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The Nuclear Industry and Its Regulators: A New Compact Is Needed

International Energy Associates Limited

Prepared for
U.S. Nuclear Regulatory
Commission

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ABSTRACT

The problem of the lack of integration in the nuclear power decision-making process in the United States is the subject of this study. The three institutions with the greatest influence on commercial nuclear power generation include the utilities, the Nuclear Regulatory Commission (NRC) and the state public utility commissions (PUCs). The diverse objectives of the three institutions are difficult to satisfy without producing conflict. This has contributed to inefficiences and delays in nuclear plant construction and operation, gaps in quality assurance, and may also result in compromises to public health and safety. This report reviews the perspectives of each of these institutions and provides recommendations for improvements. Particular emphasis is given to recommendations that NRC might consider to help alleviate the potential for adverse impacts on public health and safety resulting from a disaggregated nuclear power decision-making process.

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EXECUTIVE SUMMARY

The utilities, Nuclear Regulatory Commission (NRC), and Public Utility Commissions (PUCs) are the three institutions that have the greatest influence on the nuclear power decision-making process. However, this process lacks cohesiveness, and the diverse objectives of the three institutions are difficult to satisfy without producing conflicts. This has contributed to inefficiencies and delays in nuclear plant construction and operation and gaps in quality assurance.

The lack of integration in the industry has contributed materially to inefficiencies, delays in construction, and quality assurance problems. The utility industry contains a large number of companies that vary widely in size, capabilities, regional interests, and approaches to building or operating nuclear power plants. It is an industry that built mostly one-of-a-kind plants and whose few standardized plants sometimes varied in major aspects due to differences in the balance of plant. The lack of standardization limited the transfer of experience from one utility to another and also made standardized regulatory treatment difficult. Lack of integration applies not only to the utility companies, but also to their regulators, both federal and state. There is little formal or informal interaction between the PUCs and NRC, yet both regulators issue directives that may be conflicting for the nuclear utilities. Problems, such as potential compromises to public health and safety or quality assurance gaps, may result from this lack of regulatory integration.

To provide a broader perspective that helps to explain how state and federal regulatory influence evolved over time and resulted in disaggregated decision making, a historical review is provided in Chapter 2.0. The review begins with discussions on major federal legislation most applicable to nuclear power decision making; this includes (1) the Atomic Energy Act of 1954, (2) the Energy Reorganization Act of 1974, (3) the National Environmental Policy Act of 1969, and (4) various other environmental protection laws. Several other pieces of federal legislation, applicable to all electric utilities, are also significant and are thus discussed; these include the Public Utility Act of 1935 and the Public Utilities Regulatory Policy Act of 1978.

Other major federal regulatory influences are not based directly on legislation but arise from federal agency regulatory mandates. Section 2.3 is devoted to tracing changes in NRC's regulatory influence over nuclear utilities in the 1970s and 1980s. It describes the increased scope and reach of NRC regulatory review, particularly after the accident at Three Mile Island (TMI) in 1979, and discusses the effect of the expanded review on the utilities.

The role of state regulation is also reviewed in Chapter 2.0. The origins of state regulatory authority are briefly reviewed and contrasted with the authority exercised by the federal government. The primary function, responsibilities, and interest of the PUCs are described, and conflicts that arise between state and federal regulators are discussed. Factors that intensified the conflicting interests and perspectives between utilities and their state and federal regulators are detailed. The discussion focuses, in part, on intensified economic pressures (some of which were highly politically motivated) from the PUCs, which centered on reducing nuclear construction and operation costs. Many PUCs delayed or denied rate increase requests by utilities and initiated lengthy prudency investigation of past utility management decisions to determine whether to allow inclusion of invested utility money in the rate base. NRC added to the economic pressures by more stringent and demanding regulatory reviews and requirements (particulary the poorly controlled wave of backfitting requirements after the accident at TMI) that generally eschewed consideration of economic impacts.

These conflicting regulatory pressures on the utilities created a potential for compromises in plant safety and reliability. Some of the utilities contributed to the intensified pressures from their state and federal regulators. For example, cost increases were poorly constrained, contractors were not tightly monitored, utility managements failed to instill a corporate "culture" that would maintain accountability and responsibility for high standards and quality assurance, and the differences between building a nuclear plant versus a coal plant were underestimated. Nevertheless, many utilities with well-managed nuclear plants found themselves in trouble caused by factors external to their control such as inflation, high interest rates, and regulatory influence. Concerns arose that utilities squeezed by regulators might try to cut corners by, for example, cutting back on plant maintenance expenditures.

The federal government has vital interests in the nuclear power industry, yet it has failed to define a role for itself in the problem of disaggregation. Various parts of this issue are being addressed, but there is no organized, centralized approach to the matter.

Unless better coordination can be encouraged, the accusations between the utilities, NRC, and the PUCs could continue to breed

more distrust and to encourage adversarial relations. What has resulted from the combination of these institutional and regulatory influences is that utilities are reluctant to assume the high risks, both economic and regulatory, to commit themselves to constructing nuclear plants in the future. Chapter 2.0 provides several examples of proposed initiatives by some utilities, which are forecasting a need for power, to bypass traditional state PUC reviews, in favor of Federal Energy Regulatory Commission reviews, in constructing coal plants and selling the electricity.

Many of the problems that led to the disaggregation of interests and responsibilities have been previously analyzed. In Chapter 3.0, IEAL reviews previous recommendations for improvements that could be made by the nuclear utilities and their state and federal regulators. These recommendations emphasize changes intended to improve quality assurance in reactor construction and operations (enhancing plant safety), make the licensing process more efficient and effective, reduce costs, enhance service reliability, and improve the industry's health. However, none of these recommendations help to focus on changes that would resolve the lack of integration problems. Those recommendations that could be generally implemented within the nuclear industry's present structure and within existing regulatory authority are identified. The criterion used to discern whether a recommendation could be implemented in the existing environment is whether it would require new federal or state legislation. Progress that has been made in implementing these ideas, in whole or in part by INPO, NRC, or others, is also referenced and progress noted.

While Chapter 3.0 focuses primarily on solving generic problems of utilities and the federal and state regulators, Chapter 4.0 provides a more in-depth discussion and analysis of how a number of specific utilities undertook comprehensive efforts to address economic and management concerns by consolidating their resources. As in the previous chapter, the solutions discussed herein focus on resolving problems at a single source, in this case the utility, and do not address the problem of the lack of integration between nuclear utilities and their state and federal regulations caused by differing interests, incentives, and responsibilities.

Four case studies are included in Chapter 4.0 in which public or private utilities have consolidated their resources, or have attempted to do so, to build and operate electric power plants more economically. Each review describes reasons for consolidation, major events or projects in the history of the consolidated entity, the centralization of management and decision-making authority that resulted, and the level of unanimity achieved among the project participants. The analyses focus in particular on how well the project participants achieved their initial consolidation objectives and on how factors such as unanimity and centralization affected their success. The four

cases studied include (1) Yankee Atomic Electric Company, (2) Northeast Utilities, (3) Washington Public Power Supply System, and (4) Empire State Power Resources, Incorporated.

The case studies reviewed suggest that under the right circumstances, consolidation goals can be achieved successfully by a variety of methods. One important characteristic in all cases, however, is that the organization created provides a strong, centralized decision-making structure. Although project participants may share the same fundamental investment objectives -- presumably why they decided to consolidate -- centralized project-related decision-making is important to prevent disagreements over specific matters, not related to major corporate policy, from causing costly delays in project activities. In addition, the opportunity to centralize the design, construction, and operation of the plant would also result in major savings of resources. Even in a situation where utilities are sharing the capital costs of a project without any organizational affiliation, such centralization is important and could be achieved if one participant is allowed to assume the lead role on the project and make the necessary decisions in a timely fashion. However, in order to be accepted in such a role, the lead participant would have to be a major owner of the plant and have substantial experience and qualifications to undertake a large project, including the ability to manage other share owners and assure their continued participation. The participants with smaller shares of the project would share the same investment objectives and be willing to relinquish the lead of authority in exchange for the chance to own part of the plant, but play a more passive role.

The key concern is that the various utility investors continue to share their original investment objectives so that unanimity is maintained on major policy and investment decisions. This is more likely to be achieved if the investors consolidate into one large company with one management as opposed to forming a jointly owned subsidiary.

In the most successful projects, it has been found that the best means of preventing differences of opinions from causing major rifts among participants is to maintain a conservative investment and management plan that enables participants to continue to have the same investment objectives in spite of such potentially divisive effects. The difficulty has arisen in predicting the effect of certain external factors. In light of such uncertainties, it has been found that the better managed utility has not committed to a large share of a facility unless it has strong confidence, based on past experiences that its resources will not be unduly strained, possibly changing its investment priorities if: electrical demand drops, interest rates rise, project costs increase, or other divisive factors come into play. In determining the

appropriate level of subscription to a large capital intensive facility, the better managed utility has made conservative assumptions about (1) the growth in demand and interest rates and (2) the accuracy of its cost projections.

Another factor found to have potential for a large impact on the ability to achieve consolidation goals is the size of the organization created. While greater resources will allow utilities to make investments that take advantage of economies of scale, it is unlikely that these benefits can be accrued without limit. To determine the optimal organization size, participants could review demand forecasts throughout the region as well as long-term excess capacity margins for each utility. Furthermore, the size of potential participants could be carefully scrutinized so that no sponsor subscribes to a share of new capacity unless it is affordable to them. Finally, participants could place priority on ensuring that their long-term investment objectives are similar so that members will be able to achieve unanimity on issues and management will be able to make decisions on behalf of all participants.

In conclusion, these case studies have demonstrated that a conservative investment strategy (based on lessons learned) coupled with a superior, centralized management plan is the best formula for utilizing economies of scale and ensuring that consolidation goals are achieved. The lessons learned from these case studies help to provide insights on how effective consolidation of utility resources can help utilities provide reliable power at reasonable costs, and with acceptable economic risks. Nonetheless, even if all utilities were willing and able to take advantage of these lessons, the problems of disaggregated interests, responsibilities, and incentives between utilities and their state and federal regulators would remain. Current views on how to alleviate the disaggregation problem are the subject of Chapter 5.0. For this chapter, 14 U.S. utilities, two large architect-engineering firms, five nuclear and/or electric utility organizations, and two PUC representatives were interviewed. To enhance the candid nature of the material presented, names or organizations any of the persons interviewed are not identified. The utility representatives interviewed were either top management executives or senior managers one or two layers below the Chief Executive level. They expressed their viewpoints from personal experience and, thus, did not necessarily provide IEAL with official company views.

The utilities ranged from those that have had very favorable experiences with constructing and operating nuclear plants (and were, for the most part, willing and able to share with or sell their services to others) to utilities that experienced varying degrees of difficulties in plant construction or operation. Eleven of the utilities were investor-owned utilities, answering to their state's PUCs, while three were municipal utilities, answering to their municipal utility boards or districts. The following summary is a representative collection of comments from those interviewed.

Views on the industry problems and possible improvements it could support spanned a broad range of views but focused on several key themes:

1. The majority of those interviewed thought that industry should expand and enhance the role of industry-sponsored organizations such as the Institute for Nuclear Power Operations (INPO) and the Nuclear Management and Human Resources Committee (NUMARC).*

2. Industry must take the initiative to improve itself and must encourage improvements by its weaker nuclear utilities.

3. There is need for a means of transferring a successful management "culture" from one utility to another. However, this is recognized as very difficult to achieve.

4. Utilities need to give more emphasis to improving their accountability for their operations, including the quality, costs, and schedule of work assigned to contractors.

5. Standardization of plant designs would be highly desirable, but without a national consensus on what this would entail, it will never happen.

6. Existing regulatory, institutional, and financial problems greatly inhibit investments in new nuclear plants.

Improvements in PUC relationships with the utilities and NRC are also discussed. These focused, in particular, on the following themes:

1. The PUCs need to have a better understanding of NRC's functions and the utility's responsibility to comply with NRC regulations.

2. Unqualified PUC commissioners can present problems; elected commissioners that have to be responsive to short-term public opinion are of particular concern.

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*A minority of utilities we visited expressed dissatisfaction with INPO's aggressive approach. Their complaints centered around annoyances with having an outside organization telling them what corrective actions should be taken. Ironically, these utilities were the ones that could benefit from INPO's assistance.

3. A better consensus needs to be created among utilities, PUCs, the financial community, and the public regarding the treatment of utility expenditures and the need for power.

4. The PUCs and NRC need to have more frequent contact with each other regarding the utilities they mutually regulate.

Finally, the need for improvement in NRC's interface with the utilities and PUCs are also presented. The major themes were:

1. Readiness reviews are viewed as a particularly attractive NRC tool for approving plant construction.

2. NRC management of late allegations and its own whistleblowers needs improvements.

3. NRC needs to do a better job of explaining its requirements to the state regulatory agencies and to the public.

4. There is still a need for more consistent regulatory direction between the NRC regions, between the regions and headquarters, and between various staff at headquarters.

5. High turnover of NRC staff results in delays and other problems for the utilities.

6. NRC's system of fines is not effective and needs improvement.

7. NRC needs better management controls, exhibiting some of the same needs the utilities have in this regard.

8. NRC's regulatory process is unnecessarily burdened by legalistic requirements; the system should be critically reviewed.

The conclusions and recommendations for this study are contained in Chapter 6.0. The conclusions address changes seen as needed for the utilities, NRC, and the PUCs. The utilities have available resources that can be or are being used to restore industry confidence in the nuclear option. Some promising industry initiatives are already underway, but there is more the industry can do and should be doing to help itself. A limited sampling of large utilities that have completed nuclear projects with passable to excellent results suggests that some of these have assets that could be made available to other utilities. These resources

are largely under-utilized. Some utilities have been transferring these assets to others by lending of personnel. The primary problem in lending people has been found to be the different corporate cultures that can make the inserted team ineffective. At present, the most effective means of transferring experienced people to companies in trouble is as new managers or employees other than on loan. The effectiveness of new key personnel is highly dependent on the circumstances of the organizations and projects they are hired to join.

Other means of cooperation, without transferring or marketing personnel and/or services, are also available and could be used to enhance the exchange or sharing of experience. This includes more solid and uniform support of INPO throughout all nuclear utilities. This institution presently serves as the keystone of utility initiatives and has been very useful in setting standards of excellence for the nuclear industry. INPO represents industry's efforts to police itself by using audits to pinpoint problems in construction, operation, and management. INPO's capabilities in auditing operations were developed early and succeeded well. More recently, upon request from some utilities, INPO also began to provide audits of construction and construction management.

NUMARC is another important utility initiative. Since NRC has provided NUMARC with the opportunity to prove that an industry-sponsored effort can reduce the need for detailed NRC regulations, the success of NUMARC's efforts is critical to (1) proving that the industry can assume a leadership role in assuring quality of performance and (2) proving that other industry-sponsored programs can displace NRC regulations in other areas outside NUMARC's scope.

Neither NRC nor any other authority can successfully regulate quality into a utility. It is generally recognized by industry executives that (1) the initiative will need to come from within the utility organization itself and (2) to improve their reputation and standing in the view of the public, the regulators, and Wall Street, the industry as a whole will need to assume the responsibility for improving the performance of the weaker utilities. Industry's best opportunity to improve its image today lies in its recognition of the need to promote corporate cultures that are dedicated to high quality of work and the philosophy of "doing it right the first time." Only when the industry is perceived to be providing the leadership and follow-through necessary for ensuring excellence and quality in all aspects of nuclear power construction and operation will NRC's role and mission of overseeing the protection of public health and safety be able to undertake some fundamental changes. Moreover, if utilities can attain credibility for the prudent management of their nuclear activities, then the PUCs, especially those less affected by political influence, may be able to respond more favorably to rate increase requests.

Existing utility self-help initiatives seem to be working, and other areas could enhance this effectiveness. For example, the industry may want to broaden its scope beyond studying generic human factors issues and perhaps also consider generic hardware issues. Continuing movement in industry self-help initiatives is to be commended and encouraged and will help to promote an emphasis on quality from within the industry.

One area in which NRC could initiate useful changes would be to develop an aggressive program for encouraging better coordination and communication between NRC and the PUCs. For example, this could take the form of periodic educational workshops for collaborating on ideas and jointly addressing problem issues, similar to NRC's program with its Agreement States. More informal means of encouraging communication might also be effective. This initiative deserves serious study.

In its Ford Amendment Report to Congress on quality assurance, NRC recognized that good management is critical to having a well-run and high-quality nuclear utility. However, NRC, a federal regulatory body manned by highly scientific, technical staff, is not especially qualified to detect and analyze management deficiencies or to prescribe solutions to them. NRC could, however, alter its incentive structure so that good performance records are encouraged. NRC is now considering reducing routine plant inspections for plants with good performance records. This idea is highly recommended. NRC might want to consider undertaking a pilot program with three or four of the better performing utilities to test which incentives would be most effective in rewarding performance without sacrificing regulatory review; ample feedback from test utilities would be necessary to make such determinations.

The implementation of regulatory reform measures (such as the backfit rule and regulatory reform legislation), which are designed to bring stability and predictability into the licensing process, should be pursued. This task will become easier if the utilities are able to build a record of good performance. Stabilizing the regulatory process should help NRC's relationship with industry, and industry's relationships with the PUCs and with Wall Street.

NRC could also utilize industry audit and advisory capabilities to identify options for delegating more oversight to INPO and its member utilities. By taking advantage of this capability, NRC could simplify and streamline its regulatory process and, if done effectively, could stimulate less formal communication between NRC and the industry and also enhance the public's trust in the regulatory process.

Not only are changes in federal regulation critical to achieving better integration in the nuclear industry, but changes in state regulation are also needed. The PUCs need to give greater consideration to the long-range economic implications of their regulatory decisions. Regulatory incentives that incorporate the long-range view are often more effective in getting utilities to make changes that resolve the source of the problem; short-range incentives often address only the symptoms, cause unnecessary financial burdens, further alienate relations with utilities, and may have adverse impacts on overall plant reliability and operations.

Many PUCs have incorporated incentive regulations that are aimed at (1) punishing poor performers, (2) rewarding good performers, or (3) both. Those regulations that aim at the first method but not the second are viewed by utilities as far less effective. Incentive regulations vary widely but generally tie financial rewards or penalties to utility efficiency in plant construction and operation. Presently, approximately 15 states use performance incentives affecting approximately 35 nuclear reactors.[1] While NRC's Office of State Programs has a program in place to keep track of changing state PUC regulations, this effort is largely for monitoring proposed performance regulations and their eventual effect on plant safety once implemented. The NRC staff in charge of these efforts occasionally establish informal contact with state PUCs, and their consultants, but do not promote formal and regular communication between the NRC and PUCs where problems of mutual interest could be discussed.

The motivation behind many of the PUC prudency investigations is highly political, and it would be impractical to expect these tendencies to wane as long as plant construction (and sometimes operation) costs remain high. The long-held social compacts between PUCs and utilities are apparently not always valid under today's financial and political pressures. Unless the utilities, PUCs, and perhaps even the NRC can work out alternative arrangements, involving firm and legal agreements before a plant is built, regarding accountability for costs and responsibilities for quality control, it is unlikely that any utility will risk building another nuclear plant under existing regulatory and economic constraints.

For example, state certification procedures could be reviewed to provide more guarantees that the PUC will allow the approved plant into the rate base in exchange for agreements from the utility to meet certain performance or cost targets. This concept could possibly be linked with mini-prudency reviews, similar to the Readiness Review concept at NRC, whereby PUCs could provide reviews in incremental stages as a plant is being built.

Finally, to facilitate this idea, PUC representatives should meet periodically with NRC to discuss licensing issues of common concern. Confidence in NRC's regulations, issued to assure public

health and safety, can be undermined by careless or counter-productive economic regulatory incentives issued by the PUCs. To ensure that the twin goals of safety and favorable economics are each pursued mindful of the other, a better dialogue needs to be established between NRC and the PUCs.

In summary, the analysis of this report emphasizes that the relationship between the utilities and NRC will be more constructive if the utility industry is able to upgrade the performance of its weaker performing utilities. Although it is commonly recognized that NRC cannot regulate these reforms into utilities, there are several key changes that NRC could undertake to help alleviate the problems that result from a lack of integration in the nuclear power decision-making process. IEAL recommends that NRC:

1. Support and encourage effective industry self-help initiatives such as INPO and NUMARC.

2. Not try to regulate in matters in which it has little expertise -- like certifying effective means for managing nuclear power plants by utility executives.

