change in nuclear design and construction and to examine whether future applicants should be required to submit an essentially complete design at the construction permit (CP) application stage.

(5) One-step licensing and more prescriptive criteria are a logical combination. — 1 utility

Response: The study agrees, see Chapter 6.

(6) The QA study should investigate the amount of engineering and design review the NRC could perform. — 1 C.O.

Response: The case studies, pilot programs, and NRC inspections have shown that most often design interfaces and implementation are the problems, not the design itself. To address this problem, the NRC initiated a new program for integrated design inspections (IDI) in 1983. The IDIs examine the design interfaces and implementation as well as provide selected overchecks for the design itself. The IDI program is described in greater detail in Chapters 2 and 7. As with construction and operation, the licensee is primarily responsible for ensuring that the design and engineering work is adequate. The IDI program is an NRC overcheck of the effectiveness of the design and engineering review and process of the licensee and its architect-engineer (A/E), and it in no way relieves the licensee and contractors of their design responsibilities, nor does it replace any licensee activity.

(7) More prescriptive A&E criteria will not solve the quality problem; do not add more requirements. — 1 P.C., 2 other, 4 utilities

Response: The study agrees. As noted in the report (see Chapters 2 and 6), the design quality problem does not appear to be with the criteria for the plant design as much as with design changes and with design and engineering work not staying sufficiently ahead of construction work.

(8) More prescriptive criteria would negate designers' flexibility and creativity and may also lead to less rigorous design and more reliance on the NRC. — 1 other, 1 utility, 1 P.O.

- Response: The study agrees. A significant level of design completion at the outset of construction, e.g., through the procurement phase, was found to be more important in avoiding quality problems than rigorous adherence to specific criteria. See Chapter 6.

10.2.2 Section 13(b)(2): Demonstration of Capability to Independently and Effectively Manage the QA/QC Function

	Comment	Commenter *
(1)	Licensees should be required to demonstrate their capability to independently and effectively manage the QA/QC function.	2 utilities 1 P.C. 1 P.O. 1 other 1 C.O.

Response: The study agrees. The study recommends increasing NRC's efforts in reviewing the applicant's management capability before CP issuance, which presumably would include an audit of pre-CP design activities. The study also recommends requiring an independent review in the first 12 to 20 months of construction in which the licensee and the project team must demonstrate their capability to independently and effectively manage the project, including the quality function. Subsequent NRC or third-party audits would be conducted about every two years thereafter, and management capability would be one of the areas of appraisal. See Chapters 2 and 4.

(2)	The NRC should perform a cost/benefit analysis on requiring a demonstration of QA/QC management capability.	1 utility

Response: A cost/benefit analysis is a routine administrative requirement for the NRC when it performs a regulatory analysis of proposed changes to NRC requirements. A cost/benefit analysis will be performed as a part of the regulatory analysis for any rulemaking activity in this area.

(3)	Adequate provisions are already in place to evaluate management's capability to manage a QA/QC program.	1 utility 1 P.O.

Response: The requirement for the NRC to evaluate management capability is already in place. However, the method, criteria, and approach for implementing the requirement to evaluate management's capability should be revised to reflect the results of this study. The study showed that the NRC has historically performed little pre-CP evaluation of management capability and has not focused on management issues in inspection until after major problems have occurred. The study recommends that NRC focus more on the management capability issue both before and after the CP is issued. See Chapters 2 and 3.

*For abbreviations and codes used to identify commenters, see Section 10.2.

(4) Evaluation criteria for management capability should be flexible enough to permit the Institute of Nuclear Power Operations (INPO) to perform this function. — 1 other

Response: The study has concluded that using INPO to perform a quasi-regulatory function is not consistent with INPO's current mission or in the best interests of improving quality and the assurance of quality in the nuclear industry. INPO is in the process of seeking to raise the overall standard of performance and to achieve excellence in the nuclear industry through evaluation, education, and counseling. Placing INPO in a position where it would be a determinant in the licensing process could significantly damage its primary function. See discussion of INPO in Chapters 2 and 5.

(5) Requiring the licensee to demonstrate its management of the quality function would unnecessarily restrict the owner/licensee to managing the project itself. — 1 utility

Response: The study has not interpreted this provision as a requirement for the licensee to solely manage the project. There are varying arrangements under which the licensee can choose to manage the project. The case studies (Chapter 3.0 and Appendix A) provide examples of different organizational arrangements that have worked, including the owner/licensees in an oversight role. However, this study has indicated that certain functions must be retained by the licensee to properly discharge its responsibilities. The ability to independently confirm that an effective quality assurance and quality control program is in place and is being properly implemented is one of those functions. Criterion I to 10 CFR 50, Appendix B, specifically states that although a licensee may delegate establishment and execution of its QA program to contractors, the licensee is still responsible for it. Both this Ford Amendment alternative and the study's recommendations are consistent with this criterion. See discussion of this alternative in Chapter 2.

10.2.3 Section 13(b)(3): Evaluations by Organizations of Professionals Which are More Effective Than Those Currently Performed

Comment	Commenter *
(1) The NRC should establish a requirement similar to ASME "N" Stamp for electrical equipment and eliminate utility audits.	1 other

Response: The American Society of Mechanical Engineers (ASME) "N" stamp program was initiated and implemented by the nuclear industry and was not an NRC requirement. If any other professional association wants to implement such a program, the NRC could participate in its development

*For abbreviations and codes used to identify commenters, see Section 10.2.

and consider endorsing such a program through a regulatory guide or its regulations, as the NRC has done for the Boiler and Pressure Vessel Code. It is NRC policy to adopt national consensus standards wherever possible and to the greatest extent possible.

(2) QA programs should have independent review groups whose overview would constitute independent design review. — 1 P.C.

Response: The study analysis of alternatives 13(b)(3) and (b)(5) and the conduct of the pilot program found that periodic independent audits of construction projects, of which QA would be one aspect examined, would be useful and would assist the NRC, as well as the licensee, in establishing an assurance of quality in the design and construction of the nuclear power plant. In the regulatory analysis preceding implementation of such a regulatory requirement, the NRC will consider establishing procedures and criteria that will allow certain of these independent audits to also serve the purpose of independent design review.

(3) Independent audits should be conducted at set stages of construction completion, such as 25%, 50%, and 75%. — 1 P.O.

Response: The recommendation for an independent review mentioned in the response to Comment 2 above would be conducted at predetermined stages throughout construction. The stages may be based on percent of plant construction and/or time (years). The study recommends that the independent reviews should occur about every two years. See Chapters 2 and 4.

(4) The independent auditing group should be selected by jurisdictional authority or by the NRC, not by the utility. — 1 P.O.

Response: If independent audits are established through NRC regulation, it is anticipated that the auditors would have to meet criteria established by the NRC and would have to be approved by the NRC. However, the option of the utility to freely select and contract with an acceptable auditor should be preserved.

(5) The NRC should require independent audits that are based on the Preliminary Safety Analysis Report (PSAR). — 1 C.O.

Response: PSAR commitments that are not conditions of the construction permit currently are not enforceable. Chapter 6 addresses this problem and recommends that certain PSAR commitments should be made conditions of future construction permits. These commitments could then be included in the scope of coverage for the independent audits.

(6) INPO is a professional organization that already provides such audits. — 4 utilities, 1 other, 1 P.O.

Response: Study staff observation and reviews of INPO evaluations have revealed areas that would need to be altered before the NRC could accept the results of INPO evaluations as part of the NRC inspection process. However, as noted under 10.2.2, Comment 4, assumption of such a quasi-regulatory role by INPO would damage INPO's ability to act as the industry's medium for improving and seeking excellence in industry performance. This study concluded that this loss would be irreplaceable, whereas the independent audit function can be performed by many organizations. See discussion of INPO in Chapters 2 and 6.

(7) INPO, the ASME, and the National Board are organizations of professionals that already provide evaluations. — 2 P.O., 1 other, 1 utility

Response: The study has interpreted this alternative [Alternative b(3)] to represent Congress' desire to examine whether audits currently performed by the above-mentioned organizations or other professional associations could be expanded, thereby increasing their effectiveness. In its review, including polling of the organizations, the study found that only INPO evaluations covered more than one professional discipline. Although all of these programs were capable of expansion within that discipline, and the NRC would welcome their doing so, the INPO program was studied most extensively because of its wide scope and closest correspondence to what the study believed to be Congressional intent of Alternative b(3). Therefore, the study did not believe that the above-listed organizations already provided the evaluations that Congress had envisioned. See Chapter 6.

