

5.0 AUDITS BY ASSOCIATIONS OF PROFESSIONALS

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

Alternative b(3)

Evaluations, inspections or audits of commercial nuclear power plant construction by organizations comprised of professionals having expertise in appropriate fields which evaluations, inspections, or audits are more effective than those under current practice.

The major associations of professionals currently conducting evaluations, inspections or audits of commercial nuclear power plants are the Institute of Nuclear Power Operations (INPO), the American Society of Mechanical Engineers (ASME), and the National Board of Boiler & Pressure Vessel Inspectors (NB). The analysis of alternative b(3) included an evaluation of the audits conducted by these organizations.

Many U.S. associations of professionals also participate in developing national consensus standards for different aspects of quality assurance. Applicable national standards are endorsed by the NRC and represent the core of many inspections and audits. However, no changes to this process are contemplated, and these standard-making activities are not covered in the analysis of alternative b(3) because they do not constitute audits, inspections or evaluations.

The evaluation, inspection, and audit activities of the three organizations identified above supplement NRC inspection activities and provide detection and assurance capability beyond that provided by NRC's inspection program. For example, in the early phases of construction at Marble Hill, the NB confirmed ASME code compliance problems with piping installation and brought this quality problem to NRC's attention. At Zimmer, the ASME identified and brought to NRC's attention problems in the quality of safety-related piping welds.

During the past two years, INPO has tested and implemented an extensive evaluation program of plants under construction. Because of NRC's familiarity with the long-established ASME and NB programs, the relative newness of the INPO program, and the broader spectrum of construction activities examined by the INPO program, field work to support the analysis of Congressional Alternative b(3) concentrated on the INPO evaluation activity. The analysis of all three organizations sought to determine how these efforts can best be used to enhance the overall level of assurance provided the public. Some consideration was given to whether any of these programs could act as a surrogate for the NRC program, rather than as a complement to the program, but this was a secondary consideration. Section 5.1 presents the conclusions and recommendations resulting from this analysis, and Section 5.2 describes the separate analyses.

5.1 CONCLUSIONS AND RECOMMENDATIONS

In this section, the conclusions and recommendations of an analysis of ASME's and NB's audits and inspections are discussed first, followed by a more detailed discussion of the analysis of INPO's Construction Project Evaluation program.

5.1.1 ASME/NB Audits and Inspections

The ASME and NB audit and inspection programs cover a limited number of areas in more depth than the routine NRC inspection program, thereby providing a valuable supplement to the NRC inspection program. The ASME and NB audit and inspection programs have a proven record of providing detection and assurance capability beyond that provided by the routine NRC program. The NRC should continue to use this narrower but deeper oversight capability in the limited areas in which they work, thus permitting better focus of NRC resources in other areas.

The NRC, ASME and NB should continue earlier efforts to coordinate selected inspection activity to avoid unnecessary duplication. However, the ASME and NB effort provides a valuable additional independent measure of assurance beyond the NRC inspection program, and any coordination initiatives should not compromise the independence of the ASME and NB nuclear inspection program.

5.1.2 INPO Construction Project Evaluation Program

The new INPO Construction Project Evaluation (CPE) program fits the alternative b(3) criteria of "evaluations...by organizations comprised of professionals having expertise in appropriate fields which evaluations... are more effective than those under current practice." INPO implemented its CPE program after enactment of Public Law 97-415, and this program represents a significant enhancement of efforts by the nuclear industry to improve quality assurance and quality control in design and construction. The CPE program is consistent with INPO's stated mission of promoting the highest levels of safety and reliability and encouraging excellence in all phases of construction, design control, and operation.

Consideration was given to suggesting alterations in the CPE program to make it more like NRC construction audits and thereby to allow the INPO program to directly substitute for portions of NRC's inspection program. However, this idea was rejected on the basis that INPO's current mission of improving industry performance and raising the industry's standards better serves the public interest. The NRC can and does set minimum standards that meet the requirements of law, but a regulatory agency is not equipped to adopt the counseling and advisory role required to move industry practice above those minimums. INPO was established for just such an advisory and counseling role. The study concluded that any attempt to use INPO as a surrogate for NRC construction inspections would limit the ability of INPO's CPE program to provide candid assessments to licensees and would damage this industry-initiated mechanism for improving overall performance of the nuclear industry for establishing industry-wide standards of excellence.

Some consideration was also given to INPO's ability to qualify as an independent auditor for performance of independent audits similar to those tested in the pilot projects. The apparent weakness of this proposal--INPO's

"independence" from the licensee--becomes INPO's strength in the counseling and advisory role.

The study concluded that public health and safety interests seem best served presently by INPO continuing in its role of "inside" independent auditor for the nuclear utilities--which is useful and necessary in assuring excellence and upgrading of industry's programs for achieving and assuring safety and quality. INPO is seen as a very important contributor to this result, rather than as a substitute for NRC regulation and inspection of the utilities' safety and QA programs and results thereof. However, NRC's and INPO's respective roles, which presently are fixed and separate, are not immutable and over time they may change.