3. Continue efforts to stabilize and introduce predictability into its licensing process; this includes a continuation of NRC's efforts to encourage standardized plant designs.

4. Study and implement means of establishing more effective and formal means of communicating with PUC representatives to induce both institutions to work together toward common goals. NRC must aggressively pursue this initiative to halt uncoordinated and possibly conflicting state and federal regulatory directives given to utilities.

5. Continue efforts already underway that are designed to minimize regulatory burdens on the better performing utilities.

6. Recognize that adverse and unavoidable financial pressures induced on utilities may have serious side effects that could reduce plant safety; in short, NRC should incorporate economic effects in evaluating its regulatory decision directives.

7. Make better use of industry audit and advisory capability to identify options for more efficient regulation and to ensure protection of public health and safety.

REFERENCES

1. "Incentive Regulation of Nuclear Generating Facilities by State Public Utility Commissions," Letter to the NRC Commissioners from William J. Dircks, SECY-85-260, July 26, 1985.

1.0 INTRODUCTION

1.1 PURPOSE

The Nuclear Regulatory Commission (NRC) contracted for this study in response to several particular concerns raised in NRC's April 1984 Report to Congress on improving quality assurance. These concerns addressed the potential conflicts between the state Public Utility Commission's (PUC's) financial objectives and NRC's interests in ensuring public health and safety.

The NRC sponsor for this study is the Office of Inspection and Enforcement, Division of Quality Assurance, Vendor and Technical Training Center Programs. The authority of NRC to conduct broad inquiries in this area of study is derived from the Atomic Energy Act, Chapter 1, "Declaration, Findings, and Purpose," Section 2.d:

> The processing and utilization of source, byproduct, and special nuclear material must be regulated in the national interest and in order to provide for the common defense and security and to protect the health of the public.

The overall purposes of this study are to (1) explore the institutional and legal relationships between the utilities, NRC, and state PUCs, (2) help clarify how potential conflicts between public health and safety and plant economics might arise (and the disincentives to safety and quality assurance problems they could cause), and (3) provide recommendations for resolving these conflicts.

1.2 BACKGROUND

There are six major components of the nuclear industrial/governmental/public decision-making system. These include (1) the utilities and their nuclear service and support organizations such as the vendors, architect-engineers, etc., (2) the state PUCs, (3) the NRC, (4) the investment community, (5) the public, and (6) the Administrative, Judicial, and Legislative Branches of the federal government. However, only three of these components

have the most direct and most significant effect on the control over and operations of nuclear power plants: the NRC, the utilities, and the PUCs. If all nuclear power plants were built (1) to meet public health and safety requirements, (2) without quality assurance problems, (3) on time, (4) within budget, (5) without the need to backfit new safety requirements, and (6) without requiring rate hikes, these three institutions would achieve their objectives with few conflicts or confrontations. This synergism has not happened. Instead, nuclear power decision-making generally lacks cohesiveness, and the scattered objectives of the three main institutions involved are difficult to satisfy without producing conflicts. Inefficiencies and delays in nuclear plant construction and operation and gaps in quality assurance are due in part to this lack of cohesiveness.

The lack of integration in the industry has contributed materially to inefficiencies, delays in construction, and quality assurance problems. The utility industry contains a large number of companies that vary widely in size, capabilities, regional interests, and approaches to building or operating nuclear power plants. It is an industry that built mostly one-of-a-kind plants and whose few standardized plants sometimes varied in major aspects due to differences in the balance of plant. The lack of standardization limited the transfer of experience from one utility to another and also made standardized regulatory treatment difficult. Lack of integration applies not only to the utility companies, but also to their regulators, both federal and state. There is little formal interaction between the PUCs and NRC, yet both regulators issue directives that may be conflicting for the nuclear utilities. Problems, such as potential compromises to public health and safety or quality assurance gaps, may result from this lack of regulatory integration. Brief descriptions of how each of these three institutions (utilities, NRC, and PUCs) helped contribute to this lack of integration in the nuclear power decision-making process follow.

Utilities suffered a number of setbacks that helped to bring greater regulatory attention to them from their state and federal regulators. During the 1970s, a number of factors external to utility control, such as high rates of inflation, lower demand growth, and higher interest rates, contributed to increased construction and operation costs. Not all of the cost overrun problems were caused by external factors. Due to poor management practices and controls and insufficient attention to quality control, some utilities contributed to their own technical problems, cost overruns, and construction delays. Those utilities that encountered these problems invited closer scrutiny by their state and federal regulators. The accident at Three Mile Island (TMI) in 1979 helped to intensify regulatory attention on safety issues, and all plants were subject to a large number of post-TMI required backfits. In addition, the lack of standardization among the several generations of nuclear power plants resulted in (1) less useful transfer of knowledge from one utility to another

because of differences in the plants, (2) the inability to perfect one or more designs, (3) difficulties in treating all utilities equally from a federal regulatory perspective, especially since each new design had to go through a lengthy NRC review process, and (4) widely differing effects from regulatory directives from one plant to another. In summary, the setbacks suffered by utilities were caused not only by uncontrollable economic factors but also, for some utilities, by poor utility management and controls. The accident at TMI highlighted some of the quality assurance gaps, brought attention to a number of generic issues, and required utilities to install a large number of costly backfits at a time when utilities were already trying to cope with a number of economic difficulties. In short, a series of internally and externally inflicted utility setbacks attracted closer state and federal regulatory scrutiny over both costs and public safety matters. The PUCs and NRC did not coordinate their directives to ensure that conflicts did not arise. As is discussed below, each was concerned only with those matters over which it had jurisdiction.

The second major institution, PUCs, issues regulatory directives that center around financial concerns. While some of the PUCs managed to recognize the influence of uncontrollable external cost factors and granted more timely and reasonable rate increases to their nuclear utilities, this was not universal. In reaction to public objections over increasing utility costs (even though these increases were roughly consistent with or less than the rate of inflation), many PUCs responded to political pressures and were reluctant to grant timely rate increases. This was a problem for those affected utilities in the 1970s because inflation was rising much faster than rate increases were granted, thereby severely straining utility finances. Other delays in granting timely rate increases could be attributed to inadequate PUC staff resources to handle the more frequent requests for rate increases. A later trend that emerged in the early 1980s was to analyze rate increase requests in light of the prudence of management decisions that led to cost increases. Many PUCs held lengthy hearings to judge the prudency of previous utility management decisions. Some of the utilities objected to the outcome of these investigations and complained that their PUCs judged past decisions using hindsight instead of knowledge that was available to the utility management at the time that decisions were actually made. Moreover, as part of an effort to stem rising costs, PUCs instituted incentive regulations that were geared toward financial performance with little regard to overall operating effects. Such regulations might improve plant operations, and thereby plant economics, over the short term but may not over the long term; this reflects the politically acceptable and economically motivated short-term perspectives held by some PUCs. In short, the "social compact" between utilities and PUCs, under which today's nuclear power pl s were planned and constructed, is no longer universally honor v the PUCs. Under this "social compact," utilities that buil nts according to the rules and regulations were supposed to b ven the opportunity to earn a rate of return on the money i..vested. Great uncertainties now

exist for some utilities over whether they will be able to recover costs already expended on nuclear plants, even if the job was well done or if utility management decisions were prudent in light of the information available at the time they were made. PUC efforts to stem rising cost increases through incentive regulations, prudency investigations, and questioning whether a utility has earned the right to a rate of return on money invested, may result in stricter and more effective cost control measures for some utilities. However, it is possible that some of these measures may also force utilities to cut corners, such as reductions in plant maintenance expenses, which may have adverse long-term safety impacts for plants.

The third major institution, NRC, has also had a major role in the disaggregated nuclear power decision-making process. Following the accident at TMI, NRC required numerous backfits to plants in operation and those under construction. These backfits were imposed without adequate regard to their impact on overall plant safety (or cost), and there was no centralized senior management overview controlling how backfits were imposed or integrated with other NRC requirements. Licensees complained of differing interpretations of requirements between NRC reviewers and inconsistent directives from NRC staff. Some licensees complained that the lack of NRC control over the process introduced delays and substantial financial costs. NRC-required designs, which had cost utilities substantial sums of money, sometimes had to be removed and replaced with updated parts due to still further changes in requirements. The large number of backfits introduced delays in licensing at a time when such setbacks were extremely costly due to high rates of inflation and subsequently high interest rates on borrowed capital. Much antagonism between NRC and the utility industry resulted; some utilities perceived NRC as unreasonable and without understanding of their problems, while NRC viewed some of the utilities as slow to respond, even uncooperative. These problems were eventually acknowledged, and licensing reforms were undertaken at NRC. Nonetheless, the experience left a strong impression on many utilities that NRC's licensing process was unpredictable and unstable. In summary, the effect of NRC's role in this process, which began before the TMI accident but was intensified afterward, was that utilities were required to comply with a growing body of regulatory directives. Many of these directives resulted in increased costs and delays, thereby further exacerbating already tense utility relationships with their PUCs. No particular attention was paid by NRC to the overall economic impacts that these directives would have on the utilities; these concerns were not NRC's responsibility.

What resulted from the interactions among the three primary institutions controlling nuclear power is an incoherent decision-making system with major institutional components lacking coordination and at times working at cross purposes with one another.

Pursuing their independent objectives, incentives, and responsibilities, these three decision-making bodies may collectively have adverse impacts on public health and safety and quality assurance. To prevent these undesirable impacts, the social compact between the PUCs and the utilities must be restored, and the performance of both utilities and NRC improved. This study identifies recommendations for improving the relationships among the PUCs, utilities, and NRC toward the objective of enhanced plant safety and quality assurance. Recommendations that identify particular actions that NRC could undertake in its regulatory activities are highlighted.

1.3 SCOPE AND APPROACH

Since this study is aimed at exploring and analyzing the lack of cohesiveness, or integration within the nuclear industry and, between the industry and its regulators, its scope is very broad. To provide some background for discussion of the existing regulatory and institutional structures within which the nuclear industry must operate, this study begins by briefly outlining the history and extent of federal and state regulatory influences in Chapter 2.0. This chapter provides historical perspectives that help to describe how differing interests, incentives, and organizational responsibilities led to an incoherent decision-making system. This is followed by a discussion of previously recommended changes to the practices of the PUCs, NRC, and the utilities in Chapter 3.0. These suggested changes are analyzed to determine which ones could be implemented within the industry's present structure and regulatory environment, and if attempts have been or are being made to implement these recommendations, such actions are noted and briefly discussed. Although Chapter 3.0 reviews previous attempts to solve individual problems, those recommendations did not focus on the problem of incoherence in the overall nuclear power decision-making process. Instead, the recommendations were geared toward solving specific problems of utilities, NRC, or the PUCs.

Real-life examples of industry-sponsored attempts to consolidate resources to construct or operate nuclear plants are provided in Chapter 4.0. Four case studies of this concept are presented, three of which were implemented and one of which failed to obtain support and subsequently never materialized. The purpose of these case studies is to examine the effect of the consolidation of utility resources on utility operations and performance.

In Chapter 5.0, the report explores the views of utilities, utility support organizations, and PUCs on utility practices and policies. The interactions among NRC, PUCs, and utilities are also explored. The purpose of this chapter is to present views from the utilities and their state regulators on changes to their policies and practices that they feel might alleviate some of the problems caused by the lack of integration between the nuclear

industry and its regulators. These changes are both short and long term and focus on improving the quality of nuclear plant construction, operation, and regulation.

A broader perspective of proposed changes is provided in Chapter 6.0, with highlights and analysis of modifications of institutional behavior that could be implemented by (1) NRC, (2) the PUCs, and (3) the utilities to provide more efficient integration of decision-making in the nuclear industry. This chapter also contains the conclusions of this report and highlights key recommendations that could be implemented by NRC.

1.4 METHODOLOGY

Various methods were used to obtain information to conduct this study. In Chapters 2.0 and 3.0, in which the historical background on institutional relationships and the previous recommendations are discussed, publicly available literature was utilized. In Chapter 4.0, in which case studies of utility consolidation of resources are reviewed, a combination of publicly available literature and telephone interviews with knowledgeable people was used to obtain information. A more hands-on approach was employed for Chapter 5.0. Members of the project team interviewed representatives from 13 U.S. utilities representing both companies that had or are having regulatory or quality assurance problems constructing or operating their plants and companies that have had relatively good experience with their reactors. Two large architect-engineering firms, five organizations representing nuclear or electric utility interests, and two PUC representatives who are also active in the National Association of Regulatory Utility Commissioners were also visited. The purpose of these interviews was to survey the utility industry and its state regulators for ideas and recommendations.

2.0 THE HISTORY AND ROLE OF FEDERAL AND STATE REGULATORY INFLUENCES

The purpose of this chapter is to provide a historical perspective on the sources of regulatory influences that affect the nuclear industry. The sources considered are federal legislation that applies to nuclear power plants and to electric utilities and federal and state regulation of nuclear power plants. Not only does the historical perspective reflect the differing interests, incentives, and responsibilities held by utilities and their state and federal regulators, but it also helps to show how the utilities were made to answer to an ever-increasing number of laws and regulations that not only slowed the construction process but also increased operational complexities.

2.1 FEDERAL LEGISLATION APPLICABLE TO NUCLEAR POWER

The federal government derives its responsibilities for regulating commercial nuclear power from a number of federal acts. Since the Nuclear Regulatory Commission (NRC) is quite familiar with these acts, the following subsections only briefly review them, stressing in particular those that contribute most to defining NRC's regulatory role in contrast to that of the states.

2.1.1 The Atomic Energy Act Of 1954

In August 1954, Congress amended the Atomic Energy Act of 1946. The 1954 act differed from the act of 1946 in that it defined a role for the federal government in encouraging the development and use of nuclear energy technology for peaceful commercial purposes, thereby ending the government's monopoly on nuclear technology. It also directed the Atomic Energy Commission (AEC) to develop specific standards for the protection of public health and safety. This role was later transferred to NRC.

One of the key provisions in the 1954 act is contained in Section 105, which requires NRC to consider antitrust implications of a proposed nuclear plant before issuing a construction permit or operating license. Based on its findings, NRC may grant, deny, or attach conditions to the license.[1] Congress included

Section 105 because it recognized that the nuclear industry, once a government monopoly, currently represents the product of past public expenditures for technological developments. Thus, strict antitrust standards were applied to ensure that the public as a whole could reap the benefits of nuclear technology. Today, this broad principle is important because it could potentially pose obstacles to utility consolidation of efforts to (1) produce common, standardized plant designs using standardized parts or (2) pool economic resources in order to provide more economical sources of power.

2.1.2 The Energy Reorganization Act Of 1974

The significance of this act is that it formalized an existing division in AEC between regulatory and promotional functions. NRC was given sole possession of all the regulatory functions, and the promotional functions of nuclear energy were given to a separate agency, the Energy Research and Development Agency (ERDA). ERDA was also given responsibilities for developing other forms of energy production. This act alleviated the potential for internal conflicts of interest that had prevailed at AEC but did not remove it; instead, it merely elevated it to a higher level. The federal government today still experiences occasional schisms between the public health and safety regulatory interests of NRC and the promotional interests of the Department of Energy (DOE, the agency that replaced ERDA). This is not to suggest that these competing interests are necessarily bad (the federal government itself is structured on a system of checks and balances), but it does mean that NRC and DOE do not share similar interests and responsibilities concerning nuclear utilities. Thus, the federal government's commercial nuclear energy policy as a whole sometimes lacks integration.

2.1.3 The National Environmental Policy Act Of 1969

The National Environmental Policy Act (NEPA) had a profound impact upon the regulatory responsibilities of NRC. NEPA states that it is the continuing policy of the federal government to use all practical means, consistent with other essential considerations of national policy, to improve and coordinate federal plans, activities, and resources to preserve and enhance the environmental values and quality of life for both the present and future.[2] As a result, NRC must include in its recommendations for a construction permit or an operating license a statement detailing probable adverse environmental effects, alternatives to the proposal, short-term environmental use weighed against long-term productivity of the environment, and the irreversible commitment of resources.[3]

NEPA also requires that NRC conduct a "need for power" determination before a nuclear power plant can receive a construction permit. Not only does this require NRC to conduct analyses that are somewhat outside the realm of its primary mission to protect public health and safety, but it is also an exercise that is repeated by the state Public Utility Commissions (PUCs) in their economic analyses. This is a prime example of the potential for disaggregated decision-making between state and federal regulatory authorities.

Perhaps the most significant effect on the nuclear utilities from NEPA's requirements was that it introduced substantial delays in the licensing process. This happened during a period when the utility industry was growing rapidly and using many different reactor designs, and inflation and other economical setbacks were beginning to surface.

2.1.4 Other Environmental Protection Laws

In addition to NEPA, there are seven other environmental acts that constitute the primary legislative regulatory influences on nuclear utilities. These acts are significant in that they represent further layers of regulatory burdens that utilities are required to comply with to obtain construction permits or operating licenses. Some of these environmental laws require hearings or reviews that are duplicated by state regulatory authorities. Delays and inevitable increases in utility costs are experienced both in response to burgeoning environmental regulations and because of duplicative environmental reviews in some states. The basic purposes of these acts are briefly described below:

1. The Federal Water Pollution Control Act of 1972 - This act controls the discharge of pollutants (e.g., radiological and others emitted by nuclear power plants) into navigable waters.

2. Marine Protection, Research and Sanctuaries Act of 1972 - This act established U.S. policy for regulating the dumping into ocean waters of "any material which would adversely affect human health, welfare, or amenities, or the marine environment, ecological systems, or [result in] economic penalties."[4] Radioactive waste or material is included in the definition of "materials."

3. The Endangered Species Act - This act, first passed in 1973 and amended in 1978, can significantly affect the siting of nuclear power plants. It sets forth as federal policy a goal to conserve endangered and threatened species of fish, wildlife, and plants. Critical habitats, where these endangered or threatened species

survive, may not be disturbed in the furtherance of economic growth and development, such as the construction and operation of a nuclear power plant.

4. Transportation Safety Act of 1974 - This act, cited as the Hazardous Materials Transportation Act, improves the regulatory and enforcement authority of the Secretary of Transportation to protect public health in the transportation of hazardous (e.g., radioactive) material.

5. The Clean Air Act of 1977 - Several sections of this act impose regulatory requirements related to emissions of radioactive materials into the air.

6. Uranium Mill Tailings Radiation Control Act of 1978 - Congress enacted this act to (1) ensure that the federal government cooperates with states or Indian tribes, who own the mill tailings, in assessing and instituting remedial measures at such sites and (2) institute a regulatory program at active and terminated mines to stabilize and control the tailings in the interest of protecting public health and the environment.

7. The Low-Level Radioactive Waste Policy Act of 1980 - The federal government policy on low-level radioactive waste disposal is defined in this act. States are directed to form compacts, as necessary, to provide for the establishment and operation of radioactive waste disposal sites on a regional level. The responsibility for providing for this capability rests on the states that generate low-level wastes within their own borders (for other than defense or federal research-and-development-related purposes). This act specified that compact regions with Congressionally approved compacts could exclude waste generated outside their borders as of January 1, 1986. It was envisioned that new disposal sites would be available by that date. However, the states have failed to meet these terms, and the governors of the three states with the only operating disposal sites (which were operational before 1980) threatened to close their sites to other states by January 1986. This prompted Congress to introduce and pass legislation to amend the 1980 act by providing for an additional four-year extension period to help the states form compacts and select new facility sites.

8. Nuclear Waste Policy Act of 1982 - In contrast to the approach taken for the disposal of low-level radioactive wastes, the federal government assumes responsibility for the disposal of high-level radioactive wastes and spent nuclear fuel in the provisions of this act. The stated purposes of this legislation are (1) to establish a schedule for safe siting, constructing, and operating

repositories, (2) to establish federal policy and responsibilities for disposal of such waste and spent fuel, (3) to better define the relationship between the federal government and the state governments in carrying out the intent of this act, and (4) to establish funding mechanisms whereby utilities generating nuclear power would bear the costs of disposing of nuclear waste and spent fuel.

2.2 FEDERAL REGULATION APPLICABLE TO ELECTRIC UTILITIES

While the laws discussed in the previous section affect the operation and construction activities of nuclear utilities, from a federal regulatory viewpoint, none address the organizational structure of utilities or the pricing structure for electricity rates. These subjects are addressed in this section in discussions on two significant federal acts: The Public Utility Act of 1935 and the Public Utilities Regulatory Policy Act of 1978.