(8) An additional layer of inspection will not solve the industry's quality problems. — 1 utility

Response: The study agrees. The focus should be on better inspections, not on more inspections. The pilot program study demonstrated that the independent audits were not an additional layer of inspection but provided inspection coverage in areas such as design, for which little inspection has been accomplished in the past. The independent audits were also shown to be an augmentation of NRC's regular inspection program rather than an additional layer. The independent audits would allow NRC to expand its current areas of inspections without a commensurate increase in NRC staff and would allow the NRC more flexibility in prioritizing its inspection effort to areas that appear to warrant increased coverage.

(9) There are too many yearly audits of component suppliers already. The ratio of product costs to audit costs is way out of line. Audit frequency should be a function of product complexity. — 1 other

Response: The study agrees that inspections and audits should be a function of project/product complexity. NRC has initiated two separate research projects directed toward developing greater guidance for acceptable ways to implement a QA program whose requirements are commensurate with the product's safety significance. This area has not received the attention it should have received in the past and is now a priority research effort. See Chapters 2 and 7.

10.2.4 Section 13(b)(4): Improvements to NRC's Programs, Methods and Organization

	Comment	Commenter *
(1)	NRC puts too much emphasis on procedures and documentation and not enough on implementation and product quality.	3 P.C., 2 C.O. 2 P.O. 2 other 1 utility

Response: The study found that this has been a significant shortcoming in the NRC inspection program. The NRC has started to shift emphasis of the inspection program away from the QA process and documentation, and toward implementation and product quality. This subject is covered in considerable detail in the report (especially Chapters 2 and 7). The large number of comments in this area made it of particular concern during the conduct of the study.

(2)	Although serious problems have been overlooked under current NRC programs, existing programs can be effective. The NRC should concentrate on enforcing existing programs.	1 utility 1 C.O.

Response: NRC's existing programs have not detected some problems at a sufficiently early stage. Considerable effort was devoted during the conduct of this study to determine if quality-related problems in design and construction were due to a basic fault in the NRC licensing and inspection programs or to licensee's implementation of the programs. The study concluded that the problem has been in both rather than a basic fault in either program. This study outlines a course of action intended to strengthen each area. See Chapters 2, 3, and 7.

(3)	NRC should inspect both safety-related and nonsafety-related work.	1 P.C. 2 C.O.

Response: The NRC currently has research efforts under way to address whether a change is required in NRC's methods for selecting which structures, systems, and components should be inspected and the appropriate quality assurance measures that should be applied. The research is directed toward providing better guidance on the prioritization of quality assurance measures to be applied to structures, systems, and components that are considered either "safety-related" or "important to safety". This is a priority issue and more guidance should be available when research is complete. See Chapters 2 and 7.

(4)	The NRC has not exercised sufficient control to prevent danger to public health and safety by assuring quality of plant design and construction. The NRC should increase the number of resident inspectors to 20-30 per site and should be responsible for plant quality.	3 P.C. 5 C.O.

*For abbreviations and codes used to identify commenters, see Section 10.2.

Response: Having the NRC directly responsible for plant quality rather than the licensee would represent a fundamental change from the private ownership and responsibility course the U.S. embarked on in 1954. Such a change would represent a fundamental change in this country's public policy and in NRC's regulatory policy and would require legislative changes, as well as a substantial increase in Congressionally authorized funding and personnel limits. As this comment correctly observes, such change would require very significant increases in the numbers of NRC inspectors. It is doubted that even 20-30 per site would be enough. The study does not conclude that current circumstances warrant such a fundamental change.

(5) NRC fines are hidden in future rate increases and therefore are not an incentive for improved performance. — 1 P.C., 1 C.O.

Response: Most Public Utility Commissions (PUCs) do not allow fines to be passed through to the ratepayer. However, this study did examine the effects of state PUCs on the NRC mission. This study concluded that some PUC actions have had a previously unappreciated impact on NRC's mission and are likely to have a different but equally significant impact in the future. This area is discussed in Chapter 8 and Appendix C. Further study is under way.

(6) The NRC does not properly investigate or evaluate allegations. — 2 C.O.

Response: The NRC has included additional resources in its budget for investigating allegations and has formed a new Office of Investigations to handle many of the allegations received. Also, in 1982, the NRC developed a computerized tracking system to track the receipt and disposition of all allegations received by the NRC to ensure their proper treatment. Use of third-party audits for increased coverage of NRC's regular inspection program is expected to allow more staff time for reactive inspections such as those arising from allegations.

(7) The NRC should use statistically based sampling techniques. — 1 P.C., 1 C.O.

Response: Statistically based sampling techniques are used when it is not possible to inspect all of or a substantial part of some activity. A licensee's QA/QC programs essentially provide for 100% inspection coverage of safety-related structures, systems and components, so a "sampling" process is not applicable to the licensee's QA/QC process. Because the NRC is not responsible for direct inspection, as is the licensee, but for auditing the licensee's compliance with the QA/QC program, the NRC performs only a very limited sampling of the licensee's efforts. Current estimates are that the NRC directly verifies no more than 1 to 2% of a licensee's activities. A sampling of such small size does not lend itself well to a statistically derived process.

For direct NRC inspection, the NRC inspection program has historically used engineering judgment to select items that best indicate the total process or that will have the greatest impact on plant safety. Also, the NRC wants to hear any allegations of improper practices from plant workers. The NRC inspection program continues to be based on the belief that the application of engineering judgment is superior to a mechanistic sampling technique. However, the study concludes that NRC's methods for implementing engineering judgment should be improved, and research is under way to improve current methods for classifying structures, systems and components according to their safety significance. See Chapter 2 and Section 7.4.

(8)	NRC inspectors are technical specialists with little QA knowledge and have problems relating findings to QA program weaknesses.	1 utility 1 P.O.

Response: This comment highlights a finding of this report. Inspectors require technical training in QA, just as technical training is required in other technical and scientific fields. In 1983 the NRC instituted formal QA training courses for its inspectors in construction, operations, and modifications. This study has identified additional topics that appear to be needed for inspector training, including improving inspector and supervisor skills in relating inspection findings to QA program weaknesses and project management shortcomings. The study believes that a technical specialist appropriately trained in QA and management disciplines can be more effective for NRC inspection purposes than a QA professional without appropriate specialty training. See Chapters 2 and 7.

10.2.5 Section 13(b)(5): Audits by Third-Party Independent Inspectors

	Comment	Commenter *
(1)	Independent inspectors should be independent of the nuclear industry, not just the utility, to avoid conflict of interest.	2 P.C. 2 C.O.

Response: Independent inspectors must have the necessary qualifications to perform the audit. The best qualified personnel would be those with nuclear industry experience. The study recommends that the NRC establish criteria that include measures of the objectivity of the independent inspectors. See Chapters 2 and 4.

(2)	Independent auditors and QA personnel should report to the NRC Resident Inspector.	2 P.C. 1 C.O.

Response: The NRC should not assume the licensee's responsibility for quality of construction. The study recommends that the NRC review the efforts and results of the proposed independent audits. If the NRC were not satisfied with the independent audit, appropriate actions would have to be taken.

*For abbreviations and codes used to identify commenters, see Section 10.2.

(3) The NRC should increase the use of independent inspectors. — 2 C.O., 2 P.C.

Response: As noted under the comments for 13(b)(3) (Section 10.2.3) and the above comments, the study has found that independent auditors/inspectors can be a useful addition to NRC's program for assurance of quality and recommends their use be increased.

(4) More independent inspectors will not solve the problem of poor quality and quality assurance in the nuclear industry. — 1 P.O., 1 utility

Response: It is not necessarily a question of more or fewer inspectors, but how resources are used. A major finding of this study has been that some utility managements have not implemented an effective QA/QC program. Where this lack of implementation has resulted from a lack of commitment to an effective QA/QC program, the study agrees that more inspectors will not solve the problem of poor QA/QC in the nuclear industry. Whatever the case, the NRC must be capable of detecting that a QA/QC program is not being effectively implemented. Given NRC's current inspection resources and increasing reactive inspection workload, its detection capability is questionable. This problem becomes particularly evident when it appears that team inspections must be increased to solve the "threshold" problem. Use of independent inspectors to augment NRC's regular inspection program is considered to be the most feasible way to address this problem. Until a third-party program can be put in place, the study recommends an expanded Construction Appraisal Team (CAT) program. See Chapters 2 and 7.

(5) INPO programs provide sufficient independent inspectors. — 2 utilities, 2 other

Response: See response to Comment 6 under 13(b)(3) (Section 10.2.3) and Comment 4 under 13(b)(2) (Section 10.2.2).