This study has confirmed a widely held impression that INPO is developing into an effective industry instrument with significant potential for raising the quality of design and construction of nuclear power plants. Because INPO's potential is not yet fully realized, the NRC should remain alert to future changes in INPO's program that would justify NRC's placing greater reliance on it and which would lessen the combined impact on the industry of NRC Construction Appraisal Team (CAT) inspections, INPO CPE evaluations, and the proposed program of periodic third-party audits. Such action is not without precedent. Past successes in the INPO program for operating reactors have allowed NRC to reduce some inspection activity because industry improvements attributable to INPO resulted in a less intensive inspection presence needed by the NRC. Improved industry performance resulting from INPO activities at operating reactors led to a reduction in NRC Performance Appraisal Team (PAT) inspections from 14 to 4 per year.

5.2 TECHNICAL APPROACH IN EVALUATING ORGANIZATIONS OF PROFESSIONALS

Letters were sent to 15 organizations having various nuclear-related interests to draw their attention to the NRC study required by the Ford Amendment. Each letter provided a copy of the Federal Register Notice requesting public comments and information about the alternative programs in the NRC study. The letter requested their review and comments on methods to improve quality in the construction of nuclear power plants. Among those organizations receiving letters were the ASME, the Institute of Electrical and Electronics Engineers (IEEE), the National Board, the American Welding Society (AWS), INPO, and the American Society for Quality Control (ASQC).

The programs of the ASME, NB, and INPO were selected for evaluation because they were in place and either currently do supplement or have the potential to supplement the NRC inspection program. The IEEE, which was suggested for consideration as a possible candidate professional organization for conducting audits when the Ford Amendment was debated in Congress, recommended instead that ASME and INPO perform the evaluations by organizations of professionals. The IEEE stated that alternative b(3) was already in effect:

The evaluations performed by INPO and the ASME 'N' Stamp Program in addition to independent verifications for near-term license plants have been quite effective in identifying and correcting areas requiring attention. There is evidence in the reports generated by each of these that the programs provide an adequate and effective means of monitoring and evaluating licensee's quality

assurance program in addition to the Commission's evaluations. We recommend the use of these programs to satisfy this alternative.

This section describes NRC's process of evaluating the potential of each of these three organizations of professionals (1) for supplementing NRC's inspection program for nuclear power plant construction, and/or (2) for acting as a third party, and (3) for performing comprehensive construction audits similar to those recommended for the future in Chapters 2 and 4.

5.2.1 ASME/NB

ASME's and the NB's current audit and inspection programs provide valuable supplements to NRC's inspection program. In areas such as ASME code work and pressure vessel and primary coolant boundary welding, these programs inspect in more depth than the NRC inspection program, except for CAT or other special inspections. However, the ASME/NB programs are narrower in focus than the overall NRC inspection program and do not cover many of the areas covered by the NRC. Because there is some overlap between the ASME/NB, and NRC inspection programs, each can use the results of the other's audits and inspections to check the effectiveness of its own program.

Because of the current narrower focus of the ASME and NB programs, they are not considered to be viable substitutes for the comprehensive third-party audits described in Ford Amendment Alternative b(5) and the pilot program analysis in Chapter 4. The ASME/NB programs would have to be considerably expanded in scope to reach the level of comprehensiveness of the recommended third-party audit program. Such expansion is not considered to be as feasible as adoption of alternative b(5) with private companies performing the audits because of the start-up time and additional ASME/NB resources that would be required. In either case, the NRC has no control over the ASME/NB inspection programs. In contrast, a third-party program such as that recommended from the pilot program has already been partially implemented (the Independent Design Verification Program). Moreover, expanding the ASME/NB program rather than implementing the recommended comprehensive third-party audit program is considered to have less overall benefit because the total level of detection capability and assurance provided by an expanded ASME/NB program and the NRC program would be less than that provided collectively by the present ASME/NB programs, the NRC program, and the recommended third-party audit program. The NRC has the necessary authority to require third-party audits.

5.2.2 Institute of Nuclear Power Operations (INPO)

INPO, a utility-sponsored and funded organization, was established in 1979 to promote improved safety and reliability in operating nuclear power plants. INPO's Institutional Plan (May 1983) states that INPO's mission "is to promote the highest level of safety and reliability in the operation of electric generating plants. In carrying out its mission, the Institute strives to encourage excellence in all phases of construction, design control, and operation..."

In 1982, INPO developed performance objectives and criteria to evaluate design control, construction activities and other related areas in the construction of nuclear plants. INPO initiated and conducted a pilot program consisting of several evaluations. Following training sessions with utilities on the new

evaluation methodology, about 20 self-initiated evaluations were conducted by utilities to evaluate their construction performance using INPO criteria. Subsequently, in early 1983, INPO began a formal program of INPO construction evaluations. This program was named the Construction Projects Evaluation (CPE) Program, and evaluations of 22 plants in an 18-month period are planned under this program. INPO further established guidelines that plants under construction would be evaluated every 18 months thereafter, except those in the near-term operating license phase. The CPE evaluations are conducted by INPO evaluation teams, which may be supplemented by utility-appointed personnel or by third-party evaluation teams contracted by the utility and monitored by INPO.