2.2.1 The Public Utility Act Of 1935

Legislation that addresses the structure and organization of electric utilities was enacted in 1935: the Public Utility Act (or the Wheeler-Rayburn Act). This act provides explicit details on how utility companies are to be structured, what kind of accounting procedures are allowable, and the interstate transmission and sale of wholesale electricity. There are two important divisions in this act that are of particular interest here. Title I is known as the Public Utility Holding Act and Title II is known as the Federal Power Act.

Passage of the Public Utility Holding Act occurred in reaction to severe abuses in the use of holding companies by electric utilities in the 1910s and 1920s. The abuses inherent in this consolidation came to light following the stock market crash of 1929, when over 53 holding companies, with combined securities of a par value of $1.7 billion, went into bankruptcy or receivership.[5] Many investors lost substantial amounts of money.

The primary abuses practiced during this period were pyramiding, write-ups, and excessive fees for services. Under pyramiding, a small group of individuals at the top of the organization controlled enormous amounts of investment in an arbitrary manner. In the words of the Federal Trade Commission:

> In such a situation few men could be relied on to devote their attention to prudent management of the operating companies, because the speculative element is so over whelming. It tends, apparently, to make them (1) neglect good

management of operating companies, especially by failing to provide for adequate depreciation; (2) exaggerate profits by unsound, deceptive accounting; (3) seek exorbitant profits from service fees from subsidiaries; (4) disburse unearned dividends, because the apparent gains, so obtained, greatly magnify the rate of earnings for the top holding company; and (5) promote extravagant speculation in the prices of such equity stocks on the exchanges. Such concentration of control, even without that speculative pressure, appears objectionable as a matter of sound national welfare.... Finally, the exaggerated importance to the top holding company of comparatively small differences in the profit of the operating companies greatly enhances the incentive of the holding company to increase such profits, or to obtain a revenue through the extraction of service and other fees in addition to the ordinary revenue by way of dividends.[6]

Excessive write-ups were a closely related abuse. Stocks were greatly watered down and capital assets inflated. Finally, charges of excessive fees by the holding companies to the operating companies (for services rendered) were often unrelated to services supplied. These were hidden costs that were ultimately paid for by the consumers.

Accounting practices of many of the holding companies were shoddy, and the operating companies were financially weakened. For example, depreciation charges were insufficient, dividends were sometimes excessive and paid out of capital, and annual maintenance charges were neglected.[5]

The state PUCs were powerless to control the development and practices of holding companies over the transmission of interstate power. The PUCs were allowed to determine retail rates for services sold to local customers by the interstate companies but were not allowed to investigate the cost of goods and services sold to operating companies if the holding companies were interstate. Most of the largest holding companies were interstate and, thus, were not subject to PUC regulation.[5] Finally, the federal government undertook efforts to stop these abuses with the enactment of the Holding Company Act, which substantially limits both investments by public utilities in other companies and the investment by other companies in public utilities. Regarded as one of the most restrictive laws enacted by Congress, the act defines a holding company as one that owns, controls, or holds the power to vote 10% or more of the stocks for any electric or gas utility. Exemptions to this act are granted under some strict conditions, but even exempt holding companies must operate carefully for fear of losing their exempt status.

Another major control included in the act covers the issuance of new securities. The Securities and Exchange Commission (SEC) was given veto power over the sale of assets by utilities. For example, the SEC must give advance approval if anyone wishes to purchase 5% or more of a utility or holding company's stock. Moreover, before a utility or holding company may purchase securities, assets, or interest in any other non-utility business, the SEC may block these actions unless the transaction promotes "economical and efficient development of an integrated public utility system." The terms of the act block any such transition that may cause "interlocking relations" or the "control of power" that may harm investors, consumers, or the public. The SEC was also given control over payment of dividends and service contracts and was granted power to specify the format and manner of accounting by holding companies and utilities. In addition, the SEC "prescribes a standard set of accounts" for service companies. Under this system, charges are "limited to the costs of services performed; all proposed modifications in service contracts must be approved by the Commission."[5]

In overview, the Holding Company Act serves as a significant barrier to anyone wishing to acquire a public utility and provides the utilities with strong protection against unwanted takeovers. In 1982, seven bills were pending in Congress with a purpose of repealing or amending some sections of this act. These proposed bills (none of which passed) attempted to make it easier for utility holding companies to diversify into non-utility system operations. Many view the Holding Company Act as "obstructive and obsolete...a hindrance to capital formation by financially troubled utilities."[7]

Title II of the Public Utility Act of 1935, known also as the Federal Power Act, provided the Federal Power Commission (FPC) with broad authority over the interstate transmission and sale of wholesale electricity. The FPC's power was later transferred to the Federal Energy Regulatory Commission (FERC), an independent branch DOE, under the authority of Sections 7172(a)(1)(B) and 7293 of Title 42 of the act titled "The Public Health and Welfare." Of interest here are the provisions detailed in Subchapter II that affect electric utility companies engaged in interstate commerce.

One important provision in Subchapter II is contained in Section 824(a), where FERC is directed to "divide the country into regional districts for the voluntary interconnection and coordination of facilities for the generation, transmission, and sale of electric energy...." FERC may order a public utility to establish physical interconnection of its transmission facilities provided it does not impair the ability of the utility to render adequate services to its customers or does not involve an enlargement of generating facilities. Under certain limited circumstances, FERC may also order wheeling of power between

regions.* There is a potential for state governments to impede FERC's efforts to facilitate power wheeling between regions. It is common for large nuclear and coal power plants to be built to satisfy the needs of several states within a region. However, the lack of cooperation from one state may delay or permanently prevent the power plant from operating despite the detriment this may cause to the general region.

FERC was also given authority, under Sections 824(b) and 824(c) of Title II, to regulate (1) the disposition of utility property, (2) any consolidations, purchases, or issuances of securities, and (3) the assumption of any liabilities. These activities are evaluated by FERC to determine if they are consistent with the public interest and do not impair the ability of the public utility to render services.

Another important provision is contained in Section 824(d), where FERC is directed to ensure that all rates and charges are "just and reasonable." Public utilities involved in the interstate sale or transmission are thereby required to file rate schedules for FERC review, and a 60-day review period is required before the utility can change its rates, classification, or service. Automatic adjustment clauses are reviewed every four years to determine whether the clauses (1) provide incentives for efficient use of resources and (2) reflect any costs other than costs that are "subject to periodic fluctuations" or "not susceptible to precise determinations in rate cases prior to the time such costs are incurred."

In addition to the above provisions, the Federal Power Act authorized FERC to conduct several studies (now completed) related to power pooling, wholesale ratemaking, and automatic adjustment clauses. There are also some provisions, described in Section 824(a)(3), that encourage affected public utilities to sell and buy electricity produced through cogeneration and small power production.

Whereas FERC regulates the wholesale rate of electricity transmitted across state lines, the state PUCs determine rates to be charged for retail electricity sold intrastate. This dual regulation has the potential to create a situation known as a "price squeeze." The typical price squeeze situation arises when the seller of wholesale power, normally an investor-owned utility (IOU), competes at the retail level with the purchaser of the wholesale power, usually a municipality that owns little or no generating equipment. If, because of the wholesale price, the muncipality cannot compete effectively at the retail level

*It should be emphasized that these legislative provisions are voluntary. According to the legislative history of the Federal Power Act, as well as the findings of the courts, FERC has no authority to compel a utility to put a wheeling tariff on file that would turn its transmission system into a common carrier.

with the IOUs, it may be the victim of a price squeeze. FERC has provided an affirmative defense against price squeeze allegations. It compares the rates of return that the wholesale supplier earns on its wholesale sales with the rate it earns on its retail rates. If the retail earned rate of return is equal to or greater than the wholesale rate of return, there is no price squeeze. Usually, the difference between the rates of return is a function of time. With FERC setting wholesale rates and the state PUC setting retail rates, it is sometimes difficult for a utility to time its wholesale and retail rate changes to move in tandem.

2.2.2 The Public Utilities Regulatory Policy Act Of 1978

As a result of the nation's efforts to reformulate national energy policy following the Arab oil embargo and subsequent energy shortages, Congress enacted the National Energy Act in 1978. The act is comprised of five major statutes; the one most relevant to electricity-producing public utilities is the Public Utilities Regulatory Policy Act (PURPA). The other four include (1) the National Energy Conservation Policy Act (for promoting energy conservation by providing a variety of assistance programs, incentives, mandatory standards, and requirements), (2) the Powerplant and Industrial Fuel Use Act (which directed the backing out of oil and natural gas use in the generation of electricity), (3) the Natural Gas Policy Act (which completely revised U.S. policies regarding the pricing and regulation of natural gas), and (4) the Energy Tax Act (which provided tax incentives to promote conservation and reduce the nation's dependence on foreign oil and natural gas).

PURPA represents a significant change in utility regulation. It is very comprehensive legislation that requires state PUCs to consider the adoption of 11 federal standards, where appropriate. However, utilities were not required to adopt these measures, only to consider them. The first six of these touch on rate policies and are briefly described below:

1. Cost of Service - prescribes that rates closely reflect the actual cost of services to each class of customer.

2. Declining Block Rates - prohibits the use of this pricing practice unless the utility can demonstrate that costs actually do decrease as consumption increases.

3. Time of Day Rates - encourages utilities to offer these rates unless such provision is shown not to be cost effective.

4. Seasonal Rates - encourages utilities to use this rate when costs are shown to vary seasonally.

5. Interruptible Rates - directs utilities to offer this rate to large customers.

6. Load Management Techniques - directs utilities to use these techniques upon state PUC determination that they are practical, cost effective, reliable, and provide useful energy or capacity management advantages.[8]

The other five standards address the consideration of prohibiting (1) master metering, (2) rate discrimination of any kind, and (3) recovering from rate payers the costs of advertising by utilities for political or promotional purposes. Also specified are the need to consider establishment of "lifeline" rates (providing barely essential services to customers at lower rates) and the need to provide more complete information to consumers on rate schedules.

Other relevant provisions in PURPA include (1) requirements that direct utilities to gather detailed information on costs of service and to report to FERC at least every two years and (2) a requirement that electric utilities purchase power produced from cogeneration and small power producers at the utility's "avoided costs." Section 210 of the act defines this avoided cost as the "incremental cost of electricity." Disagreements have arisen between FERC and the utilities over the exact definition of this concept as it was not clearly described in the legislation. Nonetheless, it has resulted in a substantial boon to cogenerators. When long-term contracts can be obtained from the utilities, cogenerators can secure financing far more easily. Some question whether adding high-cost cogenerated power to the utility's base instead of lower cost base-load generation makes economic sense for the long term. These issues will continue to be debated.

2.3 FEDERAL REGULATION OF NUCLEAR POWER PLANTS

The process of obtaining approvals for constructing and operating a nuclear power plant is elaborate and involves many different government agencies. Although NRC is the authority for the granting of construction permits and operating licenses, a number of other federal agencies also provide review and comment on specific related issues under their jurisdiction that can affect nuclear siting licensing, or construction activities. These include, for example, the Federal Emergency Management Agency, Environmental Protection Agency, Department of Energy, Department of the Interior, Department of Agriculture, Department of Defense, Department of Transportation, U.S. Geological Survey, Department of Housing and Urban Development, Advisory Council on Historic Preservation, Federal Aviation Administration, Council on Environmental Quality, River Basins Commissions, and Great Lakes Basin Commission. The types of issues

covered by these federal agencies vary widely and range from approval of alert and notification systems for emergency planning to various environmental issues such as the impact of a nuclear power plant on land and water. Despite the wide range of issues addressed by this large number of federal agencies, their influence is minor compared to that of NRC.

As might have been expected, NRC's (and its predecessor, AEC's) regulatory requirements grew as the nuclear industry matured and as technical information either changed or redefined the general understanding of public health and safety. Increases in plant complexities, due to a relatively fast scale-up in plant size, and improved technology also had effects on the government's perception of how to best assure public health and safety. These evolving conceptions in turn resulted in new or additional requirements in the form of hardware, procedures, and manpower. Some of the changes were mandated by NRC and AEC; others were self-initiated by the licensees.

The extent and breadth of NRC's and AEC's regulatory influence increased markedly during the 1970s and early 1980s. The industry's growth, both in terms of the greater number of reactors being licensed and the larger size and greater complexity of plants, was only partly responsible for this trend. The accident at Three Mile Island (TMI) was a major cause of more prescriptive NRC regulation.

Much has been written about the adverse effects on utilities of the large number of backfits for nuclear power plant designs and operations issued during the period following the accident at TMI-2. In response to the need for clarifying problems that led up to TMI, studies were undertaken by a number of different parties, including both federal government and industry representatives. These studies produced the Rogovin report and the Kemeny Commission report. Several additional government studies were also undertaken in this time frame to analyze the effectiveness and impacts of NRC regulations. These included NRC's survey of senior utility managers, the NRC Regulatory Reform Task Force report, and the DOE Regulatory Reform Task Force report. These studies generally confirmed the picture of a disordered backfit process, lacking consistent senior NRC management overview, where overall safety benefits were largely unspecified and unquantified, the costs of implementation were not required to be evaluated, and backfits were not sufficiently integrated with other NRC requirements. Other common themes found in these studies include the need to (1) clearly define backfits, (2) issue generally understood and universally accepted standards of safety (a safety goal), and (3) develop clear guidance and criteria for the procedures, people, and analyses required to be involved in a rational and equitable backfit process.[9,10,11,12]

Licensees have cited their experiences with poorly controlled backfits during this period as one of the reasons contributing to higher plant costs, lower capacities, unnecessary complication of plant systems, and ultimately, higher costs to the consumer. Some utilities were also less skillful than others in controlling these increased costs.

Many of the problems with backfitting procedures have been acknowledged by NRC, and several measures to reform the process have already been undertaken or are proposed. In 1982, the Committee to Review Generic Requirements was formed. Procedures were initiated in its charter to bring more order and discipline to the issuance of generic backfits. In addition, in July 1985, NRC voted in favor of a backfit rule that addresses procedures covering both generic and plant-specific backfits. The rule specifies that backfits must result in "a substantial increase in overall protection" of public health and safety. In addition, the rule directs NRC to consider such factors as costs, radiological exposure, operational complexity, NRC resource burden, and differences in plant types before implementing a backfit, and it directs that implementation be the responsibility of the Executive Director for Operations.

In addition to internal administrative changes, NRC has also submitted a licensing reform bill to Congress.[13] The bill has no specific section dedicated to backfitting reforms; however, in several places it contains implicit references to backfitting that direct NRC not to implement a plant modification unless it first determines that the modification "will substantially enhance" the public health and safety by "improving overall safety of facility operation." Moreover, the bill directs NRC to, within 180 days after passage, propose regulations establishing procedures and criteria for implementation of backfits. Even the purpose section of the bill contains references to backfitting procedures by (1) acknowledging the need for stabilizing licensing standards and criteria to assure the finality of NRC licensing approvals and (2) referring to the consideration of economic consequences of its regulatory practices "appropriate and in the public interest."

Aside from backfitting reforms, NRC's bill encourages the development and use of standardized nuclear power plant designs, allows for a combined construction and operating license, and makes allowances for early site approvals. These reforms are considered to be helpful steps in facilitating licensing decisions while still fulfilling NRC's basic mandate of protecting public health and safety.

In summary, NRC's regulatory reach has a substantial influence on utilities operating or constructing nuclear power plants. Quite a few other federal agencies are also involved in the licensing process at some point, but their regulatory influence is less direct than that of NRC's, which is more dominant and

pervasive. Nonetheless, these other agencies contribute to the multiplicity of requirements that licensees must address.

The purpose of this overview is to demonstrate that the focus of NRC's attention has shifted, and the plethora of backfitting requirements, which resulted in many financial and operational problems for utilities in the past, is likely to be less of a concern in the future. Even for backfits that may surface as unresolved safety issues are acted upon, NRC has shown a tendency to be more receptive to industry-initiated proposed solutions. For example, NRC recently endorsed the Institute of Nuclear Power Operation's (INPO's) reactor operator training accreditation program and pledged to refrain from introducing new rules in that area for at least two years. This action reflects NRC's agreement with INPO and the Nuclear Utility Management and Human Resource Committee (NUMARC) to give industry a chance to prove that performance standards from NRC and self regulation can work better than government rules.[14] The success of these industry-initiated efforts will be important. If the industry can demonstrate successful self-policing efforts and if industry performance improves across the spectrum of reactors, this will lessen the need for prescriptive NRC regulations.

2.4 ROLE OF STATE REGULATION

Another key element in the regulatory structure for nuclear utilities is the role played by states and local governments. One purpose of this section is to discuss the history of and basis for state regulatory authority over utilities. Also discussed in further detail are the institutional relationships between the federal and state regulators and how this has led to some conflicts for utilities.

2.4.1 Origins Of State Authority

The state role was defined in the 1930s. State regulatory control over rates charged by utilities was the price utilities had to pay to enjoy the privilege of selling retail electricity under monopoly conditions.* State regulatory powers are derived from the Tenth Amendment to the U.S. Constitution, in which it is defined that powers not delegated to the federal government and not specifically prohibited to states may be exercised by the states. These rights enable states to regulate a number of

*All wholesale power sold interstate is regulated by FERC. Thus, a utility that sells power both within and outside of its state borders will be subject to both state and federal regulatory financial regulation (which may differ significantly) even if its power is derived from one power plant.

different areas such as health, safety, public welfare, and internal commerce.[15] Those powers not delegated to the federal government are characterized as states' "police powers" and represent the regulation by state legislators for the public good. For example, this authority is used in state economic regulation of utilities and in the regulation of land uses (including zoning).

The primary limitation on state use of police powers lies in the supremacy clause, also known as the preemption doctrine. In cases in which federal and state laws conflict, the supremacy clause says that the federal law will override. For the regulation of nuclear power, the Atomic Energy Act of 1954 sets the stage for orderly development and use of atomic energy, and the courts have interpreted this act to mean that the federal government holds exclusive jurisdiction over radiation hazards. Although the states are free to regulate for purposes other than the protection from radiation hazards, the precise extent of permissible state regulation is not clear.[15] States have considerable power in the regulation of non-radiation hazards of nuclear power and for the generation, sale, and transmission of electric power. States are also entitled to participate in site selection for purposes other than protection against radiation hazards.

Other avenues for state regulation include those aspects of a nuclear power plant that share characteristics with other sources of power generation. This includes regulation over environmental matters such as air and water. For example, under the Federal Water Pollution Control Act, states participate by granting water quality certificates and discharge permits.[16] In addition, under authority delegated to them from the Environmental Protection Agency, states can regulate plant non-radiological emissions from power plants.[17]

The states may also supplement these federal statutes with laws of their own and may call hearings and conduct reviews of the impact of nuclear power plants on environmental matters for which they have responsibility. Because of the dual responsibilities over environmental matters by both federal and state governments, some licensees find that they must prepare both federal and state environmental impact statements and prepare for two separate sets of hearings, even though there may be substantial overlap between them. This is especially true for facility siting, in which state, local, or regional government organizations may get involved to protect their interests in areas such as zoning, mining, resource development, and local land-use considerations. Approximately half the states have siting laws, which vary significantly from state to state in their effect on utility siting plans.

Despite the role asserted by states in facility siting, their influence is limited when compared to that of the federal government. The ultimate decision as to reactor siting is controlled

by NRC under its reactor site criteria.[18] These criteria are based on factors relevant to the safe operation of nuclear reactors and include such factors as engineering characteristics of the proposed plant in relation to its site, and site-specific conditions such as the area's meteorology, hydrology, geology, and seismology.

2.4.2 The Public Utility Commissions

The focus of state regulation usually centers on the state Public Utility Commissions (PUCs), which have the responsibility for setting retail rates for the sale of electricity from investor-owned utilities (IOUs). In some states, PUCs also set rates for municipal and rural electric cooperatives.

Other areas in which PUCs may establish authority include the following:

- Standards of Service - Such standards may be established to ensure that utility practices are safe, adequate, and uniform.

- Service Areas - These areas can be defined by the issuance of Certificates of Public Convenience and Necessity (CPCN). Generally, no utility will proceed beyond engineering to construction without a CPCN. These certificates were originally designed to (1) certify that when the facility goes into service, the capitalized cost will be added to the rate base and (2) lay out the boundaries and other service conditions within which a utility proposes or may be required to serve.[19,20] Other factors that may be considered in evaluating a nuclear plant's eligibility for a CPCN are (1) need for power determinations and (2) an alternative fuel analysis. These two determinations are also evaluated at the federal level by NRC, as required by NEPA. Even though the original purpose of a CPCN may have been to allow the state regulators a chance to review the need for a plant, today, its existence in no way guarantees that the utility will be allowed to bring the plant into the rate base.