(6) INPO, ASME, and the NRC currently provide sufficient independent inspectors. — 3 utilities

Response: See response to Comment 7 under 13(b)(3) (Section 10.2.3) and response to Comment 4 in this section.

10.2.6 Section 13(c): Pilot Programs

Comment	Commenter *
(1) Pilot programs are of questionable value because people provide quality and people at each site are different.	1 other

*For abbreviations and codes used to identify commenters, see Section 10.2.

Response: The study agrees that qualified, capable people are crucial to achieving quality. One of the major points that the case studies found to be important was the quality of the people associated with the project, particularly the management. One of the major differences between apparently successful projects and unsuccessful projects was the capability and experience of a few key members of management and their commitment to and knowledge of achieving quality in construction. The pilot programs were intended to test the concept of using independent auditors as part of NRC's process of confirming that licensees have implemented an effective QA/QC program. As a test of the concept, the pilot programs were of considerable value. As would be expected in any test program, strengths and weaknesses of individuals and organizations resulted in differences among the pilot programs, but the test of the concept was successful.

As a result of the pilot programs, the study concluded that independent audits are a useful addition to the NRC program and that guidelines for what constitutes an effective audit can be developed. See Chapters 2, 3, and 4.

(2) A few revoked construction permits (CPs) would do more to emphasize quality than any pilot program. — 1 C.O.

Response: The NRC is required by law to issue licenses to qualified applicants, and it cannot arbitrarily revoke CPs for deficiencies or violations without giving the licenseee an opportunity to correct deficiencies and to conform to requirements. If a licensee is willing to upgrade QA/QC efforts to correct deficiencies so that the NRC's minimum criteria are met, there is no reason to revoke a CP. If the NRC's criteria are not met, the plant should not be issued a CP at the outset, and, if criteria are consistently not met after the the CP is issued, then revoking or suspending a CP may be the correct action.

(3) Midland, Zimmer, South Texas and Diablo Canyon should be included in the pilot program. — 1 P.C. 1 C.O.

Response: The Midland, South Texas, and Marble Hill projects were included in the pilot program. An independent audit of Zimmer was incorporated in the case studies, and Diablo Canyon was examined in the case studies. See Chapters 3 and 4.

(4) The pilot program emphasis should be on quality control, including training and qualification. — 1 other

Response: NRC's evaluation of the pilot programs puts great emphasis on the licensee's quality assurance program, including the quality control portion. Training and qualifications of quality control inspectors have been identified as areas of special NRC concern, and research is currently under way to assess the nature and extent of problems in these areas for possible NRC action. See Section 7.4. While training and certification of quality control inspectors are obviously of great importance to the NRC,

the pilot programs were not viewed as the most effective place to solve the many questions that have arisen in this area, so they were not the area of greatest emphasis.

10.2.7 General Comments

	Comment	Commenter *
(1)	The study should recognize that three interrelated parties are responsible for assuring quality and reliability: (a) owner/licensee, (b) A/E, constructor, contractors, labor unions, vendors, and (c) the NRC.	1 utility

Response: The owner/licensee is ultimately responsible for assuring quality and reliability of the plant. The A/E, constructor, contractors, labor unions and vendors are responsible to the licensee to the extent that the owner delegated responsibility. However, ultimate responsibility, even though delegated, is retained by the licensee. The NRC is responsible for the health and safety of the public. The NRC attitude in the past has been that if the licensee has not fulfilled its responsibility for building a safe plant, the NRC can still fulfill its responsibility by denying an operating license. Rather than passively relying on the possibility of such a strong action after a plant is essentially complete, the study has recommended a more active ongoing NRC program for ensuring quality in design and construction aimed first at prevention and second at detection. See Chapter 2.

(2)	Quality is not bad at all nuclear plants. Excessive emphasis has been placed on a few bad examples.	1 utility

Response: The study agrees that quality is not bad at all plants. NRC's programs set minimum standards for all plants. Plants that cannot meet those standards should receive additional emphasis as is required. Plants that have experienced general breakdowns of their quality assurance programs should receive even greater NRC inspection and enforcement attention. This attention is necessary for NRC to fulfill its responsibility to protect public health and safety, and it is not believed that this emphasis has been excessive. See Chapter 3.

(3)	Quality would be better served by assuring competence of doers rather than overemphasis on competence of the verifier. The NRC should require certification of management, designers, field engineers, and others.	1 other

Response: The study agrees that both the doer and the verifier have to be qualified to produce and assure quality work. For example, the NRC staff

*For abbreviations and codes used to identify commenters, see Section 10.2.

is currently working to establish a positive method of welder identification to ensure that only welders who have passed the qualification criteria actually perform the work. The staff is also working to establish revised standards for qualification of nondestructive examination personnel. Other such areas will also be examined. The study does not recommend establishing criteria for individual management positions or for the licensing of individual managers. However, this study has indicated that the NRC should develop criteria to evaluate the "management team". This area will receive much greater NRC attention in the future. See Sections 7.4.3 and 7.4.4.

(4) The Federal Register Notice did not contain specific proposals. These should be commented on, not just the Ford Amendment. The NRC should publish preliminary results of studies after 9-12 months for public comment. — 1 utility, 1 C.O.

Response: Because of the relatively short time available to prepare the report for Congress (15 months), time was not available to publish preliminary findings for public comment. Also in the interests of time, NRC elected to request public comments at the beginning of the study so that the comments could be used in devising the study plan. The NRC did not want to develop a study plan and discover, through the public comment process, that a significant item had been missed but could not be added because of time. The eventual study plan was presented at a public meeting of an ACRS Subcommittee in July 1983. To provide a broad range of expert advice and guidance in conducting the study, a review group of distinguished professionals from outside the NRC was established. See discussion of the review group and individual members' comments in Section 10.4.

(5) The NRC should provide incentive programs for craft workers to improve quality. — 1 utility

Response: Although the study agrees that incentive programs for craftsmen have the potential to improve quality, they are not something the NRC should mandate by regulation. Licensees may elect to use incentive programs if they so desire.

(6) The NRC should require a greater degree of mandatory personnel qualification and requalification than is presently the case. — 1 Utility

Response: See response to Comment 4 under Pilot Programs (Section 10.2.6) and response to Comment 5 above. Also see Section 7.4.

(7) All personnel from management down to craft workers should receive training in quality. — 1 utility

Response: The study agrees. Training in the areas of quality, QA, and QC is important to foster a better understanding of how quality programs can benefit all involved, from managers to craftsmen. INPO is currently conducting periodic seminars covering these subject areas for senior utility management. NRC senior staff have participated and should

continue to participate in these seminars. The study recommends more training in quality for NRC staff. See Chapters 2 and 7.

(8) Quality assurance would be improved if the industry's attitude were improved. — 1 other

Response: The study agrees. See the response to Comment 1 under Pilot Programs (Section 10.2.6), and Comments 3 and 7, above. See also Section 2.5.

(9) QA/QC is not always effectively used as a tool by management. — 1 other

Response: The study agrees. The case study analyses (Chapter 3) of nuclear power plants under construction examined the premise advanced by this comment in great detail and give examples where QA/QC was used effectively as a management tool and where it was not. The study has proposed revisions in NRC programs to correct this deficiency. See Section 2.4.1.

(10) The Congressional Amendment doesn't provide enough guidance. Studies are being undertaken without identifying the problem they are supposed to study. — 1 other

Response: The study does not agree. The study understands the problem to be a search for improved ways to ensure the achievement of quality in the design and construction of commercial nuclear power plants. The study activity resulting from the Ford Amendment was designed to identify the root causes of cases of both poor and good design and construction quality and to devise programs that would provide greater assurance that achieved design and construction quality is at least equal to NRC's mininum requirements.

10.3 ACRS COMMENTS

The ACRS Subcommittee on Quality and Quality Assurance in Design and Construction was briefed twice in open meetings by the NRC staff on the Ford Amendment project, the study approach and preliminary results. These briefings, which took place on July 18, 1983, and December 6, 1983, were announced in advance in the Federal Register and were attended by members of the public.