The NRC's evaluation of the INPO effort for this Congressional study is based on NRC staff observation and review of the Beaver Valley 2, Limerick and Millstone 3 evaluation efforts. These efforts were conducted in the following time frames:

Beaver Valley 2	-	May 16 through May 27, 1983
Limerick	-	July 11 through July 22, 1983
Millstone 3	-	August 22 through September 2, 1983

This new INPO program and NRC's evaluation of it was in a sense a pilot program as defined in the Ford Amendment. However, the three plants reviewed did not include projects identified as having had major quality-related problems. Therefore, the INPO CPE program is discussed here rather than in the discussion of pilot programs in Chapter 4.

The INPO performance objectives and criteria require review of the following areas: Licensee Organization and Administration, Design Control, Construction Control, Project Support, Training, Quality Programs and Test Control. INPO's design review is essentially an effort to identify in the management control systems deficiencies and weaknesses that could permit design or construction deficiencies to occur. This approach is different from the NRC integrated design inspections (IDI) methodology, which includes detailed examination of equipment and system design, including the checking of design calculations. INPO's position is that programmatic review is superior and more productive than a verification approach, which consists of examining a limited sample of design details.

INPO's construction review emphasizes observation of work "in-process" as well as detailed review of programmatic controls to determine the effectiveness of management control of the construction process. INPO limits its review of actual construction to work in progress during the course of the two weeks the INPO team is on site. There is a limited retrospective look at completed work to assure that installed hardware conforms to design and specifications, which is a characteristic of the new NRC construction and design inspection programs (CAT and IDI). INPO's findings concentrate on ways to improve the construction process and are not, in many cases, directly applicable to assessing that completed work conforms to NRC requirements. Therefore, NRC's ability to rely on these evaluations in support of the licensing process is limited.

The INPO teams used for an evaluation usually consist of a team leader plus 4 or 5 evaluators for the design review at the A/E's office and a team leader and

10 to 12 evaluators at the site for the construction evaluation. INPO prepares detailed work schedules for each evaluator so that each of the INPO performance objectives and criteria are reviewed. The licensee provides any pre-licensing documentation needed. Approximately two weeks after the evaluation is completed, an exit meeting is held with the utility to discuss in detail the evaluation team's findings and to permit utility management to respond to those findings. The utility further responds in writing to each finding and prepares a corrective action plan that is reviewed by INPO. INPO then prepares a final report and sends it to the utility. INPO encourages licensees to make the report available to the public, but the member utility may withhold the report from the NRC and the public. To date, the NRC has received a copy of all final reports that have been prepared.

To be an acceptable alternative to the third-party audits recommended under alternative b(5), INPO's CPE methodology would have to be modified and expanded. The current program focuses on identifying deficiencies and weaknesses in the management control system. While management control is a key factor in the design and construction of nuclear power plants, an acceptable comprehensive audit must also examine the end product in depth to be assured that it meets the design intent and is of acceptable quality. The design review program would need to be more comprehensive and include checks of the calculation of selected design features. Where there are subcontractors to the A/E, the INPO evaluation would also need to review their activities. In the construction area, the programmatic and "in-process" observations would have to be supplemented by an increased retrospective detailed examination of representative plant hardware. For example, various sample sizes of welds, radiographs, structural steel, concrete, pipe runs, hangers, mechanical equipment, cables, terminations, cable trays, tray supports and other representative hardware would have to be selected and inspected. The final INPO report would have to be comprehensive enough to include not only the current information provided, but the amount and condition of hardware and equipment inspected and the detailed findings. The reports would also have to be made available to the public, without exception.

This analysis has been presumptive in that it hypothesized that INPO's Board of Directors may find it in their organization's best interests to act as a third-party auditor, part of whose mission is to confirm compliance with NRC regulations. Such action was not envisioned by INPO's founders, nor does it necessarily seem to be in the public interest to have INPO act as such a third party or as a substitute for NRC. This study concludes that there is great value in having a separate industry-sponsored body that performs, in effect, management reviews and project diagnoses for the nuclear industry and then provides advice and support in a cooperative atmosphere for improvement. Assumption of a quasi-regulatory role would significantly hamper self-improvement activities. The great value of INPO is its acceptance by utilities as a peer that they believe is there to help. The study concludes that NRC should not attempt to burden INPO at this time with roles that are inconsistent with this very valuable aspect of its mission.

A thoughtful analysis of the relationship between NRC and INPO was offered by Robert V. Laney, a member of the special review group established to provide advice to the study staff on this project. Excerpts from his comments on the analyses leading to this report appear below. The full text of Mr. Laney's comments may be found in Section 10.4.

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 Construction Project 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...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.

...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."

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.

The study concurs in this recommendation and carries it forward to the study findings, conclusions, and recommendations appearing in Chapter 2.