- Accounting - A PUC often adopts a uniform system of accounting whereby it can keep tabs on the utility's operating expenses and capital investments. A PUC may require the utility to provide it with regular reports on balance sheets and budget estimates for construction.[19,20] On the federal level, FERC has also developed a uniform system for accounting. However, it has no authority for monitoring the specific application of the accounting system utilized by a PUC.

- Issuance of Securities - A PUC may require prior examination and approval before securities can be issued or any major financial reorganizations are undertaken.[19,20] In contrast, at the federal level, the SEC requires that the sale of all publicly held securities be registered with the SEC (under the requirements of the Security Act of 1933). In addition, concurrent jurisdictions exist between some states and the SEC in the area of authorization and approval of utility financing. FERC is involved with securities issuance only in those states where concurrent jurisdiction is not recognized.

- Property Changes - In the interests of assuring that the utility can continue to provide adequate service, the PUCs may require prior approval before a utility conducts a purchase, sale, or major alteration of status of any substantial portion of utility property. This is a check on the utility's continued ability to render adequate service to the public.[19,20] The state governments hold sole jurisdiction in these matters.

- Corporate Relations - Similar to the above condition, a PUC may require prior approval before a utility company makes any major organization change, such as a consolidation or merger, which may lead to changes in corporate control. Moreover, business arrangements, such as leases, services, property sales, etc., may also be subject to PUC review and approval.[19,20] FERC may get involved in some corporate matters once the plant is operational and selling wholesale power; it may even rule retroactively on these issues.

- Procedures - PUCs are granted powers by their state legislatures to establish rules and regulations for carrying out the above functions related to retail sales of electricity. This includes actions such as hearings, investigations, and inspections.[19,20] In contrast, FERC's jurisdiction in these areas is limited to wholesale electric power rates.

Thus, state authority over power facilities is traditionally limited to economic and environmental matters such as the need for power, the type of generating facility to be licensed (e.g., nuclear versus coal), land use, environmental impact, and ratemaking, while federal authority is directed toward safety and security issues as well as federal environmental interests. There is significant overlap between federal and state reviews and approvals and, because serve different interests, considerable conflicts over such matters as pricing can arise. Nonetheless, because PUCs control the retail rate setting, and hence the return on investment, they have significant influence over the

construction projects and operations of investor-owned utilities with nuclear power plants.

2.4.3 Conflicts Between State And Federal Interests

With the large cost increases of nuclear power plants that have been experienced since the early 1970s, state PUCs have become reluctant to allow all costs into the rate base. Increasingly, requests by utilities for higher rates have met with tough scrutiny; PUCs have questioned the prudency of management decisions, both large and small, and have sometimes refused rate increases or stalled their adoption. In addition, various forms of incentive regulation have been adopted that penalize utilities for not bringing plants on line or not keeping them running at high capacity. The PUC's regulatory influence has the potential for conflicting with NRC's regulation of health and safety matters. To gain full appreciation for how these potential conflicts between state and federal regulators may arise and what the implications might be, it would be useful to review the regulatory and institutional structure affecting, and the interactions between, the utilities, PUCs, and federal regulators.

2.4.3.1 The Utility Point Of View

As noted in Section 2.4.1, it is part of the regulatory bargain that utilities agree to provide reliable and sufficient service in their designated area in exchange for a guaranteed monopoly of supply. However, as discussed below, circumstances have evolved that are increasingly making it impossible for utilities to hold up their share of the bargain. The primary factors responsible for this have been the skyrocketing costs of building coal and nuclear plants and the reluctance of PUCs to grant sufficient and timely rate relief.*

A number of factors contributed to the escalation of costs for new nuclear and coal plants. The Arab oil embargo of 1973 initiated major structural changes in electric utility economics. It ignited a full-scale recession with inflation that greatly increased energy and capital costs. Utility costs for buying fuel skyrocketed, and higher inflation contributed to a doubling of the costs of capital. A subsequent reduction in demand growth (due in part to the recession as well as consumer

*Although not specifically mentioned in this chapter, municipally owned utilities and their regulators, the municipal utility boards (or, in some cases, their PUCs), suffer the same dilemmas described in this chapter for IOUs and their state regulators. Henceforth, all references to IOUs and their PUCs are also applicable to municipal utilities and their regulators.

reactions to higher energy prices) lessened the need for near term capacity additions; this required schedule stretchouts that in turn contributed to higher carrying charges. Several years prior to the oil embargo, the growing awareness of the need for protection led to environmental-movement-induced changes in legislation and regulation for protecting the environment. Compliance with these new requirements resulted in capital cost additions as well as greater management and labor costs.

The reduction in demand growth presented further problems for utilities. Lower load growth yielded a smaller-than-anticipated kilowatt-hour base over which to spread costs; this resulted in even greater increases in electricity costs. In addition, utilities had begun to reach the limits of achieving increased efficiencies through economies of scale. In short, there were fewer means left for reducing per-kilowatt costs.

After the accident at TMI in 1979, NRC issued orders for numerous backfits, for both new hardware and revised safety procedures. This contributed to increased investment and operating costs at existing nuclear plants. The frantic pace of backfitting that followed the TMI accident contributed to what many nuclear utilities referred to as an unstable and unpredictable licensing environment rendering future commitments to nuclear power to be extremely risky from a financial viewpoint.

On the other hand, it is now recognized that some nuclear utilities, through inexperience in managing programs as complex and unforgiving as a nuclear power plant, contributed substantially to their plant's cost increases. For example, some utilities did not closely monitor their architect-engineers and other contractors, did little to instill a corporate "culture" that would maintain accountability and responsibility for high standards and quality assurance, and underestimated the differences between building and operating a nuclear plant versus a coal plant. For utilities with these characteristics, construction delays were likely and, subsequently, per unit construction costs were much higher than for other nuclear utilities. Nonetheless, many utilities with well-managed nuclear plants found themselves troubled by external factors such as inflation and regulatory influence, which were generally outside of their control. As a result, utilities owning nuclear plants found themselves struggling, to some extent, with rising costs and the resulting public resistance to recognize the legitimacy of many of the cost increases.

While the utilities were reeling from the impact of multiplying costs, the PUCs began exhibiting resistance to granting rate increases. Instead of submitting for rate increases once every several years, as was common in the 1960s, utilities were going before their PUCs at least every year, or more often, for rate relief. Not only did many of the PUCs have inadequate staff and resources for handling this workload increase, but in many cases, they were also responding to political pressure from their constituents to keep rates from rising. What resulted was

regulatory lag; rate increases could not or would not keep up with utility expenditures for additional fuel and capital costs.

The response of utilities to inadequate rate relief and a perceived unstable NRC regulatory environment has been to minimize capital investments and to cancel plants to reduce company losses from rate suppression. Inadequate rate relief leads to a reduction in a utility's ability to raise cash and lowers its bond ratings. Because of the perceived higher risks, the returns for debt issues (bonds) and equity capital (stocks) must be higher. This raises a utility's cost of capital.

Eugene Myer, Vice President and Director of Finance at Kidder Peabody & Co., explains how declining bond earnings exacerbate the problems of raising external financing:

> Already, declining bond ratings have taken many of the companies into rating levels where some pension funds and some insurance companies are no longer able to hold these securities. They may have to be marked down on the books or the securities may have to be sold at decidedly lower levels than their original value.[21]

This lowers the value of the stocks and increases the utility's costs to raise capital. Not only will it then become more expensive to issue stocks and bonds, but there is also pressure from the credit rating authorities, such as Standard and Poors, to toughen the criteria used to measure utility credit worthiness. Standard & Poor's cites trends for continued cost increases (such as the lack of assurance of future sales growth, and customers seeking alternatives to traditional service -- such as through cogeneration) as reason for making it harder for utilities to raise money.[22]

The rate relief problem is further exacerbated by the refusal of many PUCs to allow utilities to include construction-work-in-progress (CWIP) costs in the rate base. Without CWIP costs, these utilities must use the allowance-for-funds-used-during-construction (AFUDC) accounting method; the latter adds to rate shock because it delays payment for the costs of borrowed money until the plant comes on line. The Financial Standards Accounting Board (FSAB) issued proposed rule changes that, if adopted, would limit the ability of utilities to defer costs and claim profits that have not been realized (these non-realized profits show up in annual reports as profit but, in fact, result from AFUDC earnings). In previous years, this did not cause problems because deferral periods usually spanned only two to four years. However, with construction delays of 10 years or longer:

> ...the amount of expenses utilities defer has grown, thanks largely to the $3 billion to $5 billion being spent on building nuclear plants.... Meanwhile, state regulators are becoming increasingly hesitant to allow utilities to recover their deferred costs within five to 10 years. Indeed with the prospect of nuclear plant abandonments, regulators have raised doubts about whether some utilities will ever be able to recover deferred expenses.[23]

Not only have PUC rulings denying or delaying rate relief had a major impact on utility finances, but an increased tendency in recent years by PUCs to question the prudency of previous management decisions (largely in reaction to plant abandonments, cost overruns, and excess capacity) has also had a significant effect on utilities. A recent study conducted by the National Regulatory Research Institute (NRRI), the research arm of the National Association of Regulatory Utility Commissioners, discusses the likely effects:

> ...where the prudency test is regularly applied, a utility policy of minimal investment in future generating capacity "seems likely to occur unless commissions also provide positive investment incentives or underinvestment penalties." Besides the extremes of underinvestment and potential bankruptcy, other conceivable effects of a rigorous use of the prudence standard are increased capital costs, more formal "arms length" dealings with vendors, higher construction contract bids, increased litigation among parties to a construction project, more detailed record keeping and less technical innovation.[24]

The NRRI report argues that several key issues need to be clarified on the subject of prudency in regulatory law:

> ...state [public utility commissions] in applying the test have concentrated more in setting out the facts of specific cases than on the elements of a prudent decision or on the procedural elements of a prudence inquiry. What still needs to be developed is a well established process for determining what constitutes a prudent decision for utility managers.[24]

In summary, the utility reaction to rising costs, rate suppression prudency hearings, and an unstable regulatory environment has largely been to reduce capitalization plans; forestall planning for future demand by using the lowest cost, short-term planning alternative; and cancel plants. Utilities caught in such binds have begun to confront state regulatory authorities with

the consequences of regulatory pressures. For example, Public Service of Indiana adopted a shareholder's resolution, backed by management, that it will "minimize future capital investments for the purpose of construction of new generating plants until the state of Indiana adopts a better attitude towards construction and shareholders' investments in new plants."[25] While acknowledging that additional generating capacity will be needed in the near future, the resolution states that "the investment of the company shareholders should not be unreasonably put at risk through large capital programs planned to meet such demands."[25] Utilities are also fighting incentive regulation policies of PUCs when such policies are perceived as (1) being inflexible to changing plant conditions, (2) being counterproductive to utility planning efforts, or (3) increasing utility financial risks. Not only do the conflicts discussed in this section pit ratepayers against investors, but as will be discussed in the following section, it is possible that these conflicts may indirectly have negative effects on the safety of nuclear power plants.

2.4.3.2 Independent Regulatory Directives

Under-investment in new power plant construction is not the only serious result that can occur under rate suppression conditions. A more subtle result can also be the reduction of expenditures for plant operation and maintenance. A trimming of expendable operation and maintenance costs is not problematic, but when crucial maintenance is delayed or not conducted at all, in order to save costs, then the question arises "How much does this hurt plant safety?" In a study of declining performance of electric generating units, Dr. Marie Corio of the National Economic Research Associates, Inc., surveyed coal units to find the causal factor of lower performance. The study found:

> ...that if a utility's earnings are squeezed, poor unit performance follows -- although it takes a couple of years for this to become apparent in lower availability and higher costs to the ratepayer.[26]

The study recommended that PUCs not establish incentives that "could backfire and send a utility into a declining cycle of low availability, poor heat rates, high fuel costs, and low returns on investments."[26] Although this study examined only coal plants, these same principles could also apply to nuclear units. Reducing operation and maintenance expenditures beyond a certain point in response to pressures from state regulators to reduce overall operating costs is bound to be counterproductive to measures for improving reliability, quality control, and quality assurance.

State PUC pressure to reduce costs by issuing directives and incentives to get nuclear plants on line sooner or to keep them operating is another possible concern to plant safety. At an October 4, 1984, NRC meeting, two of the Commissioners, Frederick Bernthal and James Asselstine, voiced these exact concerns. At this meeting, NRC voted unanimously to grant a full-power operating license to Union Electric Company for Callaway Unit 1. Union Electric faced a deadline to get its plant into commercial operation, yet the plant had suffered a number of mishaps in preoperational testing that caused delays since receiving its low-power license.[27] The Commissioners voiced concern that such pressures by state regulators could be hurting plant safety.

Another means by which PUCs can exert influence that may possibly result in undesirable safety consequences is to require a nuclear plant to operate at a certain capacity or else face financial penalties. The worse the plant's capacity factor becomes, the more likely a PUC is to try to create incentives for better performance. Public Service of Colorado is fighting such an order by its PUC. The Colorado PUC is requiring that Public Service of Colorado's Fort St. Vrain plant operate at a minimum of 53% capacity for 12 months; if not, then the company would be required to distribute rebates to its 900,000 electric ratepayers.[28] Rulings such as this provide powerful incentives for utilities to comply, with little regard to evaluation of the overall consequences involved, such as its overall and long-term effects on plant safety and reliability.

Another example of a PUC ruling that is possibly harmful to plant performance concerns the California PUC and its proposal for setting rates at the Diablo Canyon nuclear plant. The California PUC is considering using the PURPA-based concept of avoided costs (or basing payments on the economic value of the energy produced) instead of the traditional "cost-of-service" method, whereby the utility is reimbursed for its construction costs. Under the avoided-cost pricing method, "the risk of downtime and below-par operation of a power plant are transferred to its owners, and are not shared by its customers."[29] One of the California PUC's economists estimated that the impact of using this novel rate proposal would be "a $500 million to $3 billion cost disallowance over the life of both units" with the wide range due to "differing assumptions on future fuel prices and capacity needs used in determining avoided-cost rates."[29] Adoption of such novel rate methods would change the assumptions for cost reimbursement under which Pacific Gas & Electric constructed the two Diablo Canyon units. It is not clear whether this rate method would distinguish in any way between costs incurred because of utility mistakes and costs that the utility incurs (1) in its efforts to comply with NRC regulations or (2) to enhance plant safety or reliability.

In summary, the problem facing nuclear-owning utilities is how to set their own standards for assuring plant safety and to also satisfy possibly conflicting regulatory initiatives issued by their state PUCs and NRC. The PUCs, reacting to political pressure from their constituents, attempt to reduce nuclear construction and operation costs, some of which resulted directly from NRC directives, and the NRC issues directives to utilities largely without regard to the economic impacts on operations. The regulatory responsibilities of both parties do not have to be mutually exclusive, but as long as safety and economic regulators continue to operate independently, these possibilities may continue to arise. There are potential safety and quality assurance problems that can arise from these conflicts; these merit serious attention from NRC's licensing staff. NRC's Office of State Programs has a monitoring effort underway to track changing state PUC regulations and their eventual effect on plant safety once implemented. The NRC staff in charge of these efforts occasionally establish informal contact with state PUCs, and their consultants, but do not promote formal and regular communication between the NRC and PUCs where problems of mutual interest could be discussed. NRC's program represents a step in the right direction. However, more formal, regular communication between the NRC's licensing staff and the PUC staff is needed to assure that potential conflicts are identified and alleviated.

2.4.3.3 The Federal Government Perspective

The federal government has vital interests in resolving some of the differences and conflicts between state and federal regulators of nuclear power plants. From the federal government's perspective, a number of key concerns appear to be critical:

- Rate suppression that deteriorates utility financial health and discourages investment may result in supply shortages in the 1990s and beyond. This could result in deterioration of economic growth, and if a solution is not implemented in time, the only way to meet short-term capacity shortfalls is to build smaller, less efficient, generators. In the long term, this will translate into higher costs to produce electricity.

- Continued reliance on foreign oil and purchased power (e.g., electricity purchased from Canada and Mexico) has potentially serious national security implications.

- Future shortages of electricity, and resultant economic impacts, will not be evenly disbursed, but regional, and may result in labor displacement.

- No national grid exists by which regional power could be more evenly distributed. Some areas of the country have access to substantial resources from regional power

pools, but certain areas of the country, such as Texas, are not connected to any regional power pool that could help alleviate potential future shortages in their areas. With inadequate power, jobs and economic growth will be hurt; this effect is likely to occur only in certain regions.

- The financing of plants under construction could have a significant overall impact on the U.S. debt structure. The longer these plants take to be completed, the more severe this impact. While current calculations are speculative, one investment firm estimates that completion costs for all outstanding units could total $40 billion and would have to be raised in the capital markets due to insufficient internal utility cash reserves.[21]

Despite these concerns, the federal government has not yet defined a role for itself in addressing and resolving the conflicts between federal and state regulators. Various parts of these problems may be understood, but there is no organized, centralized approach to the matter.

Unless better coordination can be encouraged, the accusations made between the utilities, NRC, and the PUCs will continue to breed more distrust and to encourage adversarial relations. The battles over who is to pay for nearly completed plants such as Seabrook, Shoreham, and Grand Gulf will continue to rage between ratepayers and stockholders. It is not uncommon for regulators to rule that unless new plants coming on line are "used and useful," they will not be allowed in the ratebase. Some PUCs, such as the Ohio PUC, have ruled that absolutely no amount invested in a plant will be allowed in the rate base unless the plant is used and useful. Another example is a tendency of some PUCs to deny rate recovery if a new plant brought on line results in an excessive reserve margin. The Kansas State Corporation Commission criticized the recently licensed Wolf Creek nuclear plant because bringing the plant on line would result in excess capacity. It proposed only "scanty payback to cover utility investment in the $3 billion plant."[30] Investor wariness and distrust of the capital raising system will continue to cause problems for utilities needing more capital to complete their plants.

In reaction to state regulatory pressures, some utilities that are forecasting a need for power are going to extremes to avoid unfavorable regulatory rulings from their state PUCs by:

- Using privately raised money in place of ratepayer money, Public Service Company of New Mexico is "considering taking part in a power plant venture with General Electric Corp., Bechtel Group, Combustion Engineering Corp.,

and the Navajo Indian tribe. Project officials say four 500,000-kilowatt plants would be located in northwest New Mexico and would sell power to utilities in several western states."[30]

- "Five Iowa utilities recently banded together to form a power dispatching partnership known as Enerex. At first...the partnership will channel existing power supplies among the partners. But in the future... Enerex could be converted into [an] independent power producer, selling power to utilities and sidestepping state regulators."[30]

- Tucson Electric Company "spun off its wholesale sales unit in December, forming a power operation and sales company called Alamito Co. Alamito assumed ownership of one Tucson Electric power plant in Arizona and part ownership of another in New Mexico. The company sells power from the plants to Tucson Electric and San Diego Gas & Electric Co. Shifting Alamito into the interstate bulk power market means the company moves from state to federal regulatory control."[30]

- Nevada's Sierra Pacific Power Company proposed construction of an eight-unit, 2,000,000-kilowatt "energy park" near Wells, Nevada. Such non-utilities as Paine Webber Group, McDermott's Inc., Babcock & Wilcox Co., and Union Pacific Corporation's Rocky Mountain Energy Corporation expressed interest in building the coal-fired project and selling power to out-of-state customers. Sierra Pacific itself might some day buy power from the park, but it would own only a small piece of the project, freeing it from state regulatory control.[30]

These cases illustrate a belief by utilities that new generating plants may receive better treatment during rate-setting procedures from FERC than from their state PUCs. FERC is now experimenting with decontrolling bulk power sales among six southwestern states and plans to extend this experiment to other states. Depending on the outcome of these deregulation experiments, "some industry experts believe utilities will seek federal shelter for future energy projects, thereby avoiding harsher state regulation."[30] This path could result in some relief to utilities caught between federal government-instituted high construction costs and PUC rate suppression.

2.5 SUMMARY

Understanding the roots of regulatory and legislative influences affecting utility construction and operation of nuclear power plants helps to provide insight into how today's nuclear power plant decision-making process became so complex and disordered;

it also helps to describe the restraints within which each of the major institutions active in this decision-making process must operate. Utilities are subjected to delay and higher costs as a result of increasing federal authority (derived from various sources) over their activities. Yet, state regulators are often unwilling to recognize and accept thes additional costs, and many utilities, caught between federal and state jurisdictions, feel trapped. Some utilities, forecasting a need for power, are considering alternative arrangements to bypass traditional regulatory restraints presented by their state PUCs.