In addition, the ACRS Subcommittee reviewed and commented on an earlier revision of this report. They provided oral comments to the NRC in a closed briefing on February 24, 1984. The comments have been incorporated into this report at the end of this chaper. The full ACRS reviewed an earlier version of this report and was briefed on the study findings and recommendations in a open briefing on March 15, 1984. The text of the ACRS letter to the NRC Commissioners regarding this report follows.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

March 21, 1984

The Honorable Nunzio J. Palladino
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Dr. Palladino:

SUBJECT: ACRS REPORT ON DRAFT NRC REPORT TO CONGRESS ON IMPROVING QUALITY AND THE ASSURANCE OF QUALITY IN THE DESIGN AND CONSTRUCTION OF COMMERCIAL NUCLEAR POWER PLANTS

During its 287th meeting, March 15-17, 1984, the Advisory Committee on Reactor Safeguards reviewed the draft NRC report to Congress, "Improving Quality and the Assurance of Quality in the Design and Construction of Commercial Nuclear Power Plants," Revision 3, dated March 13, 1984. An earlier version of the draft report was considered during a meeting of the ACRS Subcommittee on Quality and Quality Assurance in Design and Construction held in Washington, D.C. on February 24, 1984. In addition, the Subcommittee reviewed and discussed the NRC's quality-related initiatives during meetings held on July 18, 1983 and December 6, 1983.

The report is both useful and constructive. It gives thoughtful attention to the five alternatives which the Commission was required to consider under Section 13(b) of the Ford Amendment (Public Law 97-415) and reaches well-reasoned conclusions on each. Further, the results of the pilot program mandated under Section 13(c) of the Ford Amendment substantiate the conclusion that comprehensive audits of nuclear construction projects by qualified third parties can provide significant additional preventive and detection capability as well as enhanced assurance that nuclear plants are built in accordance with their design and licensing commitments. The report is candid in conceding errors of omission or commission on the part of the NRC which have contributed to quality assurance deficiencies in the past.

During the Subcommittee's early review of the study, it suggested that the Commission take advantage of the opportunity presented by Congress and expand the scope of the study to address issues beyond those mandated. We are pleased that the report provides a more comprehensive picture of the Commission's actions and initiatives.

Although the report is well written, it is voluminous and repetitious. A concise executive summary would improve the report. This can be accomplished without delaying the submission of the report to Congress.

The lessons learned from past problems in the design and construction of commercial nuclear power plants are described. As indicated in the report, little is said about the operation of plants although many of

the same observations and lessons should apply. Many of the problems described relate to the inability, or the difficulty, of assuring the quality of some plants as a result of shortcomings in quality assurance and/or quality control programs during design and construction. Not addressed is whether the QA/QC shortcomings had an effect on quality or had significant effect on public safety/risk.

The distinctions among quality, quality assurance and quality control, and their relationship to public safety/risk are, at times, not made clear in the report. This is compounded by the NRC's continued inability to clearly identify those systems and components for which quality is essential to public safety and thus for which programs to control and to assure quality are necessary. Probabilistic risk assessments (PRAs) could help in this regard. We encourage the NRC to expedite the collection of the data necessary to clarify these issues.

Further, although recommendations are based on the findings of the case studies, pilot programs, and other initiatives, it is not clear whether their implementation will actually improve quality or enhance public safety or whether they will merely improve the public's perception of safety. We recommend that the NRC Staff undertake to determine the relative risk significance of the various recommendations and proposed actions as well as determine whether safety would be enhanced by the proposed actions. The NRC should then concentrate its efforts on actions which will enhance public safety.

The report does not contain priorities or schedules for further development of the various recommendations or proposed actions. We believe that the NRC Staff needs to develop more specific recommendations following the submission of the report to Congress. We recommend that in forwarding this report to Congress, the Commission make clear its intention to develop a plan for achieving the assurance of quality in the design, construction, and operation of nuclear power plants. However, we caution that the development of a program plan should not be allowed to interfere with proceeding expeditiously with those actions found to improve public safety significantly.

The NRC Staff has identified management as a major factor affecting the success or failure in assuring the quality and safety of nuclear power plants. While we agree that a poor quality assurance program is an indication of poor management, an apparently good quality assurance program does not necessarily imply the presence of good management. We see the need for an organizationally independent quality assurance department that reports to senior management; however, we fear that the emphasis on independence has in some cases led to the belief that the assurance of quality is someone else's responsibility. To assure quality and public safety, a strong sense of the need for and the benefits from quality, the assurance of quality, and professionalism should permeate a licensee's and/or a vendor's entire organization. The

NRC should continue its efforts to stimulate this kind of professionalism in the nuclear industry.

One of the recommendations from the management analysis conducted by N. C. Kist & Associates, Inc. is to establish a quality assurance program within the NRC. Although noted in passing in the report, it remains a fallow recommendation. The report does contain a recommendation for performance audits of NRC QA activities. However, we believe that the relationship between QA and prudent management, as discussed in Section 3.5 of the report and in this letter above, is equally applicable to the entire NRC. Therefore, we suggest that the Commission give prompt and careful consideration to the recommendation that the NRC establish a program to assure the quality of its activities. We do not believe, however, that a formal QA program is necessary or desirable.

The recommendation that the NRC establish a body of experts to advise the Commission on the capability of applicants to effectively manage a nuclear construction project is worthy of further consideration. The ACRS currently does not contain extensive expertise of the types envisioned for the proposed advisory body, and to establish such expertise within the ACRS membership might sacrifice other requisite expertise. The report has also recommended that future construction permits be conditioned on a demonstration of the licensee's continuing ability to effectively manage the project. Those responsible for the development of these recommendations should consider the difficulties associated with judging such management capabilities.

The ACRS supports the NRC Staff's shift in inspection emphasis from looking at the content of quality assurance plans to looking at actual plant quality and at the implementation and effectiveness of programs to assure quality. However, we believe that the NRC Staff will experience difficulties implementing the modified inspection program until performance criteria are established.

Useful insights have been obtained from Integrated Design Inspections (IDIs), Independent Design Verification Programs (IDVPs), and Construction Appraisal Team (CAT) inspections. We recommend that for the present these inspection programs continue.

The concept of using designated representatives is worthy of further consideration. In addition to augmenting NRC resources, it may be a way of stimulating and rewarding professionalism and dedication to quality in the workplace. We would like to be kept apprised of the NRC Staff's efforts regarding the designated representative concept and other QA initiatives, and we would appreciate the opportunity to comment on them at a later date.

Additional comments by ACRS Member Glenn A. Reed are presented below.

Sincerely,

Jesse C. Ebersole
Chairman

Additional Comments by ACRS Member Glenn A. Reed

I consider the report to Congress to be deficient in its study of Alternative b(4), and I am concerned that Congress may continue endorsing regulatory approaches that are too similar in many ways to those that have in the past proved ineffective. I concur with this ACRS report concerning the above referenced report to Congress in most aspects, but in my opinion it does not go far enough, and is not critical enough with respect to the following:

1. The ACRS report states that the report to Congress "gives thoughtful attention to the five alternatives ...." I disagree that thoughtful or appropriate in-depth attention was given to Alternative b(4), which addresses improvements in the NRC's organization, methods, and programs for quality assurance.

2. The report to Congress recommends that a body of experts be established to advise the Commission on an applicant's management capabilities. The ACRS report states that this recommendation is worthy of further consideration. I disagree, and do not feel such expertise, with the time and objectivity, could be constituted to undertake this activity. Further, I disagree that such a body of experts is even desirable or necessary if a more astute study of Alternative b(4) is made.

3 What the ACRS report does not address, or recommend, is more in-depth consideration of the NRC's organizational structure, and what obstacles this present structure may place in the path of achieving quality in design and construction. The present NRC structure does not motivate professionalism and craftsmanship in the workplace. In my opinion, high quality can only be achieved by the enthusiastic and dedicated action of real professionals and crafts people who are motivated to standards of excellence by a regulatory structure that better recognizes human factors. I am aware of and have read an NRC Staff report which addresses the FAA designated representative (DR) system. In my opinion, the report to Congress should not have glossed over the FAA's DR program, but should have included a detailed study of that system and its potential for correcting the adversarial climate that is growing in the nuclear workplace. Given the current structures of the nuclear

industry and the NRC, the genuine professionals and crafts people are somewhat overwhelmed by top brass and regulations, yet the answers for real quality in this highly technical nuclear industry lie with those professionals.

In my opinion, the achievement of a high degree of design and construction quality can come from a modified version of the FAA system of DRs in design and architect-engineer organizations and in manufacturer and constructor shops. I would consider it appropriate for these DRs to be nominated by their peers, approved by their employers and perhaps the NRC, then established in a quasi-regulatory role while continuing their regular duties. Along similar lines, the NRC might consider structuring some licensed personnel in nuclear power plants into a DR system somewhat similar to the way in which the Massachusetts Department of Public Safety has incorporated licensed operating engineers into its regulatory structure.

References:

1. Public Law 97-415, NRC Authorization Act for Fiscal Years 1982 and 1983, Section 13 on Quality Assurance, dated January 4, 1983.