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3.0 PREVIOUS RECOMMENDATIONS FOR ORGANIZATIONAL, FINANCIAL, AND OTHER IMPROVEMENTS

Many noted publications addressed the problems inherent in a fragmented U.S. nuclear power decision-making process and offered recommendations for organizational, financial, and other improvements, particularly after the accident at Three Mile Island (TMI) Unit 2 in 1979. The purpose of this chapter is to review these publications for recommendations. These recommendations emphasize changes intended to improve quality assurance in reactor construction and operations, make the licensing process more efficient and effective, reduce costs, enhance service reliability, and improve the industry's health. While these recommendations address improvements to be made by the three major institutions (utilities, Public Utility Commissions [PUCs], and the Nuclear Regulatory Commission [NRC]), none focus on resolving the overall problem of disaggregated interests, incentives, and responsibilities. This subject is covered in Chapter 5.0. Those recommendations that could be generally implemented within the nuclear industry's present structure and within existing regulatory authority are identified. The criteria used to discern whether a recommendation could be implemented in the existing environment is whether it would require new federal or state legislation. Any progress that has been made in implementing these ideas, in whole or in part by the Institute for Nuclear Power Operations (INPO) or other segments of the industry, is also referenced and progress is noted.

3.1 DESCRIPTION AND ANALYSIS

The recommendations are grouped according to which institution would be effecting the change. This resulted in four categories: (1) utility-induced changes, (2) state PUC- and Federal Energy Regulatory Commission- (FERC) induced changes, (3) NRC-induced changes, and (4) Congressionally-induced changes.* The

*Changes requiring Congressional approval are not considered in detail because of a contractual preference for those changes that are possible within the existing legislative structure. However, to provide a broader perspective and for completeness, a small section in this chapter is devoted to listing recommendations that require legislation.

majority of the recommendations focus on changes in NRC's organization. This bias might be traced to the strongly negative reactions from the nuclear industry to NRC's backfitting policies following the accident at TMI. Some of these recommendations for changes in NRC have already been addressed or are under consideration. These were not excluded from this chapter because they help to provide a historical perspective on changes in NRC's policies and organization. Many other recommendations are included that NRC has no control over or that are outside of NRC's scope. For example, some of these recommendations have been included because they help describe the influences that many utilities now face that are significantly affecting their costs, their capability to provide services to electricity customers, and their ability to respond effectively to NRC regulatory directives.

3.1.1 Utility-Induced Changes

Changes that have been recommended for initiation at the utility level are discussed in this section.

1. Utilities should join together to finance, construct, and operate several nuclear units. Management would be vested in a "strong" lead utility with successful nuclear experience or drawn from the designer or supplier organizations.[1]

   COMMENT: This is feasible within the existing structure. This pattern is already evolving and several plants serve as examples. Few utilities are now single owners of large nuclear plants because of the high costs. However, as is discussed in the "lessons learned" section of Chapter 4.0 summarizing major themes brought out in the four case studies, for this recommendation to succeed, the lead utility must manage this operation well. Smaller utilities lacking successful nuclear experience could be overwhelmed if they attempted to take the "lead" utility position.

2. Federal legislation should be passed allowing states to enter into multi-state agreements covering power supply planning, siting, economic regulation, and certification of the need for power. States should be allowed the choice of limiting regional activities to planning only. Planning could be defined to include, for example: electricity demand and supply forecasts, reliability and reserve requirements, increased power pooling and interconnections, and electricity import and export agreements.[2]

   COMMENT: This would require legislative action.

3. An operating consortium should be chartered with the capacity to operate the plants of several utilities on either a contract or receivership basis.[3,4,5]

   COMMENT: This may be feasible without legislation but may require Securities and Exchange Commission (SEC) approval under the Federal Holding Company Act depending on the locations of the operating plants. However, it is IEAL's judgment that the separation of ownership from operational responsibilities and accountability may be undesirable.

4. To improve service, the vertically integrated electric utility industry should be severed into its two functional parts: generation and transmission on the one hand, and distribution on the other. Regional entities could concentrate on building a fully integrated generation and transmission system and realize the large opportunities for savings. A transmission network with common carrier obligations could foreclose redundant, duplicative lines and provide economical transfers of power between regions. Finally, if distribution companies were solely concerned with the ultimate customer, management would devote more attention to the quality of service and consumer needs.[6]

   COMMENT: This would require legislative action.

5. Federal government-owned, regional nuclear power authorities should be established. This would help to get around the gamut of regulatory impediments that require the coordination of state PUCs and many federal agencies such as NRC, FERC, SEC, the Internal Revenue Service, and the Environmental Protection Agency.[7]

   COMMENT: This would require legislative action.

6. A government entity that would finance the construction of nuclear power plants and sell power to existing utilities should be organized. The utility's role would be limited to transmission and distribution of power. The government could use this method to pursue national energy policy objectives.[7]

   COMMENT: This would require legislative action of the sort that created the Tennessee Valley Authority and the Bonneville Power Authority.

7. Utilities should organize so that they have financially independent generation and transmission companies within a holding-company framework. These companies could be initially regulated by FERC and could become participants in deregulation experiments.[8]

COMMENT: This would not require legislative action. Some utilities have already begun to try this option. See Section 2.4.3.3.

8. Mergers among very small utilities should be encouraged to the extent that they facilitate power pooling, coordination, and construction of facilities that take advantage of scale and networking economies.[8]

   COMMENT: This would not require legislative action. Because large nuclear power plants are expensive, many utilities already merge their resources for construction to attain economies of scale.

9. Future contracts for nuclear plant construction should incorporate a reasonable allocation of the risks of cost increases between the electric utilities, their constructors, and their suppliers. This allocation could range from fixed-price contracts for elements of plant construction, to provisions for cost escalation subject to caps or incentive systems. The allocation of economic risks would necessarily be linked to the allocation of responsibilities for managing the project and the ability of parties to control the costs.[9]

   COMMENT: This would not require legislative action. It is widely believed that cost-plus-fixed-fee contracts contributed to cost overruns and to failures of configuration management of some nuclear power plants. However, good contract management is needed with any type of contracting if the end product is to be of high quality.

10. Within each nuclear utility, an office should be created that would report to the chief executive officer and would be the corporate focal point on all matters related to nuclear safety.[4]

    COMMENT: No legislative action would be required. This is being done in some nuclear utilities. It helps focus corporate commitment to the safety of nuclear plants, but it is not a panacea. For example, the Tennessee Valley Authority has had this structure since approximately 1980.

11. Nuclear utilities in the construction phase should establish (where not now in place) strong, in-house nuclear construction program management expertise. With overruns in the hundreds of millions of dollars not uncommon, utilities cannot afford to get involved in the design and construction of a nuclear plant without the ability to at least make informed independent assessments of construction plans and progress. If this in-house capability is not provided, due to inadequate financial resources, contracted-for capabilities should be encouraged.[4]

COMMENT: No legislative action would be required. It is important for nuclear utilities to either have such in-house capability or to contract out if it is not available. In the latter case, however, experience with this option has demonstrated that this is most effective only when the utility can work closely with the contractor and manage its services. Contractors have left utilities without imparting the ability to do the job once the contracted work was completed.

3.1.2 PUC/FERC-Induced Changes

Recommended changes focused exclusively on rate-setting procedures are discussed in this section.

1. The inclusion of Construction Work in Progress (CWIP) in utility rate bases should be allowed.[1,7]

   COMMENT: Some states already allow some or all CWIP to be incorporated into the rate base. In states that do not allow CWIP, legislation would likely be required.

2. Federal government leadership should be provided in the areas of both federal and state actions that, by regulation or order, assure adequate financing over the full period of construction.[1]

   COMMENT: This action would likely require federal and state legislative action.

3. FERC, state PUCs, and regional regulatory entities should consider the adoption of benefit-sharing approaches to rate making designed to encourage utilities to invest in strategies providing reliable supply and energy services at the lowest possible cost over the long term.[2]

   COMMENT: Incentive regulation, designed to reward utilities for good performance or impose penalties if the utility fails to perform to specified standards, is already in place in various states. The results are mixed. Some are designed solely to contain costs and take too narrow a view of the whole picture of nuclear plant reliability. Some people fear that there is a potential to detract from safety if incentives are put in the wrong place (e.g., keeping the plant on line even if it is unreliable.)

4. FERC's authority over wholesale, interstate transactions to individual states or regional regulatory bodies should be expanded, at the option of the state or states involved.[2]

   COMMENT: This would require legislative action.

5. FERC's jurisdiction over interstate wholesale transactions should be shifted to regional regulatory bodies where they exist and when they desire such authority.[2]

   COMMENT: This would require legislative action.

6. Regional regulatory agencies should be established in place of existing state systems.[6]

   COMMENT: This would require legislative action.

7. The system of sliding rate scales (the more purchased, the less cost per unit) should be eliminated; marginal cost pricing should be substituted.[4,8]

   COMMENT: This would not necessarily require legislative action by state PUCs.

8. The National Association of Regulatory Utility Commissioners, the PUCs, and the federal government could develop a program to achieve greater uniformity among states in generic criteria used for regulation of nuclear utilities.[4]

   COMMENT: This would likely require legislative action.

9. Base rates should not be set on historical cost. This bears little relationship to the cost of new equipment.[7]

   COMMENT: As above, changes to rate-base-setting procedures would not necessarily require legislative changes. As mentioned in Section 2.4.3.2, California is considering the use of a rate system based not on historical cost but, instead, on the economic value of the electricity produced. This is a novel, unproven approach for application to large-scale nuclear power plants, and it is unclear whether this will be beneficial to the utility or to plant safety and operations.

10. Federal policy should encourage more power pooling and coordination; it should also develop clear criteria for access to transmission and coordination facilities and for rate payments reflecting true costs.[8]

    COMMENT: This is a feasible policy alternative for the federal government to undertake. NRC is probably not the right federal agency to undertake this task, except as it may require high qualification standards for owners and operators of nuclear power plants. If FERC were to compel utilities to engage in those activities, it would likely be done by attaching amendments to the Federal Power Act.

11. The federal government should be encouraged to experiment with deregulation of wholesale transactions where competitive opportunities are present.[8]

    COMMENT: This is a feasible policy alternative for the federal government to undertake. NRC is not the federal agency to undertake this task.

12. To avoid problems of rate suppression stimulated by political actions of PUC commissioners, those states that elect their commissioners should, instead, consider appointing them for terms at least as long as it takes to build a power plant. Other suggested reforms include: (1) financing PUCs through assessments on utilities in some states, rather than using general tax revenues, (2) providing PUCs with greater autonomy to determine budget size and its expenditure, and (3) assuring higher quality PUCs through higher salaries and standards.[10]

    COMMENT: The management and regulation of nuclear power plants are complex undertakings of significant importance to the public good. If unqualified people are in positions of authority at any level, it is a serious problem requiring prompt action, yet the political difficulties that would be encountered in effecting changes in these systems may be enormous. NRC could investigate the extent to which PUC policies adversely affect public health and safety. If the findings indicate such adverse effects, then NRC could investigate administrative or legal steps that are available for use.

3.1.3 NRC-Induced Changes

Proposed changes to the NRC's organization or activities are described in this section.

1. Many licensees complained that inexperienced NRC staff members were a problem. Allegedly, such staff do not have sufficient appreciation for how a nuclear power plant is constructed or operated, yet they are capable of influencing regulatory policies that greatly affect plant construction and operation. In addition, concern has also been voiced that offices within NRC do not communicate well and sometimes issue inconsistent regulatory directions. As a result of these concerns, several recommendations emerged:

   (i) NRC should establish a policy that practical experience is a requisite for key staff, and that a program should be arranged to make this possible.[3]

(ii) NRC should have a program that provides for planned rotation, or periodic reassignment, of senior staff managers. This would help to ensure that the agency performs as a team and not as an uncoordinated group of competing offices, each unfamiliar with the other's functions and capabilities.[3,11]

COMMENT: Implementation of these recommendations would not require legislation. NRC has attempted to upgrade its staff's training by using simulators and various forms of classroom training and by exercising new hiring practices. Utilities applaud these efforts but claim that they will never equal the value of on-line experience in or around reactors. Interoffice and regional reassignments of personnel have helped to eliminate the problem of parochialism, but management development at NRC deserves careful attention over the long term just as it does in utilities.

2. Strong measures are needed to strengthen the onsite technical capability and management of utilities at reactor sites, including a new philosophy and new program for improved operator training, and new NRC requirements to ensure that qualified engineering supervisors with intimate knowledge of the plant will be part of the onsite supervisory chain on every reactor operating shift. For example, the agency could accredit training institutions for operators and their immediate supervisors. Operators and their supervisors should be required by NRC to pass examinations at the licensing and relicensing stage. This training should not end once the plant becomes licensed, but should be continued and be well integrated with operating experience at individual plants.[3,12]

   COMMENT: Operators are licensed by NRC. NRC's activities to develop a licensing program for other operating personnel are generally on hold pending the outcome of industry initiatives under the guidance of the Nuclear Utilities Management and Human Resources Committee (NUMARC).

3. NRC should place greater emphasis on reviewing the relationship of safety activities to related activities of other agencies. NRC should also be required to establish and explain safety-cost trade-offs. Where additional safety improvements are not clearly outweighed by cost considerations, there should be a prescription in favor of the safety change.[12]

   COMMENT: The NRC policy statement on safety goals represents progress in this area. However, NRC has not had a significant effect on the problems that exist at the federal and state interface and the disincentives that they may create for safety.

4. NRC should be restructured to be headed by a single administrator, who will be accountable to the President and Congress.[3,4,6,12]

   COMMENT: This action would require federal legislation.

5. NRC should establish an oversight committee on nuclear reactor safety. Its purpose would be to examine, on a continuing basis, the performance of the agency and of the nuclear industry in (1) addressing and resolving important public safety issues associated with the construction and operation of nuclear power plants and (2) exploring the overall risks of nuclear power.[12]

   COMMENT: A Nuclear Safety Oversight Committee was created by the Carter Administration. It expired per its own sunset limitations and had little lasting effect. A recommendation for the establishment of a statutory Office of Nuclear Safety headed by a director reporting directly to NRC was offered by Brookhaven National Laboratory to NRC in a November 1984 report (W.Y. Kato et al., "Draft -- An Independent Safety Organization," Department of Nuclear Energy, Brookhaven National Laboratory, Upton, N.Y., November 15, 1984). However, this suggestion has not received wide support within NRC.

6. NRC should institute a quality assurance audit program for NRC regulation. This would enhance public confidence in NRC's quality assurance program. The audit should be conducted by someone independent of NRC. The auditors should be in a position in which they can receive confidential complaints from both inside and outside the agency. One major purpose of the program would be to ensure that regulatory reviews are conducted fairly and according to approved plans and criteria.[11,13]

   COMMENT: The quality assurance program was recently audited by the General Accounting Office and NRC's own Office of Inspector and Auditor, and it is expected that these kinds of audits by outside groups will appear periodically. In addition, the newly passed Backfit Rule, and related staff procedures, will provide additional assurance that regulatory reviews are conducted fairly and according to approved plans and criteria. With regard to internal complaints, the NRC has an active and viable program for differing professional opinions from internal staff.

7. With superior safety built into the plant and operators with a proven record of safety-first performance, NRC should specify performance standards and not impose a "cookbook" of rules and regulations that specify how the operator shall run the plant. The regulatory process for

all new plants should follow the pattern in other nations of stressing respect, cooperation, and performance. The NRC staff for auditing new plants should be made up of people who have experience in nuclear power plants, can recognize and respect the judgments of people in the plants, and yet can come down hard when performance is really inimical to safety.[14]

COMMENT: This could be accomplished without legislative action.

8. The nuclear industry suffers unnecessarily when federal agencies cannot reach agreement on or coordinate their regulatory policies that affect nuclear power plant construction or operation. For example, something needs to be done to simplify the current review and approval process for emergency planning measures used by FEMA and NRC. The current process is subject to abuse, inefficiencies, and financial burdens since FEMA and NRC cannot compel states and localities to adopt their requirements; yet, without their compliance, severe restraints can be imposed on the utility.[1]

   COMMENT: This is a controversial area. NRC and FEMA have tried various approaches to alleviate the problem. Early attention to local concerns and scientifically sound source-term estimates hold some promise for improvement in the long term.

9. Standardized plant designs should be licensed.[3,7,9,15]

   COMMENT: This would not require legislative action. NRC has already licensed several standardized plants, such as the SNUPPS, GESSAR II, and CESSAR System 80 designs. The burden for carrying out this option rests with the industry in that utilities, not NRC, decide to order standard plants. New laws could require standardization, but that is not possible under current law.

10. Nuclear plant sites should be considered and approved in advance of an application to construct a plant.[9]

    COMMENT: This would not require legislative action. Early site approval has been a component of NRC's nuclear regulatory process for some years, and it is also included in NRC's legislative proposals. The practical situation is that utilities and states have not had the need to stockpile any sites for new nuclear plants.

11. NRC should institute backfits only if they provide clearly substantial benefits to public safety and health that are of greater value than costs.[9,12]

COMMENT: This would not require legislative change. NRC has recently passed a backfit rule that adopts this recommendation as policy.

12. The government should institute a one-stage process for construction and operating licenses. This would help to freeze design of the plant during construction. Another idea that would stabilize the regulatory process is the institution of readiness reviews.[3,9,14]

COMMENT: One-step licensing is a component of various configuration management and associated regulatory reform bills mentioned above. Readiness reviews will help to control design changes. A sort of readiness review is being tried on the Vogtle nuclear power plant as a pilot study. Readiness reviews are also being considered for the WNP Units 1 and 3 plants.

13. NRC should change the hearing format to be more like a legislative hearing and less like a formal trial. This could make them more effective and expeditious.[9,16]

COMMENT: It is not clear whether this would require legislative action.

14. Functions of the Office of Inspection and Enforcement must receive increased emphasis, and management of those functions should be improved; for example:[12]

(i) There should be an improved program for the systematic safety evaluations of currently operating plants in order to assess the compliance with current requirements, to assess the need to make new requirements retroactive to older plants, and to identify new safety issues.

(ii) There should be a program for the systematic assessment of experience in operating reactors, with special emphasis on discovering patterns in abnormal occurences. An overall quality assurance measurement and reporting system based on this systematic assessment should be developed to provide (1) a measure of the overall improvement or decline in safety and (2) a base for specific programs aimed at curing deficiencies and improving safety. Licensees must receive clear instructions on reporting requirements and clear communications summarizing the lessons of experience at other reactors.

(iii) The agency should be authorized and directed to assess substantial penalties for licensee failure to report new "safety-related" information or for violation of rules defining practices or conditions already known to be unsafe.

(iv) The agency should be directed to require its enforcement personnel to perform improved inspection and auditing of licensee compliance with regulations and to conduct major and unannounced onsite inspections of particular plants.

(v) Each operating licensee should be subject periodically to intensive and open review of its performance according to the requirements of its license and applicable regulations.

(vi) The agency should be directed to adopt criteria for (1) revocation of licenses, (2) sanctions short of revocation such as probationary status, and (3) any kinds of safety violations requiring immediate plant shutdown or other operational safeguards.

COMMENT: These recommendations were considered and acted upon by NRC in its development of the TMI Action Plan (NUREG-0660).

15. Licensing procedures should foster early and meaningful resolution of safety issues before major financial commitments in construction occur.[12]

COMMENT: No legislative action would be required to implement this recommendation. The current NRC licensing process has failed to address and resolve this problem.

16. NRC should require a periodic and systematic reevaluation of the agency's existing rules.[12]

COMMENT: No legislative action would be required to implement this recommendation. NRC has tried to implement this option several times in the past, but it apparently has been a low priority due to budget constraints.

17. NRC should reduce the inspection frequency of quality assurance reviews and audits and inspections at plants with good inspection records and should increase frequency at plants with poor inspection records.[17]

COMMENT: NRC uses Systematic Assessment of Licensee Performance (SALP) reviews to help target inspection resources in this manner. NRC has also begun to try risk assessment and trending techniques to further improve the application of inspection resources.

18. Before issuing a construction permit or an operating license, NRC should:[12]

(i) Review the competency of the prospective operating licensee to manage the plant and assess the adequacy of its training program for operating personnel; and

(ii) Require plans for the mitigation of the consequences of accidents, including the cleanup and recovery of the contaminated plant.

COMMENT: These recommendations were considered and acted upon by NRC in the development of the TMI Action Plan (NUREG-0660). The industry has largely taken over these responsibilities.

19. NRC should establish and enforce higher organizational and management standards for licensees.[12]

COMMENT: This recommendation was considered and acted upon by NRC in the development of the TMI Action Plan (NUREG-0660). Recently, with NRC approval, INPO and NUMARC have taken the initiative in these areas.

20. NRC should upgrade its operator and supervisor licensing functions.[12]

COMMENT: Congress passed a law to this effect in 1983. It is contained in the Nuclear Waste Policy Act (Public Law 97-425), in Section 306. This section directs NRC to "promulgate regulations, or other appropriate Commission regulatory guidance, for the training and qualifications of civilian nuclear power plant operators, supervisors, technicians and other appropriate operating personnel." In addition, INPO and NUMARC have gained NRC approval to undertake efforts to improve operator and supervisor training as part of their overall programs. These efforts appear to be making progress, but a large number of utility programs remain to be accredited and years will be required to observe if there are improvements. A proposal in Congress to establish a federal training academy for operators, sponsored by Representative Patrick Moynihan (D.-New York), has not obtained sufficient support for passage.

21. NRC should upgrade its safety emphasis by incorporating:[12]

(i) System engineering examination of overall plant design and performance, including interaction among major systems and increased attention to the possibility of multiple failures;

(ii) Review and approval of control room designs (NRC should consider the need for additional instrumentation and changes in overall design to aid

understanding of plant status, particularly for response to emergencies); and

(iii) An increased safety research capacity with a broadly defined scope, including issues relevant to public health.

COMMENT: These recommendations were considered and acted upon by NRC in the development of its TMI Action Plan (NUREG-0660).

22. NRC should implement interim third-party audits (Independent Design Verification Program [IDVP]).[13]

COMMENT: IDVPs were implemented on an interim basis for reviews in the design area for current near-term operating licenses (NTOLs). The Readiness Review Program is expected to incorporate much of the IDVP methodology, except for the third-party aspect, for any new applicants.

23. NRC should improve licensee detection capabilities by developing definitive guidance for utilities to determine root causes of non-performances and to enhance the timeliness of corrective action. NRC also needs to develop definitive guidance for evaluating generic implications of non-conformances found in design and construction processes.[13]

COMMENT: NUMARC has requested that NRC defer action in this area pending the development of industry initiatives.

24. NRC should assign resident inspectors to the site as early as possible, preferably before the issuance of a construction permit and the start of safety-related activities.[13]

COMMENT: NRC has acted upon this recommendation. The timing of assignment and number of resident inspectors for any new project will be evaluated at the time of any new contruction permit application. More resident inspectors are presently being assigned to construction sites.

25. NRC should supplement the regional inspection program with additional use of contractor support for routine regional inspection programs. This will allow NRC staff more time for reactive inspections.[13]

COMMENT: The Inspection and Enforcement Program budget for fiscal year 1986 includes over $1 million in contractor funds that are available for use by the regional offices to supplement technical inspections conducted by the staff.

Contractors with particular expertise are being used as part of the Construction Appraisal Team (CAT), Integrated Design Inspection, and IDVP programs. Based on the generally successful experience of using contractors with particular expertise to supplement NRC staff in these programs, their use in other inspection programs is being considered by NRC.

26. NRC should enhance the pre-construction permit review of an applicant's managerial qualifications, quality assurance program, project team experience, and management's prior nuclear experience. It should use either an independent board/committee that would provide expert knowledge of and experience in plant management, or expand the duties of the Advisory Committee on Reactor Safeguards to advise NRC on the managerial qualification of construction permit applicants.[13]

    COMMENT: This would not require legislative action and has not been attempted because there have been no construction permit applications. In addition, due to NRC budget and resource priorities assigned to operating plants, planned work that applied solely to future plants is not being undertaken.

27. NRC should expand the CAT program until the third-party audit program becomes effective.[13]

    COMMENT: In recognition of INPO's initiative to conduct construction project evaluations, a decision was made to maintain the CAT program at a "one-team" level. Sufficient CAT inspections are conducted at selected sites to provide an overview of the effectiveness of regional construction inspection programs and the adequacy of construction at multi-unit sites. The Readiness Review Program is being evaluated as a method of achieving the results that would have been obtained through third-party audits for future projects.

28. NRC should enhance its vendor and supplier inspection program.[13]

    COMMENT: NRC has taken steps in this direction in the past two years, including reorganization and relocation of its vendor inspection program. These changes have allowed NRC to augment its capabilities for enhancing the evaluation of its quality assurance program implementation and for improving its physical examination of components and services produced and supplied by nuclear vendors.

29. NRC should expand its diagnostic capability and introduce trend analysis. NRC should:[13]

(i) Make conscious efforts to analyze each inspection to determine root causes;

(ii) Develop a set of construction performance indicators to be monitored and evaluated by licensees and NRC; and

(iii) Introduce indicators oriented toward measuring the effectiveness of activities that contribute to, control, and verify construction quality.

COMMENT: A trend analysis pilot program performed in cooperation with a licensee has been discontinued. Instead, the NRC staff plans to support the work of INPO, NUMARC, and others in this area.

30. NRC should expand its practice of conducting senior-level meetings between NRC and utility management to enhance communications.[13]

COMMENT: NRC staff has expanded its practice of conducting senior-level meetings with utility management and has routinized this function in its Systematic Assessment of Licensee Performance program.

31. NRC should apply the Ford Amendment Study (NUREG-1055) lessons to analyze plants under construction to improve NRC's and licensees' diagnostic capabilities and to better prioritize NRC's inspection efforts.[13]

COMMENT: The Readiness Review Program will use the Ford Amendment Study lessons in prioritizing NRC's future inspection efforts.

32. NRC should apply lessons learned in management appraisals to future CAT inspections. Current CAT inspections emphasize hardware inspection and only indirectly touch on management issues; this would broaden its scope.

COMMENT: Present NRC staff plans do not include the implementation of management appraisals as an adjunct to CAT appraisals. There are other ways of conducting management appraisals that are being considered by NRC, including SALP reviews and senior management meetings.

33. NRC should design performance directives for implementing Appendix B of 10 CFR 50. This requires a fundamental shift in the program from compliance to performance. The licensee would develop its own quality assurance manual design to meet NRC's performance objectives. This would substitute for current guidelines in Chapter 17 of the Standard Review Plan (SRP).[13]

COMMENT: Efforts are being made to increase NRC's emphasis on performance as well as compliance. Changes are expected to be gradual and evolutionary.

34. NRC should require post-construction permit demonstration of management capability and effectiveness. Independent third-party audits should be employed, and the licensee would have to show successful implementation of quality assurance/quality control programs.[13]

COMMENT: This recommendation has been dropped by NRC in favor of the Readiness Review Program.

35. NRC should hold management-level conferences with licensees, regarding potential enforcement action, as soon as possible after discovery of a problem. These meetings should be the basis for exchange of information that can be used by NRC in evaluating the appropriate level of enforcement action.[17]

COMMENT: NRC does now hold management-level conferences with licensees as soon as an enforcement item is identified.

36. NRC should institute changes in its backfitting process that would clarify its regulatory procedures to licensees, promote consistency and predictability, and enhance overall plant safety. These changes should include:[11]

    (i) Managers all through the chain of command should be made accountable for reviewers' actions.

    (ii) Backfits should be reviewed for commonality to determine whether there are problem branches or problem reviewers.

    (iii) A precedent value for licensing and backfitting decisions should be established.

    (iv) A process for incorporating individual reviewer interpretations should be established.

    (v) Existing licenses should be reviewed and exemptions from Standard Review Plans (SRPs), Regulatory Guides, and Branch Technical Positions should be selected or modified, as appropriate. (Staff should not demand exemptions from guidance documents because they are not requirements.)

    (vi) The staff's question-and-answer program should be reviewed by NRC. Where standards exist, standard answers should be acceptable, and where possible,

Regulatory Guides should be updated. NRC should also take steps to assure that the Final Safety Analysis Report is read by reviewers before they ask questions of the licensee.

(vii) NRC should direct that the presence or absence of differing professional opinions will not affect a manager's performance evaluation.

(viii) Management and staff should be directed to answer letters and telephone calls in a timely manner.

(ix) Headquarters and regional staff should receive extensive training in the application of the backfit rule.

(x) NRC should establish a code of ethics for licensing practices that should direct staff to avoid the appearance of intimidation in carrying out its responsibilities.

(xi) NRC should direct staff to establish a feedback system to assure that Commission directions on backfitting practices are followed.

(xii) NRC should improve Committee to Review Generic Requirements (CRGR) control over generic backfits by:

- Revising its charter to permit unilateral designation of generic backfits by CRGR, allowing staff 30 days to show cause why the issue is not generic;
- Requiring that plant-specific backfits applying to more than one plant are automatically reviewed by CRGR;
- Directing that staff not use unreviewed Standard Review Plans (SRPs); and
- Assuring that SRPs grandfathered by their charter are reviewed to assure that they have an appropriate basis and are technically sound. (The review should not be conducted by those applying the SRP.)

COMMENTS: Some of these recommendations are satisfied by NRC's new backfit rule. The others are appropriate for consideration by NRC management in the development of procedures to implement the new rule.

37. To enhance its focus on safety, NRC should transfer to other agencies responsibilities for several non-safety-oriented functions, such as:[2,3,7]

(i) Need for power determinations;

(ii) Examination of alternative energy technologies;

(iii) Review of applicant financial qualifications;

(iv) Submitting an Environmental Impact Statement as required by the National Environmental Policy Act; and

(v) Antitrust reviews and granting of export licenses.

COMMENT: These recommendations were considered and rejected by Congress in 1980.

3.1.4 Changes Initiated By Congress

Several recommendations addressed changes that could be made only at the Congressional level. Because these initiatives would require legislative action, no comments are provided, but for completeness, they are listed below.

1. There should be new indemnity proposals that strengthen incentives for safety by incorporating new schemes that vary premiums and liability protection levels related to safety performance of individual utilities and manufacturers and the levels of safety that they build into their reactors.[18]

2. Congress should extend the Price-Anderson Act with a cap on total utility liability.[6,9]

3. The cost of decommissioning and nuclear waste management should be included as current deductibles in federal income tax returns.[1]

4. Congress should impose an excise tax on electricity sales by publicly owned agencies that would be the same percentage of revenues that the private power company would pay in income taxes if it were serving those companies. Congress should reevaluate tax subsidies given to publicly owned facilities and develop clear policy regarding the role that such entities should play in wholesale power markets. If wholesale competition is to provide appropriate incentives that encourage least-cost production of electric power, the public power issue should be settled and public and private enterprises must be subject to the same tax rules and have access to capital markets on the same terms.[6,8]

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4.0 UTILITY CONSOLIDATION OF RESOURCES

The previous chapter focused primarily on solving individual problems of utilities and their federal and state regulators. This chapter provides a more in-depth discussion and analysis of how a number of utilities undertook comprehensive efforts to address economic, management, and safety concerns by consolidating their resources. Nuclear power plants are large undertakings that require superior engineering and management talents; this is the principle motive behind utility consolidations studied in this chapter. As in the previous chapter, the solutions discussed herein focus on resolving problems at a single source, in this case the utility, and do not address the problem of the lack of integration between nuclear utilities and their state and federal regulators caused by differing interests, incentives, and responsibilities.

4.1 DESCRIPTION OF CASE STUDIES

In this section, four cases are reviewed in which public or private utilities have consolidated their resources or have attempted to do so in order to build and operate electric power plants more economically. Each review will describe reasons for consolidation, major events or projects in the history of the consolidated entity, the centralization of management and decision-making authority that resulted, and the level of unanimity achieved among the project participants. Subsequently, lessons learned in each of the four case studies are compared and conclusions are drawn relevant to future utility attempts to consolidate resources. This analysis will focus, in particular, on how well the project participants achieved their initial consolidation objectives and on how factors such as unanimity and centralization of authority affected their success. The four cases studied include (1) Yankee Atomic Electric Company, (2) Northeast Utilities, (3) Washington Public Power Supply System, and (4) Empire State Power Resources, Incorporated.

4.1.1 Yankee Atomic Electric Company

The Yankee Atomic Electric Company was incorporated in Massachusetts in 1954, shortly after Congress enacted the federal Atomic

Energy Act. The company was sponsored by several major investor-owned utility companies in New England for the express purpose of constructing and operating New England's first nuclear power plant, Yankee Rowe. As currently constituted, Yankee Atomic is a jointly owned subsidiary of 10 New England utilities: 30% is owned by New England Power Company, 25% by Connecticut Light & Power Company, 10% by each of Boston Edison Company and Central Maine Power Company, 7% by each of Public Service Company of New Hampshire and Western Massachusetts Electric Company, and the remainder by four smaller investor-owned utilities serving the New England area. As owners of the entire capital stock of Yankee Atomic, these companies are entitled and obligated to purchase the output of the Yankee Rowe plant at operating cost plus a return on investment. Yankee Atomic also established a Nuclear Services Division in 1968, following approval by the Securities and Exchange Commission, which performs services on a cost basis for the Yankee plant and other plants of the sponsoring companies (as described below), and a limited amount of work for profit at other companies.

The Yankee Rowe plant went into commercial operation in July 1961 after 25 months of construction at a cost of $43 million. It is a pressurized water reactor (PWR) with a capacity of 175 MWe. After completion of the project, Yankee Atomic decided to use the same design and construction team to build the Connecticut Yankee plant, a 582-MWe PWR. When completed in 1967, Connecticut Yankee was turned over to the Connecticut Yankee Atomic Power Company, a subsidiary operating company jointly owned by 10 utilities, with Connecticut Light & Power Company (a Northeast Utilities company) in the lead.

Yankee Atomic subsequently built and brought into operation the Vermont Yankee and Maine Yankee nuclear plants, but with different design and construction teams than were used for the first two Yankee plants. Vermont Yankee, a 514-MWe boiling water reactor (BWR), and Maine Yankee, an 825-MWe PWR, went into commercial operation in 1972. Yankee Atomic continues to provide engineering and nuclear fuel services to both plants, which are operated by the jointly owned subsidiaries Vermont Yankee Nuclear Power Corporation (with 13 owner utilities) and Maine Yankee Atomic Power Company (with 11 owner utilities). The lead utilities for these two operating subsidiaries are Central Vermont Public Service Corporation and Central Maine Power Company, respectively.

Yankee Atomic attributes its early success to agreement among the project participants in support of the company's President and founder, William Webster. Webster, who was also the President of New England Power (the lead partner), succeeded in establishing a position of centralized decision-making. The Board of Directors, made up of representatives from each of Yankee Atomic's owner utilities, generally deferred to him on major issues. Yankee's Board continues to have representation from the major owner utilities, as well as from the lead utilities behind the Connecticut,

Vermont, and Maine Yankee plants to which Yankee Atomic provides technical support on a cost basis.

4.1.2 Northeast Utilities

Northeast Utilities is a holding company that was formed in 1966 by the merger of several investor-owned utilities, primarily in Connecticut. Those utilities are now wholly owned subsidiaries of Northeast Utilities and operate the company's non-nuclear generation facilities and distribute electricity. Connecticut Light & Power Company and the Western Massachusetts Electric Company are the largest of several companies that now constitute Northeast Utilities.

Northeast Utilities' first involvement in nuclear power (aside from its participation in the Yankee Rowe plant) was the development of the Connecticut Yankee plant, constructed by Yankee Atomic. The facility is operated by the Connecticut Yankee Atomic Power Company, in which Northeast Utilities has a 44% interest through its subsidiary, Northeast Nuclear Energy Company. Subsequently, Northeast Utilities completed its first wholly owned facility in 1970, Millstone 1, a turnkey 660-MWe BWR, and Millstone 2 in 1975, an 870-MWe PWR. Both plants are wholly owned by Northeast Utilities and operated by its subsidiary, Northeast Nuclear Energy Company. The company also has a 65% interest in the Millstone 3 unit, a 1,150-MWe PWR scheduled for operation in 1986. Millstone 3 is owned by a large group of both investor-owned and municipal utilities, but will be operated by the lead participant, Northeast Utilities, rather than a jointly owned subsidiary, as is the case with the four Yankee Atomic plants.

The consolidation of Northeast Utilities in 1966 was based on the anticipated evolution of the utility industry toward nuclear technology and the need to consolidate human resources to conduct the task. The aggregation of capital also provided greater financial resources to the companies involved and a larger staff for management and operation of generation facilities. Furthermore, the consolidation brought together engineering and operational divisions under one manager. This structural change was perceived to accelerate the decision-making process by avoiding disagreements between the two types of groups, traditionally competing elements, and thereby to ensure that plants would receive the necessary attention. This functional structure has evolved into an increasingly centralized organization over the years and is the basis for management of the Northeast Utilities Service Company, another wholly owned subsidiary providing services to the company's nuclear and non-nuclear generation units.

Following the consolidation of these companies into Northeast Utilities in 1966, each subsidiary company was run by its own Board of Directors, with Board memberships including both company

officers and outside Directors. This structure ensured largely autonomous operation. Each subsidiary kept its own Chairman and President.

The organization evolved gradually over time into a more centralized structure in response to the need for developing common policies and minimizing conflicting interests. The first change of major significance was the elimination of outside Directors from the Boards of the subsidiary companies in 1971. Soon after, individuals began to assume positions on several of the subsidiary Boards at one time (this involved attrition and other personnel moves). By the early 1980s, all of the Boards were made up of the same eleven individuals. Each Director manages a specific program area and holds comparable positions within each company where that program area is active. This helps to avoid conflicts that might otherwise arise if each subsidiary was represented in these decisions by its own manager. The centralized structure is also prominent at the most senior level. The Chairman and President of Northeast Utilities are now also the Chairman and President of each of the subsidiary companies. The other 14 members of the Board of Trustees of Northeast Utilities are not officers of the company, nor do they have any affiliation with the subsidiary companies.

Northeast Utilities initially consolidated in order to increase the resources and experience available to each participating company so that overall operations would improve. The autonomy of each operating company gradually diminished in order to centralize decision-making authority within the company. However, rather than merging all subsidiaries into one large corporation to achieve this, the subsidiary structure was maintained, with separate Boards of Directors. This has offered several benefits in terms of regulatory jurisdictions and financial and legal considerations. For example, the two large generation and transmission subsidiaries operate entirely in separate states, so that each company's rate-setting proceedings are conducted in only one state. The structure also provides advantages in terms of allowed debt-equity ratios and the ability to finance projects.

4.1.3 Washington Public Power Supply System

The Washington Public Power Supply System (WPPSS) is a public joint operating agency created by the Washington State Legislature in 1957. The purpose was to consolidate small and average-size public power districts in the state of Washington into an organization that could take advantage of economies of scale in building large generation and transmission facilities and in using electricity from such facilities.

Although not established specifically for the development of nuclear energy projects, WPPSS undertook a major nuclear energy effort by the late 1960s because capacity shortages were expected

in the 198 s, hydroelectric capacity was already fully developed in the region, and nuclear energy was expected to be cheaper than coal.

WPSS's 17 initial member utility districts varied in size (and in their shares of future projects), but each had equivalent representation and one seat on the Board of Directors. In 1970, the Board voted to establish an Executive Committee, which would more readily reflect members' interests by giving larger utilities greater representation. Seven Executive Committee seats were established representing Seattle, Tacoma, Snohomish County (the largest member district), and one seat for each of four groups of the remaining districts. Members of the Executive Committee would be elected by the Board of Directors.

After the federal Bonneville Power Administration (BPA) forecasted rapid growth in its Northwest market and warned of capacity shortages, WPPSS embarked on a program to develop five large nuclear power plants simultaneously, announcing WPPSS Units 1, 2, and 3 between 1971 and 1973 and WNP 4 and 5 subsequently. This was undertaken with a very small internal staff: under 100 employees as late as 1972, and nearly half of them involved in operation of the two completed facilities. The early development of these plants therefore relied on outside consultants, both managerial and technical, until staffing increased (over 1,000 employees by 1978).