2. Draft NRC report to Congress, "Improving Quality and the Assurance of Quality in the Design and Construction of Commercial Nuclear Power Plants," Revision 3, dated March 13, 1984.

10.4 REVIEW GROUP

Expert review of the NRC study on quality assurance was provided by the individuals listed below. Two day meetings were held with NRC staff in June and September 1983 to provide comments on efforts to date and to help provide direction to future work. A third meeting was held in January 1984 to review the tentative conclusions and recommendations.

The meeting format was used as the most efficient way of informing the individuals of the information that was available and of receiving their oral comments. Individual comments were formally provided by individual members after each briefing. All of these individual comments were used to help guide the conduct of the study.

° Fred Albaugh Chairman	Independent Consultant, Past Director, Battelle Pacific Northwest Laboratories. Manhattan Project. GE.
° John Amaral	Corporate Manager of Quality Assurance, Bechtel Power Corporation. Former Chairman, Energy Division, American Society for Quality Control.
° Spencer Bush	Consultant, Review and Synthesis Associates. Former Consultant, Battelle, Pacific Northwest Laboratories. Member, Advisory Committee on Reactor Safeguards, 1966-77 (Chairman 1971). Manhattan Project.
° Thomas Cochran	Senior Staff Scientist, Natural Resources Defense Council.
° George Coulbourn	Director, Nuclear Power Systems, Boeing. Former Vice-President, Boeing Construction. Former Construction Manager, Indian Point #3.
° John Gray	Chairman, International Energy Associates Limited. Chairman, Energy Policy Committee, Atlantic Council of U.S. Former Manager, Shippingport. GE, Westinghouse.
° John Hansel	Independent Consultant. Former Project Manager, Gaseous Centrifuge Enrichment Plant, System Development Corporation. Former Director, Quality Assurance, Apollo Spacecraft, Space Shuttle Orbiter, and Launch Operations. President-Elect, American Society for Quality Control.
° Robert V. Laney	Independent Consultant. Retired Deputy Director, Argonne National Laboratory. Project Manager, Seawolf prototype. Bettis Laboratory. Former Vice-President, General Dynamics.
° Leland Bohl	Manager, Quality Assurance and Reliability, General Electric Nuclear Energy Group.

10.4.1 Review Group Comments on this Report

An earlier version of this report was reviewed by the members of the review group in a meeting with NRC staff on January 10-11, 1984. Each of the review group members provided oral comments on the report during the meeting. Six of the nine review group members also provided written comments. The report was revised to reflect many of the comments offered, both oral and written. The written comments follow.

POST MEETING
COMMENTARIES
OF
GROUP MEMBERS

THIRD REVIEW GROUP MEETING
JANUARY 11-12, 1984

Battelle
Pacific Northwest Laboratories
P.O. Box 999
Richland, Washington U.S.A. 99352
Telephone (509) 375-2575
Telex 15-2874

January 16, 1984

Dr. W. D. Altman, Project Manager
Special Study on Nuclear QA
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

COMMENTS ON DRAFT REPORT - "IMPROVING QUALITY AND THE ASSURANCE OF QUALITY IN THE DESIGN AND CONSTRUCTION OF COMMERCIAL NUCLEAR POWER PLANTS"

These written comments will supplement the discussion and critique of the subject draft report which took place at the meeting of the NRC's QA Program Review Group in San Francisco on January 11 and 12. It does not seem useful or practical at this point to attempt line-by-line correction, but general comments will be made on the study as a whole and on a number of topical items.

The report is, in this reviewer's opinion, a good report which, if vigorously implemented, could substantially improve the regulation and practice of assurance of quality of commercial power reactors. It is responsive to the directives of Public Law 97-415 which mandated the study. It reaches useful and generally unambiguous conclusions on which of a number of possible measures to improve quality are likely to improve assurance of quality and which are not likely to. It is, for the most part, refreshingly candid in conceding errors of omission or commission on the part of NRC that have contributed to quality assurance deficiencies of the past. At the same time, it does not overplay its hand by offering solutions to matters which, even if relevant to quality concerns, are clearly beyond the normal role of the Inspection and Enforcement Division to recommend or decide. Finally, subject to a major rewrite of one section, the draft reviewed on January 11 and 12 promised a well-reasoned and well-written report.

1. Management Commitment to Quality

The conclusion that the foremost requirement for a quality reactor project is that utility top management and its project management team be fully committed to quality and knowledgeable of the methods and discipline required to achieve it is one with

which this reviewer completely agrees. Corollaries are that CP's have undoubtedly been granted in the past that should never have been granted, and that NRC should move diligently to identify such cases, to ascertain their present commitment and attitudes toward quality practices, and to bring about change as needed by persuasion, peer pressures, education, use of regulatory sanctions for observed transgressions and other means. However, this reviewer does not believe that NRC should have the authority to revoke a license, once given, on suspicion alone with the burden of proof placed upon the licensee to show that it should not be so. This could too easily lead to abuse of regulatory authority amounting to arbitrary confiscation of private property.

2. Audits and Inspections

A second major thrust of the study is that NRC enforcement of QA regulations will in the future be based less on monitoring compliance with approved prescriptive procedures and more on the results of audits of design quality and construction quality to be conducted by the licensee; by INPO, an industry organization; by NRC teams and by independent third parties. This is a major improvement on past practices, focusing as it does, on actual end-results observed in the field, rather than on mere statements of good intentions.

This panelist has one reservation about the plan for augmented inspection effort. Will less critical time-consuming QA reporting and test requirements imposed on licensees be eliminated or modified to compensate, at least in part, for the extra time required of the licensee in connection with the new and enlarged audit program? To this observer the draft is ambiguous on this matter and regulators are always more prone to add new regulations than to eliminate old ones of marginal value.

3. Standardized Designs and Requirements for High Percentage Completion of Design Before Construction

These two measures are closely related and both seek to avoid or minimize the need for major changes in design criteria or QA regulations after a project is underway. The record seems persuasive that such changes invite quality problems, project delays and cost overruns and the logic of this proposed requirement can scarcely be questioned. However, it is also true that the degree to which design criteria and regulations may be stabilized depends on the depth of technical understanding of reactor systems and of reactor health and safety hazards and also upon prevailing socio-political attitudes toward nuclear power.

Research and development studies, design development studies and other relevant work is planned by NRC and the nuclear industry to provide an improved basis for standardization and this is to be commended. However, until these studies have provided the needed information and NRC can thereby provide assurance against major backfitting requirements no utility can be expected to commit the funds needed for a complete design without the protection of a Construction Permit in hand.

4. Development of a Prioritized System of QA Requirements

This a commendable program which inferentially acknowledges the ad hoc or reactive nature of many QA regulatory practices of the past and looks to future development of systematic, objective criteria to guide QA priorities and the extent of QA requirements. Like 3) above, its success will depend upon results obtained in safety studies, design studies and the general advancement of technical understanding of reactor systems. The program is necessary for a stable, long-range future of commercial nuclear power.

5. Adversarial Attitudes

It is the opinion of this observer that adversarial attitudes that have often prevailed between NRC and a licensee have substantially contributed to quality problems by negating the possibility of cooperative efforts to identify and solve problems of mutual concern and for one of the two parties to understand and appreciate facets of a problem peculiarly important to the other. Without belaboring the origins of this situation, be it sufficient to say that it does not have to be so. The report cites examples of cooperative yet effective regulation in other nations and by other regulatory agencies of the United States.

The QA report reviewed here chooses to say little about this issue on the grounds that its effective correction is beyond the powers of NRC/I&E to correct. Granted that this is true, the report does offer an opportunity to call forceful attention to the issue, an opportunity that should not be neglected.

6. More Prescriptive Regulation

The conclusion of the report that more prescriptive regulation is not the key to elimination of quality problems is unequivocally correct. No amount of prescribed QC testing, required procedures and the like can ever eliminate the possibility of human error or

random mechanical failure. Rather it is the role of the regulator to set basic performance criteria and then to audit the licensee and his work to assure that his organization, personnel, designs, methods and procedures provide appropriate safeguards against threats to public health and safety.

F. W. Albaugh

F. W. Albaugh
Review Group,
Special Study on Nuclear QA

cc: JA Christensen

Review & Synthesis Associates
Spencer H. Bush, P.E. • 630 Cedar / Richland, Washington 99352

January 16, 1984

Mr. James A. Christensen
Battelle-Northwest
P. O. Box 999
Richland, Washington 99352

Dear Jim:

COMMENTS ON DRAFT REPORT, "IMPROVING QUALITY AND THE ASSURANCE OF QUALITY IN THE DESIGN AND CONSTRUCTION OF COMMERCIAL NUCLEAR POWER PLANTS - A REPORT TO CONGRESS"

Executive Summary

I do not consider this an Executive Summary. It is a rearrangement, principally of Chapter 2 with most paragraphs lifted in toto. To me, an Executive Summary is a terse overview of the significant content of the entire report, with emphasis on conclusions and recommendations.