Construction at Hanford of the WPPSS 2 plant, a 1,100-MWe BWR, was begun in 1973, followed by WPPSS 1, a 1,250-MWe PWR also at Hanford, in 1975. Both plants are wholly owned by WPPSS. WPPSS-3 at Satsop, a 1,240-MWe PWR, was begun in 1978. WPPSS has a 70% interest in Unit 3, with four investor-owned utilities sharing the remainder. By the mid-1970s, BPA believed demand would still outstrip supply in the 1980s and, according to a study by the General Accounting Office, supported its customers' participation in Units 4 and 5 and endorsed the need for additional generating units.[1] Units 4 and 5 were undertaken by WPPSS upon the request of BPA's preference customers. Unit 4, a 1,250-MWe PWR duplicate of Unit 1 located in Hanford, is wholly owned by WPPSS. WPPSS also holds a 90% interest in Unit 5, a 1,240-MWe PWR duplicate of Unit 3 in Satsop; the Pacific Power & Light Company holds the remaining 10%.

Although WPPSS represented a consolidation of resources to take advantage of scale economics, the types of plants and their constructors and contractors differed widely as shown below:

	WNP 1	WNP 2	WNP 3	WNP 4	WNP 5
TYPE	PWR	BWR	PWR	PWR	PWR
SUPPLIER	Babcock & Wilcox	General Electric	Combustion Engineering	Babcock & Wilcox	Combustion Engineering
ENGINEER	United Engineers & Constructors	Burns & Roe	Ebasco	United Engineers & Constructors	Ebasco
CONSTRUCTOR	Bechtel	Bechtel	Ebasco	Bechtel	Ebasco

Especially among the first three plants, there was less to be gained from moving the construction team from one plant to another when the plants were not standardized and the construction and engineering teams varied.

In 1978, WPPSS expected a total expenditure of about $8 billion on the five nuclear projects. At that time, the bond issues for Units 1 to 3 were AAA rated by Standard & Poor's and Moody's, while Unit 4 and 5 bonds were rated A+ by Standard & Poor's and A-1 by Moody's. The difference between the two was that BPA's revenues were available as additional security for holders of Units 1 to 3 bonds. (Due to a 1973 revision in Internal Revenue Service regulations, this form of protection was not available for Units 4 and 5.) It was believed that the bonds were well secured in four ways: (1) the "hell-or-high-water" promise of project participants to pay their shares, including debt service, whether or not the projects ever operated (also known as "take-or-pay" contracts); (2) a rate covenant by which participants agreed to raise their rates as necessary to make good the basic promise to pay their share of the projects; (3) the willingness and obligation of participants to increase their payments to WPPSS by as much as 25% if other participants failed to make their required payments (spreading risks among participants); and (4) for Units 1 to 3, the federal government would provide financial protection through BPA revenues if the above methods were inadequate.[2]

For a variety of reasons, construction costs increased substantially toward the late 1970s, and delays were experienced at all five units. With record high interest rates and a very burdensome commitment to bondholders, WPPSS was driven into severe financial difficulties, with cost estimates for the five projects

escalating to $24 billion by 1981.[3] A decrease in electrical demand, following the oil price increases of 1979, further complicated matters as it engendered skepticism over the need for five very large new baseload generating units in the Pacific Northwest. The error of building too much capacity caused the economic penalty of construction cost escalation to be particularly severe. These events shocked the participating companies into the realization that simultaneous construction of five nuclear plants placed too great a strain on their limited resources.

The Washington State Legislature took corrective action in 1980, passing a law to restructure WPPSS's Executive Committee. In addition to the seven members elected by WPPSS's Board of Directors, four new members would be appointed by the governor. Four outside members were appointed to the new Executive Board in October 1981, but all had resigned by January 1982, citing (1) public perception that they had legal authority to take actions that they did not really have and (2) their concern over the potential for legal liability.

Three of the resignations coincided with WPPSS's Managing Director's recommendation to terminate Units 4 and 5, which was later approved by the Board of Directors. Because BPA could not back the bonds for Units 4 and 5 with its revenues, the bonds had to be supported by the take-or-pay contracts with the participating utilities throughout the Northwest. But these utilities were enraged over the prospect of higher electric bills and reneged on their contracts with WPPSS. The Washington State Supreme Court ruled in favor of the utilities in June 1983, claiming that the utilities did not have the authority to enter into the contracts and that, therefore, they did not have to honor them. As a result of the loss of backing, WPPSS defaulted in August 1983 on over $2 billion in revenue bonds that had been issued for Units 4 and 5. In May 1985, the U.S. Supreme Court refused to hear an appeal of the State Court decision by the Chemical Bank of New York, trustee for about 45,000 bondholders.

Many of the lessons learned from the WPPSS experience may have less to do with the structure of the joint operating agency as a consolidated entity than it does with basic principles for sound project management. WPPSS had taken on too large a task in attempting to build five plants simultaneously, and contract oversight by WPPSS staff was inadequate. Other problems experienced may have been a result of limitations unique to public power entities, such as the WPPSS's perceived responsibility to prevent power shortages based on the best available demand forecasts. Still, the manner of consolidation may also offer insights into successful project management. The member utility districts of WPPSS shared the same overall objectives from 1957 until the late 1970s and had confidence in their management. Only when financial troubles developed did participants' interests diverge and

second guessing of management begin. At the least, this demonstrates the need to be conservative in setting investment objectives in order to have greater certainty that all participants will be able to maintain those objectives even if their investment priorities change. Furthermore, it is likely that the diversity of interests among the Executive Board members prevented it from becoming a centralized decision-making authority and that this was part of the reason for state intervention.

4.1.4 Empire State Power Resources, Incorporated

In 1974, the seven largest investor-owned utilities in New York State sought approval from the New York Public Service Commission (PSC) to form and purchase the stock of Empire State Power Resources, Incorporated (ESPRI). They intended to acquire and construct 18,600 MW of baseload capacity in New York State worth approximately $20 billion and to operate the generating facilities through ESPRI. All new construction by these seven companies would be done through ESPRI, which would eventually own all existing plants as well.

The purpose of this proposed consolidation was to segregate new generation into a special type of highly leveraged capital structure. ESPRI would have been 80% debt-financed and 20% equity-financed. The sponsors claimed that this structure would enable ESPRI to raise the capital required for future generating capacity at a lower cost than possible by individual sponsors. They believed that the highly leveraged structure could be achieved for three reasons: (1) ESPRI would sell only baseload power to the sponsors under take-or-pay contracts, (2) the sponsoring utilities would share the risks, and (3) most important, all of ESPRI's costs would be promptly passed through to consumers without regulatory scrutiny, thereby guaranteeing funds for debt service. Additional financial savings could be achieved because a substantial portion of generating revenues would be tax-sheltered.

Non-financial benefits resulting from economies in construction and operation were also anticipated. In particular, a single company building power plants based on state-wide needs could construct the plants sequentially, it was claimed, which would justify the hiring and training of in-house expertise instead of having to use higher cost architect-engineer firms. ESPRI also claimed economies from incremental capacity additions at optimal scale, improved site selection, and greater diversity of fuel choice.

The New York PSC denied ESPRI's petition in 1979 because the guaranteed cost recovery required for the leveraged financing removed competition and incentives for efficiency.[4] The PSC opposed the loss of regulatory review on the grounds that "the cost of risk is borne more properly by investors rather than

consumers, because investors have the flexibility to make investments that diversify risk. Consumers do not have the same flexibility in buying electricity."[4] The PSC opinion found invalid the fundamental financial premise of ESPRI's proposal, that automatic cost recovery would produce vast savings in the cost of capital at only a small regulatory cost. The opinion states that the regulatory cost of the proposal is significant, while its financial benefits are overstated. Regarding nonfinancial benefits, the PSC praised the potential cost efficiencies but stated that these could be achieved by a service company that would construct and operate, but not own, power generating units.

The ESPRI proposal also met a major political obstacle in the PSC's refusal to relinquish jurisdiction over plants in New York to the Federal Energy Regulatory Commission (FERC). This would have been required since ESPRI would sell electricity at wholesale rates to utilities connected with interstate systems. The PSC took the view that its authority to modify expense items is an important incentive to utility management efficiency and stated that "since we remain unpersuaded that the benefits to be realized from ESPRI are substantial, there is no good reason to relinquish supervision at a local level of the cost of electric generation."[4]

In summary, the PSC did not view ESPRI's economics as being favorable to New York State ratepayers. With lower demand projected by the late 1970s, the urgency to find a mechanism to build new plants was reduced. The strategy of the ESPRI sponsors was to seek maximal risk reduction, but it did not realistically consider the need for state control of capacity additions, rate increases, and utility profits. Although the organizational concept proposed was sound, these shortcomings prevented the intended consolidation from being approved.

4.2 Lessons Learned

Several justifications have been presented for consolidating utility resources in the four case studies reviewed in Section 4.1. As a general rule, the decision to consolidate is made when it is felt that economies of scale exist that should be taken advantage of in order to build new plants and meet anticipated increases in electrical demand. Describing the experience of electric utilities through the 1960s, the editor of Forbes Magazine recently wrote that "...the scale economies of power production enabled them to reduce the costs of producing power, and those economies were so accessible that even mediocre managements could partially achieve them."[5]

Instead of building smaller power plants to meet short-term demand in its service area, a small utility can participate in joint efforts to construct larger power plants that will provide service to a wider region. Usually, an individual utility will

undertake to build such a plant on its own only if it has sufficient resources to risk the investment and has a large enough service area to absorb the new capacity in the near or intermediate term. By sharing the ownership of a large-capacity plant and spreading the investment risk, utilities can make incremental additions to their generating capacity at a scale that they consider optimal based on demand projections and their availability of capital. In addition, by pooling their resources, the participants may be able to improve bond ratings and have better access to capital.

The high fixed cost of initially getting into the nuclear power business appears to be another basis for consolidation. This stems primarily from the need to develop a staff with the right capabilities, which differ substantially from those needed for non-nuclear generation techniques. If facing large enough forecasted growth in demand, a consolidated entity can phase in nuclear units sequentially using the same project team from plant to plant. This could justify the hiring of an in-house design and construction staff, a potential cost-saving measure, instead of contracting out for engineering and construction services. The establishment of such subsidiary service companies is a major potential benefit of consolidation.

Other factors provide additional consolidation incentives in different instances. Regulatory affairs could be simplified if the consolidation caused the resulting entity to come under federal rather than state economic regulation (states generally oppose such transfers of jurisdiction). Consolidation could improve the selection of plant sites, increase the diversity of fuel choices, or allow purchasing economies on raw materials and other commodities. Sequential construction of identical generating units could permit each unit to maintain lower spare parts inventories and allow interchangeability of personnel. More important, the opportunity to have the design and construction work teams move from one similar plant to another allows these teams to move up the learning curve and increase their efficiency and competence. The benefits in costs, quality of construction, and time savings can be enormous. This option was not exercised at WPPSS. Finally, as proposed under ESPRI, a leveraged financial structure could potentially provide substantial tax savings. However, if the company was subject to the Public Utilities Holding Company Act (PUHCA), the Securities and Exchange Commission might not allow high leveraging, and if the company was interstate, it would likely be difficult to get an exemption from PUHCA.

How successful have utilities been in achieving these consolidation goals in practice? Is the rate of success dependent on other factors, and to what extent? For example, is a large, shared plant more cost-effective than two or more small, independent plants, or do differences of opinion among project participants cause delays that may outweigh the economies of scale?

The case studies reviewed in this chapter suggest that under the right circumstances, consolidation goals can be achieved successfully by a variety of methods. Yankee Atomic, a jointly owned subsidiary, completed four plants at low cost that have provided reliable power to the participants for nearly a quarter of a century. The Northeast Utilities holding company has achieved similar success in its development and operation of the Millstone reactors, although it is still struggling to complete prudency hearings on Unit 3. In contrast, WPPSS, a public joint operating agency, made egregious errors but might have been an appropriate form of consolidated organization. Similarly, the ESPRI model could be well suited to the needs of some geographic regions, although as presented in New York, it was impractical because of regulatory and political concerns.

One important characteristic in all cases, however, is that the organization created provide a centralized decision-making structure. Although project participants may share the same fundamental investment objectives -- presumably why they decided to consolidate -- centralized decision-making is important to prevent disagreements over specific matters, not related to major corporate policy, from causing costly delays in project activities. In addition, the opportunity to centralize the design, construction, and operation of the plant would also result in major savings of resources. Even in a situation where utilities are sharing the capital costs of a project without any organizational affiliation, such centralization is important and could be achieved if one participant is allowed to assume the lead on the project and make the necessary decisions in a timely fashion. However, the lead participant would have to be a major owner of the plant and have substantial experience and qualifications to undertake a large project, including the ability to manage other share owners and assure their continued participation. The participants with smaller shares of the project would share the same investment objectives and be willing to relinquish the lead of authority in exchange for the chance to own part of the plant, but they would play a more passive role.*6 Failure to provide centralized

*A recent ruling by a FERC administrative law judge introduces uncertainty in this respect. New England Power (NEP) requested a rate increase from FERC in 1982 to recover its $56 million loss resulting from Boston Edison's cancellation of the Pilgrim 2 plant, of which NEP was a 10% owner. The judge scrutinized the 1972 agreement between NEP and Boston Edison over the shared ownership of Pilgrim 2 and found that it gave Boston Edison complete decision-making control over the plant and protected Boston Edison from liability except for severe violations of the agreement. NEP argued that it needed the power and could not have obtained it under any other terms. The judge held that NEP could have rejected these conditions and built its own plant, and denied NEP recovery of the $56 million. The ruling says that joint ventures are inherently imprudent in the regulated utility industry if the minority partner allows the majority owner to take control of the project. The ruling is currently pending resolution by the full FERC.

decision-making could prevent the consolidation goals, such as economies of scale, from being achieved.

The key concern is that the various utility investors continue to share their original investment objectives so that unanimity is maintained on major policy and investment decisions. This is more likely to be achievable if the investors consolidate into one large company with one management as opposed to forming a jointly owned subsidiary, although Yankee Atomic's success is an important exception. Regardless of the manner of consolidation, it would be very difficult to overcome a lack of unanimity on fundamental issues. Several factors could cause division among the participants:

- Changes in electricity demand forecasts for their service areas;
- Changes in interest rates;
- Project cost overruns;
- Environmental opposition;
- Regulatory philosophies toward utilities or specific projects (where applicable);
- Utility philosophies toward regulators (where applicable);
- Allocation of dividends (where applicable); and
- Weight of voter representation on managing boards.

The best means of preventing such factors from causing major rifts among participants is to maintain a conservative investment and management plan that enables participants to continue to have the same investment objectives in spite of such potentially divisive effects. The difficulty arises in predicting the effect of certain external factors. In light of such uncertainties, a utility should not commit to a large share of a facility unless it has strong confidence, based on past difficulties that utilities have faced, that its resources will not be unduly strained, possibly changing its investment priorities, if electrical demand drops, interest rates gain, project costs increase, or other divisive factors come into play. In determining the appropriate level of subscription to a large capital-intensive facility, a utility should make conservative assumptions about growth in demand and interest rates (moderate growth in demand and higher interest rates) and in the accuracy of its cost projections.

These case studies demonstrate that a conservative investment strategy (based on lessons learned) coupled with a superior,

centralized management plan is the best formula for utilizing economies of scale and ensuring that consolidation goals are achieved. More important, a plant that is built and operated by experienced, capable, skilled workers and has strong management is more likely to have fewer quality control problems and should be a safer plant. The WPPSS example reviewed in Section 4.1 had neither of these components. The WPPSS utilities over-committed themselves to an enormous capacity expansion program and did not carefully oversee contractors. The New York State Legislature felt the need to intervene to restructure the organization's managing unit in hopes of correcting a situation already out of control.

A comparison of the regulation of public and private utilities may help explain why WPPSS had some unique difficulties. First, since contract bids are made public by public utilities, these agencies may feel more constrained than do investor-owned utilities to accept the lowest offers. These downward pressures on cost will persist even though most state PUCs do not have the authority to regulate rates charged by public utilities (only 18 state PUCs have this authority).[7] Where the state PUC lacks authority over public utilities, the authority is often vested in a municipal government or other government agency in the form of an elected or appointed board or a city council.

One final factor that may have a large impact on the ability of utilities to achieve consolidation goals is the size of the organization created in the consolidation. While greater resources will allow utilities to make investments that take advantage of economies of scale, it is unlikely that these benefits can be accrued without limit. To determine the optimal organization size, participants should review demand forecasts throughout the region as well as long-term excess capacity margins for each utility. Furthermore, the size of potential participants should be carefully scrutinized so that no sponsor subscribes to a share of new capacity unless it is affordable to them. Based on hindsight, it appears that utilities have often over-subscribed to plant capacity, and part of this enthusiasm may have been based on federal promotion of nuclear technologies coupled with a feeling that state regulators would be sympathetic and provide a safety net through rate increases in the event that overruns occurred. Finally, participants should place priority on ensuring that their long-term investment objectives are similar so that members will be able to achieve unanimity on issues and management will be able to make decisions on behalf of all participants.

The lessons learned from these case studies help to provide insights on how effective consolidation of utility resources can help utilities provide reliable power at reasonable costs and with acceptable economic risks. Nonetheless, even if all utilities were willing and able to take advantage of these lessons, the problems of disaggregated interests, responsibilities, and

incentives between utilities and their state and federal regulators would remain.

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5.0 CURRENT VIEWS ON IMPROVEMENTS IN THE NUCLEAR POWER DECISION-MAKING PROCESS

5.1 OVERVIEW

To obtain viewpoints of nuclear utilities and regulatory representatives on what role the utilities, the Public Utility Commissions (PUCs), and the Nuclear Regulatory Commission (NRC) could play to alleviate some of the strains evidenced by a disaggregated nuclear power decision-making process, IEAL interviewed 14 U.S. utilities, two large architect-engineering firms, five nuclear and/or electric utility organizations, and two public utility representatives. To enhance the candid nature of the material presented, we do not identify by name or organization any of the persons interviewed. The utility representatives interviewed were either top management executives or senior managers one to two layers below the Chief Executive level. They expressed their viewpoints from personal experience and, thus, did not necessarily provide IEAL with official company views.

The utilities ranged from those that have had very favorable experiences with constructing and operating nuclear plants (and were, for the most part, willing and able to share with or sell their services to others) to utilities that experienced varying degrees of difficulties in plant construction or operation. Eleven of the utilities were investor-owned utilities, answering to their state's PUCs, while three were municipal utilities, answering to their municipal utility boards or districts.

5.2 INDUSTRY VIEWS ON PROBLEMS AND POSSIBLE IMPROVEMENTS

The following viewpoints and suggestions, provided by various representatives whom IEAL interviewed, address problems experienced by the industry and offer recommendations of actions that could be initiated by the utilities for resolving these problems.

- The Institute for Nuclear Power Operations (INPO) is well established in setting standards for and auditing operations management and training program certification. It is in the process of establishing standards for auditing construction and construction management.

- The Nuclear Utility Management and Human Resources Committee (NUMARC) is vital to the future of the nuclear industry because the people on its staff have commercial operating experience and decision-making authority. It can provide an effective and uniform view from the industry that will be more effective in representing the industry viewpoint to NRC than will any other nuclear organizations. If NUMARC succeeds in its two-year trial to improve human factors in nuclear plants, it will not only have gained a new measure of self regulation for the nuclear industry, but it will also have raised the standard of performance for some of the weaker utilities to a point of compatibility with the stronger utilities.

- Industry must police itself; self-help can and must work. INPO and NUMARC can be an integral part of this effort. Unfortunately, there is unequal support among utilities for these initiatives. The poorest industry performers, which are in the greatest need of help, are often the most likely to resist INPO's initiatives. If this problem of non-compliance or non-cooperation cannot be resolved, INPO's credibility, from the regulator's viewpoint, suffers.

- INPO's capabilities could be developed to ensure maximum possible reliance on the use of utility self-audits. Subject to NRC approval, the utilities could, with INPO's help and direction, assume some "self-regulatory" responsibilities.

- The fullest development and acceptance of INPO as the utility industry standard setter and auditor by the industry, the regulators, and the financial community is the key to improving nuclear power's financial manageability and acceptance. INPO and NUMARC are vital to the future of the utility industry and its relations with NRC.

- Some utilities expressed strong support for INPO's initiatives. These tended to be utilities that had experienced fewer problems with their nuclear plants and that were very responsive to INPO's suggestions for change. INPO was praised for its high-quality and capable staff. Some utilities expressed a desire for better integration of INPO and NRC; INPO was felt to have better qualified staff, while NRC more clout. Some utilities felt that INPO could be more effectively "used" by NRC. On the other hand, other utilities expressed resentment of INPO's activities implying that they resented the meddling, regulatory-type INPO influence and said they were tired of being constantly reminded of their problems; these utilities were generally not as supportive of INPO's activities.