P. 6, III.A

Basically, this action item says nothing will be done. If not, say so succinctly.

PP. 7-9, Re: Advisory Committee

I feel you would have a more viable committee if its scope were broader and more vague. Also, I'm not so sure regarding the pro's and con's of statutory vs. non-statutory.

P. 12, Line 4

This tends to look down on ASME/NB. I suggest replacing ",...and that....continued" with "and they provide a valuable and continuing contribution."

P. 13, D.

"...prior nuclear construction experience...in its.... (insert word)

P. 18, Top of Page

What does "in-house inspection process" mean?

RSA
Telephone: Business - (509) 375-2223 & 375-3749 / Home - (509) 943-0233

P. 24, IV.A

This is a very open-ended item entailing a great deal of effort and it appears to be advanced with little or no justification.

Table of Contents

9) Other Agency and Foreign Quality Assurance Programs (not titles of chapters).

P. 3, Chapter 1

Should Executive Summary mirror Item C, Compliance with the Pilot Program, as being accomplished?

Chapter 2

Comments are primarily in the Executive Summary heading of this memo.

P. 37, 2.3.3.A

You use many words elsewhere to explain and justify a position. Here, you casually suggest requirements that will cost millions. If you wish to cite the movement of the NRC toward expanded use PRA as a reason, I'll buy it.

Chapter 3

P. 3, 3.2

"....develop management criteria...". What does management indicate? Is it necessary? In the bottom two lines, "...having construction..."--do you mean QA/QC or construction or both?

Also, I'm not sure regarding your projection of management criteria; e.g., experienced management. For example, Consumers Power/Midland. (N.B. I agree experience is very important.)

P. 8, Top ¶, Last 6 Lines

I suggest deletion of Diablo. I doubt that any plant with a CP in the same time frame and now operating could come through an in-depth construction audit unscathed. I was there to approve an OL more than ten years ago.

P. 9, Bottom

...quasi¢...

P. 14, ¶5

I realize this is a quote. Even so, I doubt that it was just seismic criteria. I thought it was siting criteria.

P. 36

These comments tend to be snide. Why go out of your way to make enemies?

Chapter 4

Much of this chapter could go into an appendix, a la Appendix A. Then you could highlight the important items.

PP. 1-3

Why do you flip back and forth between what's in this chapter and what's in other chapters? This, in my estimation, should be done in Chapter 1.

P. 5

"End-product" vs. "process" is not clear. This means different thi to different people. Clarify.

P. 5, Bottom Item

You presume the PSAR's and FSAR's are O.K.--which isn't necessarily the case.

P. 6, Third Bullet

Wouldn't sequential sampling solve the scope problem?

P. 3, Middle ¶

Fifteen percent doesn't sound like much; however, large sums are committed in procurement, etc., that may not be recoverable.

P. 9, Item b

Unclear. I don't know what "reduced" and "promote" mean.

P. 20, Task D

Is concrete intended to be inside or outside ASME's scope? It will be different.

Chapter 5, ¶1

The paragraph is ambiguous. It talks of these activities not constituting audits, etc. If it still refers to ASME, it isn't true. If it refers to other standards, it would be clearer if a paragraph starts at "Applicable national standards.....".

Section 5.2.A, Last Line, ¶1

"...and (to?) the nuclear industry..."? You might indicate that

the broad audits could take credit for the narrow (and deeper) ASME/NB audits in the delimited areas permitting a better focus elsewhere.

P. 5, Middle ¶

In line 1, "qualit(f?)y"?

Chapter 6

P. 3, 6.2

"...either the NRC or the Licensee." This is significant and could be strengthened to emphasize that it is essential for both parties to be severely constrained if this is to work.

P. 8, Last ¶

What existed was a difference in the PSAR versus design drawings. This doesn't come through.

Chapter 7

A fairly tight chapter. No basic comments.

Chapters 8 and 9

No comments.

Chapter 10

Did not review.

General

There is a generic class of QC/QA breakdown that you have not touched on. For example, the low toughness support problem in my estimation has more true safety implications than several others discussed. This represents a breakdown across utilities rather than within utilities.

A concerted effort should be made to condense the body by deletion, shifting to appendices, etc. The repetition tends to dilute and results in a loss of focus.

In the Executive Summary, it would be helpful to tie items to appropriate chapters, sections and pages.

The ultimate text would gain with a more definitive chapter structure (regarding headings, subheadings, sub-subheadings, etc.) with numbers to identify headings.

The report or sections thereof would be in better focus by graphing or placing in tabular format such items as chronology, interactions, key actions, etc.

Please, at a minimum, cite by reference the program planned for operating reactors. This will close the loop.

Incidentally, under 10.4, I'm not BMI-PNL. I'm Consultant, Review & Synthesis Associates, ex-BMI-PNL.

Very truly yours,

Spencer H. Bush

Spencer H. Bush, P.E., Ph.D.
Consultant
REVIEW & SYNTHESIS ASSOCIATES

SHB:dp

cc: Dr. W. D. Altman, USNRC/OI&E ✓

BOEING ENGINEERING COMPANY

P.O. Box 3707
Seattle, Washington 98124-2207

January 17, 1984

Mr. James A. Christensen
Battelle
Pacific Northwest Laboratories
P.O. Box 999
Richland, WA 99352

Dear Mr. Christensen:

I would again like to express my appreciation for the work done by Battelle in arranging our third meeting. Whatever contribution we may have made was enhanced by your efforts.

As this is expected to be my final report on the NRC QA analysis required by the Ford Amendment, I have elected to provide several classes of comment. First, specific comments on the draft information provided during the process were provided verbally during our group review. These and other comments specific to your draft are provided directly on the enclosed document by means of marginal notes. Secondly, I have attached some general comments regarding the form and substance of your draft report (Attachment 1). Finally, attached are some more general thoughts concerning the current regulatory environment which are of a somewhat broader perspective (Attachment 2), but directly related to the scope of the study.

In retrospect, I feel that Congress has presented the NRC with an extraordinary opportunity. My condensation of the charge under the Ford Amendment takes the following form: "NRC, there has been a QA problem with some current nuclear power plant construction projects. You appear to be part of the problem. Examine the current organization relationships and practices and recommend improvements." I consider this an extraordinary opportunity because it provides a Congressional mandate for improvement; a convergence of recognized need, and requisite action with high visibility and transcending normal organizational inertia. I am hopeful that the NRC will respond with the bold initiatives clearly needed to restore the fundamental promise of safe and economical nuclear power to the nation.

Sincerely,

G. I. Coulbourn

Attachments

cc: W. D. Altman, NRC

ATTACHMENT 1

FORMAT AND SUBSTANCE FOR THE NRC RESPONSE UNDER THE FORD AMENDMENT

1. The final form of the document should allow the reader to easily determine what is being recommended. It should provide direction into the body of the document to the findings and rationale behind the recommendations, to allow further study, if desired, by the reader. Copious detail should be placed in appendices.

2. An important portion of the Ford Amendement instructions involved examination of the effect organization relationships had on the achievement of quality. The draft document to date is weak addressing the effectiveness of the NRC organization, especially as it relates to its internal activities. It is also weak in analyzing the manner in which the various participants in the process organize, both to work with each other, and to accomplish their own responsibilities. As the draft document is currently written, it focuses primarily on two findings: (a) that utility management is weak, and (b) that more and better inspections are needed. As discussed elsewhere, the first is only one element of the problem, and then only in certain instances. I am apprehensive that failure to identify weaknesses in the NRC organization itself which impact quality assurance may reduce the credibility of the report. At this point, perhaps further study of the current organization structure is a means of addressing the issue.

3. NRC should step back and assess the total impact of the summation of all inspections, requests for information, and other technical and procedural interfaces between NRC and the utilities. It is likely that even a rudimentary cost-benefit analysis will disclose duplication and marginal use of resources. The opportunity to integrate multiple instructions should be examined prior to incorporating an additional overlay of inspection.

4. It should be clearly stated that the NRC cannot and should not be expected to achieve quality in design, construction, and operation directly. All the NRC can do is assure that quality is achieved by others by selective audit and followup. It appears that this fundamental precept is not generally recognized by others not involved in the process.

5. Careful attention is needed in establishing the acceptance criteria before third-party audits become a part of the overall process. There appears to be a dichotomy between the experience needed and the independence desired. For example, if a person has substantial experience in the nuclear power industry, in some quarters he is suspect as not being independent. On the other hand, one cannot expect competent inspection work to be performed by people without substantial experience.

6. The term, "principal AE criteria," is used in several instances in the document. This term is undefined and may not be clearly definable. If that is the case, then meaningful regulatory requirements relating to the definition of these criteria may be difficult to achieve. This appears to need further investigation.

7. It was observed that NRC has operated on the assumption that industry was uniformly competent, while considerable variation existed and the level of competency was changing (both improving and deteriorating). It is essential that NRC recognize that a variation in competence and approach exists within the various utilities building and operating nuclear power plants. It will clearly be counter-productive to the achievement of quality and to the cost-effective production of electricity to require all operating utilities to respond to the problems of the lowest common demoninator. Selectivity will be a very difficult goal to achieve, but should be adopted from the onset.

8. It was observed that some utilities do not appear to support quality assurance because, for them, it is a cost item versus a cost savings or management tool. If this allegation is correct, then it would seem to be essential to determine why quality assurance in some instances is merely a cost item versus a useful tool.

9. It is suggested that NRC management, in conducting its review of the final draft, critically assess the extent to which the method and manner of implementation of the actions identified is described. In many instances in earlier drafts, very attractive objectives and action items were identified, but the text lacked a description of how they were to be implemented. During the discussions of some of these action items, concerns regarding the manner of implementation were raised and left unanswered.

GENERAL OBSERVATIONS REGARDING THE CURRENT REGULATORY ENVIRONMENT

The laws of physics have not been repealed. The combination of relatively abundant, low-cost fuel with no higher use and very low environmental impact are inherent. The fundamental economic promise of nuclear power remains available to any society with the determination to achieve it. However, the management process in the United States has allowed the development of a regulatory environment wherein these benefits are currently no longer available. It is unlikely that any domestic utility will consider ordering a nuclear power plant so long as this environment persists. Following is my assessment of the fundamental problems within the context of the Ford Amendment study which appeared to warrant consideration.

1. Management of Change: There is a level of change action (technical, regulatory, and procedural) beyond which any program management structure can no longer prosecute its program. Utility management has consistently been faulted for quality assurance breakdowns. In some instances, the charge is well founded. However, in most instances, I believe the root cause is found in the circumstances which produced rampant, uncontrolled change. I submit that most of the utility management structures assembled to build the nuclear power plants of the past decade could have performed adequately in a more stable design and construction environment.

   Accordingly, I recommend that NRC commission an examination of the change management process itself, both within NRC and in the other parts of the industry. This examination should focus on both the management of change as a discipline (elsewhere called configuration management) and upon the reduction of the volume of change. The latter can have numerous constituents; for example, higher percent design completion prior to start of construction, more restraint regarding in-process change, standardization, etc. All of these constituents require disciplined and consistent management.

2. Signal-to-Noise Ratio: The uncontrolled application of successive overlays of requirments and procedures has evolved into a data-management problem of major proportions. NRC can no longer quickly and consistently isolate important information from the trivial because of the mass of paperwork currently required. Frequently the system forces the paper to become the product, such that the correspondence between documentation and documented quality is lost.

   This problem should be attacked from two perspectives. The volume of extraneous data currently required must be reduced by selectively culling that which is not clearly required. And, improved methods for isolating important information at an early stage must be implemented. I recommend that NRC commission an independent effort to examine these two objectives. This cannot be accomplished from within the organizations affected because of their limited perspectives and organizational inertia.

3. Long-Range Plan: I question whether an organization such as NRC can function effectively, lacking a comprehensive long-range plan. How can staffing plans be formed? What skills will be needed, when, and where? What levels? What are some of the technical and institutional trends likely to impact NRC obligations a few years hence? How should they be met?

   At this time, a number of trends appear evident to me:

   - There will be no new plant orders for some time.
   - There will be further cancellations.
   - Plants which encountered serious design and construction quality assurance will likely have difficulty in the operating phase.
   - The source term issue must be addressed and benefits incorporated.

- The PUC's role is in transition.

- Utility operating groups appear inevitable.

I recommend that NRC develop and maintain a long-range plan.

4. Misuse of the Regulatory Process: Congress has been unable to establish and maintain a consistent energy policy for the nation. A subset of this failure is the abandonment of policy regarding the development and use of nuclear power. In the resulting void, the nuclear regulatory process is being used by individuals and special interest groups to formulate energy policy in accordance with their interests. An obvious example is the public hearing and public comment process. Public interaction processes are important and should be used to inform and enhance safety, but not to set energy policy. These conflicting uses create guarded, adversary relationships detrimental to information exchange and inevitably impacting quality itself.

   I recommend that a part of the NRC's response under the Ford Amendment requirements suggest that Congress reexamine the fundamental role of the NRC respecting nuclear power, in recognition of the manner in which the regulatory process is currently being used. If a national debate is desired, then it should be decoupled from the regulatory process charged with preserving the health and safety of the public. The mission of the NRC should be restated. The purposes, forms, and mechanisms for the public interaction process should be clarified.

INTERNATIONAL
ENERGY
ASSOCIATES
LIMITED

January 16, 1984

Dr. Willard D. Altman
Project Manager
Special Study of Nuclear Quality Assurance
Office of Inspection and Enforcement
Mail: EWS-305A
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Dr. Altman,

As requested, I return herewith copies of the draft documents which we reviewed in San Francisco on January 10 and 11. I have not attempted to duplicate the comments I made during the meeting, having confidence in your capacity to glean from what was said by me and others which thoughts you may care to use.

My reaction to the documents was, and is:

1. The Executive Summary needs to be rewritten in its entirety and especially cries for up-front balance on the treatment of NRC/Industry culpability and credit.

2. Chapters 1 through 10 presented a complete and thoughtful analysis, findings, conclusions, and recommendations as well as some background material. Substantively, with editing and changes we discussed, you appear to have in hand a very useful and constructive product. You are aware of the organization, redundancy, and material changes suggested.

3. I gave to you at the meeting suggested simplification of page 27 - F. Project Ownership and Management Arrangements and page 30 - Possible Legislative Initiative - both in the Executive Summary. If those sections do not survive in the Summary, my suggestions may be carried into the body of the report.

2600 VIRGINIA AVENUE, N.W.
WASHINGTON, D.C. 20037
202 - 342 - 6700
Telex 89-2680 Cable IEAL WASHDC

We discussed the desirability of eliminating the "scrunity" of State PUCs on the premise that their impacts on utility decision making on QA could be dealt with in the prospective study of arrangements for utility ownership, financing, design, construction, and operation.

I subsequently recommended to you that any recommendations for a study such as the latter include provision for determining what desirable changes are possible "within the present system", and not requiring legislation, as well as determining what possibly desirable changes would require legislation.

Good luck as you proceed to wrap up this very interesting study. I've enjoyed working with you and the other key NRC staff, as well as with the other consultants to the Study.

Sincerely,

John E. Gray
Chairman

JEG:kd
enclosures (3)

104 Humbolt Ct.
Oak Ridge, TN 37830

Dr. J. A. Christensen
Sigma III Bldg./3000 Area
Batelle Pacific Northwest Laboratories
Post Office Box 999
Richland, WA 99352

Dear Jim:

I wish to thank you and other Battelle personnel for having had the opportunity to serve on this panel. The panel's efforts have been productive and I believe will prove to be beneficial to the NRC. I thank you for a fine job of coordinating our meetings and the arrangements - they have been superb.

As requested, I am providing you with written comments on the material reviewed this week. I will not repeat a lot of the comments, but only expand on those that I feel to be most significant from my standpoint. Dr. Altman kept a good set of notes and should have all remaining comments and suggestions.

Comments:

1. The Executive Summary should be shortened and enhanced by some graphs or charts that tell the complete story in a few pages.

2. A better balance is required between the NRC and utilities. This statement applies to both good and bad aspects. Both are to blame for past problems, but both have also taken a lot of positive steps to improve the construction process. The report also needs to address which initiatives/actions can/will apply to the operational phase.

3. The report addresses a lot of planned and proposed actions/improvements. When studied closely, they have taken a giant step toward development of a quality system, this message does not come out loud and clear. Graphics would again be beneficial.

   Likewise, the plans also will create a need for future plans/studies, i.e., classification of characteristics for NRC and licensees, and a true evaluation/definition of inspection needs. They will be in a better position to define the number of inspections, frequency, number and type of inspectors and training requirements.