- Many utilities expressed some reservations about providing voluntary data to INPO that would later be given to NRC; this would be data not ordinarily required by NRC. INPO also has some potential conflicts if NRC wants to adopt into regulation some practice or system that INPO suggested that a utility undertake. This makes INPO more like a regulator and less like an auditor.

- Some utilities with very strong and large nuclear programs are organized to sell their services to other utilities, both domestic and overseas, who do not have the breadth of experience and staff and may be in need of additional resources. These services cover both construction management and nuclear power plant operation. The only perceived limitation on transferring such capabilities is the ability to transform the successful utility "culture" to a utility that maintains a wholly different culture. Other strong utilities with good nuclear records have no intentions of providing services to others, but will help out as part of normal, ad hoc industry practice.

- It is important to remember that some utilities can depend too much on outside help and, subsequently, never learn what operational excellence is. This was a key lesson learned from the accident at Three Mile Island in 1979. When the contractor or consultant leaves a plant, trouble can result, especially if the changes made were not fully supported or understood by plant management. This can be problematic if the plant's management does not or cannot make the necessary changes to enhance its management structure and practices.

- Utility recognition and acknowledgment of its defective operations and maintenance practices are key to industry revitalization.

- The existing utility industry-sponsored organizations, representing various electric, investor-owned, and public utilities (e.g., Edison Electric Institute and the Atomic Industrial Forum), are very useful organizations for (1) exchanging technical, regulatory, and financial information among their members, (2) developing broad, industry-wide policy options and positions, and (3) lobbying the Executive and Legislative Branches. They are less useful in pursuing more narrow, specific objectives and are not organized to initiate specific beneficial behavior or practices among their members. In addition, because of their particular membership structures, these organizations would find difficulties in trying to bridge the gaps between the three primary institutions: the utilities, NRC, and the PUCs.

- A positive, aggressive management culture is essential to a well-run nuclear utility. This management culture must be oriented toward doing things right the first time and must take a comprehensive overall look at problems and their causes. Attention on nuclear plants should be focused from the top down; Chief-Executive-Officer-level support for quality assurance and quality control concepts is essential. Corporate visibility and involvement at the plant site is also a useful means of ensuring strong corporate-to-staff communication, coordination, and commitment.

- It is the utility's responsibility to control and direct the work of its contractors. Some utilities have found success with incentive-type contracts that reward contractors for doing things right the first time and within budget.

- Quality assurance is a critical function. Some plants may have adequate funds for these programs but not the right means for spending it or the qualified management personnel to direct it.

- Quality control people should not report to the plant supervisor but to the corporate level, where responsibility for the entire project rests. Some utilities still have quality control people reporting to the plant. This situation is undesirable.

- Standardized plant designs are highly desirable. One utility with multiple plants of a standard design expressed confidence in larger nuclear units only if they are standardized. Many utilities got themselves in trouble because plants were not standardized; new products were constantly being introduced by vendors. Combined with ever-changing NRC regulatory requirements, it was nearly impossible for even bright, well-intentioned employees to understand the changes going on, much less keep track of the overall effect of these changes on the plant.

- Some utilities noted that they are forecasting the need for additional power within 10 years and, thus, should be planning now for adding capacity, but Chief Executive Officers are holding back due to a perception of insolvable regulatory, financial, and institutional problems that preclude prudent investment in new capital-intensive plants, including both coal and nuclear.

- Several utilities cited the need for smaller, licensed modular nuclear plants (of approximately 600 MW) that can be added incrementally as the need for capacity grows. However, many of these utilities also expressed the need

for standardizing all future plants. There are no modern standardized 600-MW plants that are licensed by NRC; all standard plants are 900 MW to 1,100 MW and all the 600-MW designs are of the earlier generation reactors that nobody would want to build again because of a desire to take advantage of advances in technology that have been made since then.

5.3 THE INTERFACE WITH STATE REGULATORS

The following comments and recommendations address the role of state PUCs or municipal boards in relation to the utilities and NRC. These viewpoints were obtained from the industry and PUC representatives interviewed by IEAL.

- The PUCs need to have better understanding of NRC's functions and the utility's responsibility to comply with NRC's regulations. This knowledge is necessary to assure fair and informed regulatory decision-making on rates.

- Commissioners who do not have to meet any technical background requirements can be unqualified to make decisions affecting the operation of nuclear power plants. In addition, where commissioners are elected, political concerns about reelection can sway decisions toward shorter term, less expensive options even though in the long term it may adversely affect plant safety, availability, or economics. For example, several utilities cited commissioners in their states who publicly stated that they would never vote for granting another rate increase to utilities.

- Free flow of information between utilities and their PUCs is inhibited during rate cases because of the Sunshine Act and ex parte rules. This situation can be very troublesome.

- Once a plant is operating, an investor-owned utility's biggest problem with its PUC is the disallowance of costs resulting from unscheduled (or longer than scheduled) outages, some of which are mandated by NRC.

- PUC policies that penalize utilities if they fail to reach certain capacity factors are shortsighted. A more effective solution would be to help the PUCs establish more realistic goals for performance. PUCs must understand that to raise capacity factors, it is best to set goals for a wide variety of factors such as the number of SCRAMS, challenges to the safety systems, and the heat rate. It would be preferable, for example, to dictate that the forced outage rate must show a year-to-year improvement.

- Some of the smaller, rural utilities are more prone to having problems with their nuclear plants. The Board of Directors tends to be self perpetuating, resistant to new ideas, and slow to incorporate needed changes. Many of these small companies may not have the qualifications to deal with complex nuclear issues. This can create problems for utilities that get in "over their head."

- There is a definite need for more interaction and coordination of ideas between PUCs and NRC. PUCs might help because they have more frequent contact with utility managements and their Board members and can "put economic muscle" behind getting things straightened out.

- When plant maintenance is done correctly, state PUCs can provide better rewards to utilities than can NRC, but PUCs have little familiarity with the issues related to maintenance. Perhaps NRC and the PUCs could work together on this because plant safety and public health and safety rest on high-quality operations and maintenance.

- For future plants, a consensus must be built among utility management, the regulatory community, the financial community, and consumers that the plant is both needed and wanted.

5.4 THE INTERFACE WITH NRC

This section contains comments and recommendations for improvements in the utility and PUC interface with NRC. These viewpoints were obtained from the electric utility and PUC representatives that IEAL interviewed.

- Readiness reviews, which involve incremental checking or incremental acceptance of steps during the nuclear plant's construction instead of having one Construction Appraisal Team review held at the end of construction, were viewed as an excellent joint NRC/industry initiative. This method of review is viewed as a productive step for a utility to facilitate useful cooperation with NRC. This program should be expanded.

- NRC should continue its efforts to resolve the late allegations problem by getting everything out in the open at the beginning of the licensing process.

- Reform of NRC's regulatory practices is not necessarily required. Instead, the utility itself should assume responsibility for its problems and should take an active role in facilitating better relations with NRC.

- NRC requires reporting on a lot of technical items that sometimes imply to the public that a disaster is pending, when in fact, it is not. However, NRC does not volunteer to put these things in perspective. NRC should do this because it has better credibility with the public compared to the utilities.

- Several utilities complained that NRC's senior managers do not exercise sufficient control over their junior, less experienced technical staff. For example, junior NRC staff can go to the Commission with a complaint (so-called whistle-blowers) that can delay a license for six months even when the allegation is false. There is no accountability by these inexperienced people for their actions. Utilities suffer both from loss of public credibility and from the delays in obtaining their license, even if the allegations are eventually shown to be false. They stand accused as guilty and must wait, sometimes for months, until NRC proves their innocence.

- Several utilities cited problems of non-uniformity in interpretation of NRC regulations between the regions and also between regional and headquarters personnel. They complained that there is too much freedom of interpretation by different onsite NRC staff, and appealing an interpretation is too time consuming and costly. For this reason, some utilities deliberately procrastinate complying with a new requirement, waiting for NRC to clarify its interpretations.

- Several utilities cited the high turnover of NRC staff and the resulting lack of appropriate experience as a major problem. These same staff members can force very expensive changes in previously approved designs, procedures, etc., without appreciation for the impact of their actions on utilities.

- There seems to be inadequate cross-function review within NRC, sometimes resulting in uncoordinated regulations. For example, NRC-directed security measures at the Davis Besse plant resulted in operators being unable to gain access to some of the malfunctioning equipment during the July 9, 1985, loss-of-feedwater incident.

- Several utilities cited a continued frustration expressed by their Municipal Utility Boards over never having sufficient depth of justification (for costly NRC decisions) that they can use to explain resulting cost increases to their constituents. Boards felt that their hands are tied, the fixed costs of a nuclear plant are high during outages, and the safety benefits of some of NRC's required outages are not readily identified.

- Some utilities felt that NRC's fines are an ineffective means of control. Fine amounts are not prohibitively high, but the attendant publicity is used as a weapon. NRC should shut the plant down if it feels that the plant is unsafe (as the Federal Aviation Administration does with airplanes) or make the plant operate at partial power (if NRC feels that it would be safe in that condition).

- Several utilities expressed frustrations that NRC does not communicate to the public any differences between safety and non-safety-related matters. This helps to exaggerate public doubts and fears.

- Some utilities said that NRC needs better management controls for the same reasons that utilities are being encouraged to improve their management. One representative of an architect-engineering firm suggested instituting a quality assurance program for regulation. This person reasoned, "we do engineering, procurement, construction, operation and maintenance to approved plans and criteria that are reviewed and monitored to make sure that individual interpretations do not differ from intent. Designs are approved by licensed engineers, welding is done by certified welders, NDE is done by certified inspectors, etc. -- only regulatory review is done on the basis of personal opinion of the reviewer."

- Some utilities commented on what they perceived as an overly legalistic NRC licensing process. One representative from an architect-engineering firm stated that since the role of lawyers in the licensing process has become so much greater than visualized when NRC was chartered, it would seem appropriate to convene an advisory group to review the entire licensing process, in particular to identify and comment on procedures or policies that differ from the basic U.S. legal system (e.g., qualification of professional witnesses and use of precedence).

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 THE NEED FOR CHANGE

The lack of integration in the nuclear power decision-making process has not only created an environment where the institutional and financial risks of building future nuclear plants are unacceptably high, but more important, it has created the potential for conflicts between public safety and economics. The utilities are caught between the Public Utility Commissions (PUCs), which are pressing for cost-reduction measures, and the Nuclear Regulatory Commission (NRC), which has concerns only for the protection of public health and safety and does not account for the economic impact of its regulations. Utilities may find they have to take actions that in the long run could possibly be counterproductive to plant reliability and quality assurance, and thereby to plant safety. The conditions that led to this quandary should, thus, be of great concern to NRC.

6.2 THE SOURCE OF CHANGE

6.2.1 The Utilities

Overall nuclear utility performance in the last decade, from both cost and operational perspectives, has been very difficult for some utilities. The causes of these problems were discussed in previous chapters. The utilities have available resources that can or are being used to restore industry confidence in the nuclear option. Some promising industry initiatives are already underway, but there is more the industry can do and should be doing to help itself.

A limited sample of large utilities that have completed nuclear projects with passable to excellent results suggests that there are some limited assets that could be made available to other utilities. This resource is largely undeveloped. Nonetheless, some of these assets have been marketed by utilities to provide services at unregulated market prices. The primary concern about lending or marketing of assets to another utility is the difficulty in determining if these assets could be successfully utilized in another utility that could have a very different corporate, economic, and political culture. At the present time, the most efficient means of moving assets around continues to be the company-to-company transfer of key personnel within the utility

ustry. The effectiveness of these key personnel is highly dependent on the circumstances of the organizations and projects they are hired to join.

Other means of cooperation, without transferring or marketing personnel and/or services, are also available and could be used to enhance the exchange or sharing of assets. These include, for example, more solid and uniform support of the Institute of Nuclear Power Operations (INPO) throughout all nuclear utilities. This institution presently serves as the keystone of utility initiatives and has been very useful in setting standards of excellence for the nuclear industry. INPO represents industry's efforts to police itself by using audits to pinpoint problems in construction, operations, and management. INPO's capabilities in auditing operations were developed early and succeeded well. More recently, upon request from utilities, INPO also began to provide construction audits.

The Nuclear Utility Management and Human Resources Committee (NUMARC) is another critical utility initiative that should carry forward with its intent to assure the levels of training and accreditation necessary to meet NRC standards. Since NRC has provided NUMARC with the opportunity to prove that an industry-sponsored effort can reduce the need for detailed NRC regulations, the success of NUMARC's efforts is critical to (1) proving that the industry can assume a leadership role in assuring quality of performance and (2) proving that other industry-sponsored programs can displace NRC regulations in other areas outside NUMARC's scope.

It is commonly understood that NRC, cannot successfully regulate quality into a utility. Industry executives recognize that the initiative needs to come from within the utility organization itself. Not only will the utilities need to induce productive changes from within, but to improve their reputation or standing in the view of the public, the regulators and Wall Street, the industry as a whole must also assume responsibility for improving the performance of the weaker utilities. Industry's best opportunity to improve its image today lies in its recognition of the need to promote corporate cultures that are dedicated to high quality and the philosophy of "doing it right the first time." Only when the industry is perceived to be providing the leadership and follow-through necessary for ensuring excellence and quality in all aspects of nuclear power construction and operation will NRC's role and mission of overseeing the protection of public health and safety be able to undertake some fundamental changes. Moreover, if utilities can attain credibility for the prudent management of their nuclear activities, then the PUCs, especially those less affected by political influence, will be able to respond more favorably to rate increase requests.

In summary, the initiative for enhancing the overall performance of integrating a fragmented nuclear utility industry must come from within the industry itself. Industry's overall goal should be to assure effective management and a quality-conscious

corporate culture in all utilities constructing and operating nuclear reactors. Industry self-improvement initiatives already in place, such as INPO and NUMARC, need the fullest support and cooperation from all nuclear utilities. Service companies owned by utilities with good nuclear construction records could market their offerings to other utilities that could benefit from their experience.

Existing utility self-help initiatives appear to have helped, and there could be other areas where this approach could be effective. Additional self-help initiatives could be undertaken by specialized groups such as NUMARC. For example, industry may want to broaden its scope beyond generic human factors issues and perhaps also consider generic hardware issues. Continuing movement in industry self-help initiatives is to be commended and encouraged.

6.2.2 The Nuclear Regulatory Commission

In the triad of utilities, NRC, and PUCs, NRC stands out as the key institution. Since it controls in substantial measure what the nuclear utilities can or cannot do and the costs that will be necessary to comply with its regulations, the concept of instituting changes in NRC is worthy of attention. This may be one of the most efficient means of instituting reforms, since there are so many members in the other institutions.

Economic matters regarding rates are not within NRC's mandate, however, recognition must be given to the fact that adverse and unavoidable financial pressures induced on utilities may have serious side effects on plant performance and safety over the long run. For this reason, NRC should consider the overall economic effects of its regulatory directives; to accomplish this, NRC will need to coordinate closely with the PUCs.

One area in which NRC could initiate useful changes would be to develop a more aggressive program, than that currently underway in its Office of State Programs, that would include coordination and communication between NRC and PUCs on issues of common concern. For example, this could take the form of regular educational workshops for collaborating on ideas and jointly addressing problem issues, similar to NRC's program with its Agreement States. Requiring more formal means of encouraging communication might also be effective. This initiative deserves serious further study.

In its Ford Amendment Report to Congress on quality assurance, NRC recognized that good management is critical to having a well-run and high-quality nuclear utility. However, NRC, a federal regulatory body manned by highly scientific, technical staff, is not especially qualified to detect and analyze management deficiencies or to prescribe solutions to them. NRC could, however, alter its incentive structure so that good performance records are encouraged. A more effective approach might be for NRC to

minimize the regulatory burden by requiring fewer oversight and reporting requirements for the better performing utilities.

There are several possible means that NRC could use to reward good performers. For example, NRC is now considering reducing routine plant inspections for those plants with good performance records. This initiative is highly recommended. NRC might want to undertake a pilot program with three or four of the better performing utilities to test which incentives would be most effective in rewarding performance without sacrificing regulatory review; ample feedback from test utilities would be necessary to make such determinations.

The implementation of regulatory reform measures (such as the backfit rule and regulatory reform legislation), which are designed to bring stability and predictability into the licensing process, should be pursued. Among these reform measures is an effort to standardize plant designs. This is a positive step and is highly recommended. NRC's task of instituting regulatory reform measures will become easier if the utilities are able to build a record of good performance. Stabilizing the regulatory process should help NRC's relationship with industry, and industry's relationships with the PUCs and with Wall Street.

NRC should support and encourage industry self-help initiatives such as INPO and NUMARC. In addition, industry audit and advisory capabilities could by utilized to identify options for reducing the need for detailed NRC regulations. By taking advantage of this capability, NRC could simplify and streamline its regulatory process, which if done effectively, could stimulate less formalized communication between NRC and the industry and enhance the public's trust in the regulatory process.

6.2.3 Public Utility Commissions

PUCs need to consider the long-range economic implications of their regulatory decisions. Regulatory incentives that incorporate the long-range view are often more effective in getting utilities to make changes that resolve the source of the problem; short-range incentives will often address only the symptoms, cause unnecessary financial burdens, further alienate relations with utilities, and may have adverse impacts on overall plant reliability and operations.

Many PUCs have incorporated incentive regulations that are aimed at (1) punishing poor performers, (2) rewarding good performers, or (3) both. Those regulations that aim at the first method but not the second are viewed by utilities as far less effective.

The motivation behind many of the PUC prudency investigations is very political, and it would be impractical to expect these tendencies to wane as long as plant construction (and sometimes operation) costs remain high. The long-held social compacts between PUCs and utilities are apparently not always valid under

today's financial and political circumstances. Unless the utilities, PUCs, and perhaps even NRC can work out alternative arrangements, involving firm and legal agreements (regarding accountability for costs and responsibilities for quality control) before a plant is built, it is unlikely that any utility will risk building another nuclear plant under existing regulatory and economic constraints.

For example, state certification procedures could be reviewed to provide more guarantees that the PUC will allow the approved plant into the rate base in exchange for agreements from the utility to meet certain targets. This concept could possibly be linked with mini-prudency reviews, similar to the Readiness Review concept at NRC, whereby PUCs could provide reviews in incremental stages as a plant is being built.

Finally, to facilitate the above idea, PUC representatives should meet regularly and on a formal basis with NRC to discuss licensing issues of common concern. Confidence in NRC's regulations, issued to assure public health and safety, can be undermined by careless economic regulatory incentives issued by the PUCs, which may not be as sensitive to plant safety concepts. This need not and should not occur. Confidence in a plant's safe operation should enhance the economic outlook for a plant. To ensure that the goals of safety and favorable economics complement instead of conflict with each other, a more formal dialogue needs to be established between NRC and the PUCs.

6.3 RECOMMENDATIONS

On the basis of the conclusions reached in this report, IEAL recommends that NRC should:

1. Support and encourage effective industry self-help initiatives such as INPO and NUMARC.

2. Not try to regulate in matters in which it has little expertise, such as certifying effective means for managing nuclear power plants by utility executives.

3. Continue efforts to stabilize and introduce predictability in its licensing process; this includes a continuation of NRC's efforts to encourage standardized plant designs.

4. Study and implement means of establishing more effective, formal means of communicating with PUC representatives to induce both institutions to work together toward common goals. NRC should aggressively pursue this initiative to put a halt to uncoordinated and possibly conflicting state and federal regulatory directives given to utilities.

5. Continue its initiatives to minimize regulatory burdens on the better performing utilities.

6. Recognize that adverse and unavoidable financial pressures induced on utilities may have serious side effects that could reduce plant safety in the long run. NRC should consider the overall economic effects of its regulatory directives; to accomplish this, NRC will need to coordinate closely with the PUC's.

7. Make better use of industry audit and advisory capability to identify options for more efficient regulation and to ensure protection of public health and safety.

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The problem of the lack of integration in the nuclear power decision-making process in the United States is the subject of this study. The three institutions with the greatest influence on commercial nuclear power generation include the utilities, the Nuclear Regulatory Commission (NRC), and the state public utility commissions (PUCs). The diverse objectives of the three institutions are difficult to satisfy without producing conflict. This has contributed to inefficiences and delays in nuclear plant construction and operation, gaps in quality assurance, and may also result in compromises to public health and safety. This report reviews the perspectives of each of these institutions and provides recommendations for improvements. Particular emphasis is given to recommendations that NRC might consider to help alleviate the potential for adverse impacts on public health and safety resulting from a disaggregated nuclear power decision-making process.

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