4. I have been confused on the intent of IDI's. Perhaps others are also not aware of their significance. Report needs clarification and expansion.

5. A number of inspections, audits, units, reviews are suggested. I suggest a time line covering design, construction and start-up. Overlay this with all of the plans/checks to determine if a proper approach is being taken and is it balanced.

6. Drop discussion on graded approach or change terminology and add more clarification as to what you are trying to accomplish.

7. Chapter 2, page 16 is confusing. Split into at least (3) bullets.

   - The level of detail in QA/QC requirements in procurement documents is extremely important.

   - It is essential to follow up to evaluate subcontractors' performance against these requirements.

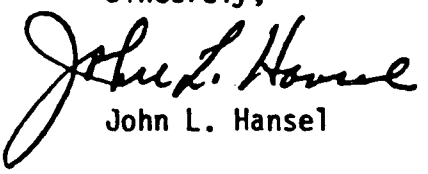
   - Necessary to evaluate a contractor's ability to perform to ~~these~~ requirements prior to issuing a contract.

8. Better define the intent of readiness reviews and the fact that they will be tied to milestones.

9. Chapter 7, pages 4 and 5. Items 2 and 5 need to also be listed in the Executive Summary.

Hopefully the above comments will prove helpful. Please contact me by phone if required at (615)482-3981.

Sincerely,



John L. Hansel

cc: Willard D. Altman, NRC

Robert V. Laney

Consultant
Energy & Project Management

24 Trout Farm Lane
Duxbury, Massachusetts 02332
Phone (617) 585-8912

January 16, 1984

Mr. William D. Altman
Project Manager
U. S. Nuclear Regulatory Commission
Office of Inspection and Enforcement, Room 305
4340 East West Highway
Bethesda, MD 20014

Dear Bill:

The draft NRC report to Congress on Improving Quality in the Design and Construction of Commercial Nuclear Power Plants, dated January 6, 1984, is returned herewith. You will find a number of comments written in the margins on those pages which have paper clips on them. These are largely editorial. More important comments are included in the body of this letter.

On the whole, I consider the report to be very good. You give thoughtful attention to the five possible courses of action which you were asked to consider, and you reach a well founded conclusion for each. Beyond this you provide the Congress a wider perspective on the status of the problem, its causes, and remedial actions. The case studies are especially useful inasmuch as they focus attention on real people and events and make us realize that the problems which led to this study are seldom as simple or one-dimensioned as sometimes portrayed.

The remainder of this letter is devoted to five subjects drawn from reading the draft report. For each I offer comments followed by a recommendation for improving the next draft.

Assessment of Blame

It is not a primary purpose of the report to assess blame for the quality problems which gave rise to the Ford Amendment and this study. However, in studying problem cases and alternative programs for improving quality, you have necessarily looked for root causes, made findings, and implied blame. To contribute to better understanding and to assure wider acceptance of the report, it is important that

it be even handed in assessing blame. We could not have confidence in a program of improvement unless it derives from a recognition of all significant causes.

In Section 2.2.2, pages 10, 11, and 12, the study finds shortcomings in project and corporate management and in NRC's slowness in detecting these shortcomings and taking enforcement actions. Clearly these are root causes which contributed to the scale of the problem. Not mentioned, however, are, (1) the failure by the NRC to make a searching evaluation of licensee management competence before issuing a Construction Permit, and (2) failure by the NRC to foresee that even an otherwise adequate management could be swamped and demoralized by numerous regulatory and hardware changes mandated in the midst of construction.

> RECOMMENDATION. Without reducing or moderating the reported shortcomings of project and corporate management, point out the contributing effect of the two NRC shortcomings identified above. This will, incidentally, lay the groundwork for the action proposed in Section 2.2.3A(1) and (2) on page 14.

Relationship Between NRC and INPO

Fostering an effective relationship between the NRC and INPO, one which allows each to do that which it can do best, should continue to be a constant goal of both organizations. This consideration is most compelling during a period of changing roles and expanding activities, such as that described in the NRC study. It is desirable for the NRC to allow ample scope to the industry's move to improve construction quality represented by INPO's Reconstruction Projects Evaluations (CPE).

INPO is the central feature of industry's determined commitment to self-improvement and self-regulation. Simultaneously, INPO is the industry's chosen instrument for achieving rising standards of performance in all phases of nuclear power, including, most recently, design and construction. Thus it is particularly important that, when setting a new agenda for strengthening the quality of nuclear construction, all concerned should recognize that INPO is similarly engaged. In deciding what inspections, audits, or evaluations it will do, the NRC should encourage INPO to do those which INPO might do as well or better. If this requires modifying the scope or methods INPO now uses, as the CPE's, NRC should discuss this possibility with INPO, as an alternative to continuing both CAT's and CPE's.

The present study includes, in Section 5.2B, page 4-6, and 9.3.1, pages 8-13, excellent descriptions and discussions of the respective NRC and INPO roles in achieving construction quality. The study concludes that the present role differentiation should continue, with INPO in a "counseling and advisory role" and the NRC in its statutory role of setting standards and inspecting to assure that those standards are met. This may be the appropriate conclusion at the present time. However, in my opinion, this section of the report would be improved if it were amplified to recognize that there are circumstances which, in the future, might argue for adjusting the NRC/INPO interface and their respective inspection activities.

First, INPO is exploring ways by which it might exert pressure on member utilities to respond constructively to correct faults revealed by INPO's evaluations. In addition, INPO appears to be moving towards a performance "ranking" system which will provide a utility management with a specific measure of relative success in achieving rising standards. These and related INPO initiatives, as they mature, will benefit from NRC recognition and a willingness to consider role adjustment as appropriate.

Second, in concluding that NRC and INPO roles are, for the present at least, fixed and separate, the study accepts the indefinite imposition of two similar design and construction evaluation programs with resulting duplication of demands on licensees.

> RECOMMENDATION. This report is the appropriate place for the NRC to acknowledge that (1) INPO is developing into an effective industry instrument for raising the quality of operations and construction, and (2) since INPO's potential is not yet fully realized, the NRC should remain alert to future improvement in INPO's program which would justify the NRC's placing greater reliance on it.

On Being More Prescriptive

In Section 2.1, page 2, the study rejects the use of more prescriptive A/E criteria, observing that degree of prescriptiveness was not a contributing factor in any of the projects reviewed. Since prescriptiveness is a favorite remedy of many who do not understand the complexity of the design process, it will probably be proposed again and again as a remedy for some perceived regulatory or enforcement lack.

RECOMMENDATION. Use Section 2.1 to inform readers of the study that there are two good reasons for the NRC to avoid being more prescriptive. First, there is more than one satisfactory way to perform most design activities, and prescription would unreasonably limit the licensee's choices. Second, too much prescription of "how-to-do-it" by the NRC tends to put the government into a management role where they do not belong and do not want to be.

Assessment of Corporate and Project Management Capability

In commenting on Alternative b(3), Section 2.1, page 2, and in Section 2.2.3A(1) and (2), page 14, the study advocates substantive assessments of corporate and project experience and management capability as a condition of issuing future Construction Permits. The study proposes developing criteria of management fitness to be used for this purpose, but does not indicate whether or in what manner these would be applied to present CP holders. NRC staff discussions with the Study Group on January 10-11, 1984, indicated that, in some manner, perhaps by third party audits as in Alternative b(5), the same criteria would be used in a capability assessment.

RECOMMENDATION. The study proposes developing criteria of management fitness for future CP applicants. It should provide an answer to the obvious question concerning their applicability to present CP holders. I believe they must be written so as to be applicable to present CP holders, for otherwise their present usefulness is quite small. If the criteria consist, as I believe they should, of a small number of basic principles of sound operation, if they are capable of objective verification by experienced observers, and if they are developed with the assistance of the industry, it should be possible to test present CP holders against them without significant claims of unfairness.

Use of Terms "Quality Assurance" and "Management"

These two terms are used throughout the report as though their meanings are approximately the same. The principal finding (page 2, Section IA of the Executive Summary) recognizes the difference. Since management failure, including QA failures, is reported to be the principal culprit, the report would be clarified by more careful use of these terms.

RECOMMENDATION. As noted above.

I compliment you and the NRC/BNL staff for the thorough preparation and presentation of the material on which the Study Group was asked to comment. The meetings were conducted with efficiency and you provided us with every reasonable opportunity to assist you. I sincerely hope that my suggestions are useful.

Sincerely,

Bob

Robert V. Laney

RVL:pb
enc
cc: Dr. Fred W. Albaugh
Mr. James A. Christensen