© Academy of Management Journal
1988, Vol. 31, No. 2, 235–256.

IMPLEMENTING EXTERNALLY INDUCED INNOVATIONS: A COMPARISON OF RULE-BOUND AND AUTONOMOUS APPROACHES

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This research analyzed how nuclear power plants implemented safety review innovations introduced by the Nuclear Regulatory Commission after the Three Mile Island accident. The findings suggested that nuclear power plants with relatively poor safety records tended to respond in a rule-bound manner that perpetuated their poor safety performance and that nuclear power plants whose safety records were relatively strong tended to retain their autonomy, a response that reinforced their strong safety performance.

Innovations are ideas, formulas, or programs that the individuals involved perceive as new (Beyer & Trice, 1978; Hill & Utterback, 1979; Rogers, 1982; Zaltman, Duncan, & Holbeck, 1973). The stages in their development have been the subject of much scholarly discussion and debate (Rothwell & Zegveld, 1985; Strebel, 1987). A common view is that implementation follows conception, proposal generation, and initiation, and that the factors that facilitate the former inhibit the latter (Duncan, 1976: 172; Wilson, 1963: 200). Rule-bound approaches, which involve central direction and highly programmed tasks, are supposed to promote implementation; that is, the number of routine tasks prescribed from above should increase as an organization moves toward implementation (Wilson, 1963: 198). Conception, proposal generation, and initiation, on the other hand, require fewer controls and more autonomy, because diversity, openness, informality, and the ability to bring a variety of bases of information to bear on a problem need to be encouraged (Duncan, 1976: 174). Duncan suggested that making the transition from conception, proposal generation, and initiation to implementation

The author would like to thank Richard Osborn, Richard Widrig, Clare Goodman, Gene Duvernoy, Larry Crocker, Fred Allenspach, Bonnie Berk, and Mike Wood, who assisted him in carrying out this study. Phil Bromiley helped with the statistical analyses. An early draft was presented at the University of Minnesota Strategic Management Research Center Conference on Innovation in June 1987. Andrew Van de Ven, Bala Chakravarthy, and Paul Lawrence commented on this draft.

This research was supported in part by a major grant from the Organization Effectiveness Research Program, Office of Naval Research (Code 4420E), under contract No. N00014-84-K-0016 to the Strategic Management Research Center at the University of Minnesota. It reflects the author's views only, and no official endorsement by any government agency or private research organization should be inferred.

can be difficult and that the "ambidextrous" organization, adept at moving from stage to stage, is likely to be rare (1976: 167).

Several authors (Burgelman, 1984; Kanter, 1985, 1986; Lawrence & Dyer, 1982; Strebel, 1987) have dealt with the problem of a dominant corporate culture in established firms that is centered around rules that tend to stifle innovation. They suggest that for innovation to occur, spin-offs, independent task forces, and autonomous teams that simulate entrepreneurship are necessary. Their analysis primarily applies to internally generated, opportunity-driven innovation (Andrews, 1971; Bourgeois, 1984; Child, 1972). However, many innovations arise when an unanticipated external threat or challenge occurs.

The insight that crises, dissatisfaction, tension, and significant external stresses play an important role in bringing about innovations is a common one (Bateson, 1979; Crozier, 1964; Cyert & March, 1963; Downs, 1967; Kelly & Kranzberg, 1975; Meyer, 1982; Schon, 1971; Zaltman & Duncan, 1977). Because people are programmed to "focus on, harvest, and protect existing practices" (Van de Ven, 1986: 591), they are likely to resist new practices and programs (Gricar, 1983; Leonard-Barton & Kraus, 1985; Rogers, 1982; Rothman, 1974; Schultz & Slevin, 1975; Sturdivant, Ginter, & Sawyer, 1985; Zaltman & Duncan, 1977; Zander, 1977). To stimulate the introduction of the new practices, disruptive events, which threaten a social system, may be needed. In fact, Terreberry (1971: 69) maintained that innovations are largely a matter of external inducement.

The problems that surface during the implementation of externally induced innovations, however, can thwart technological improvement and distort the innovation process both directly and indirectly (Ettlie & Rubinstein, 1981; Rothwell, 1981; Schwietzer, 1977). Little attention has been devoted to those problems. This study compared the effects of using rule-bound and autonomous approaches to deal with the implementation of externally induced innovations.

THE LITERATURE ON IMPLEMENTATION

A large body of research deals with the problems of implementation. Early case studies (Bardach, 1977; Marcus, 1980; Pressman & Wildavsky, 1974) supported the view that excessive decision-making autonomy during implementation is counterproductive. When numerous decisions have to be made and many participants are involved, the probability of success decreases, and the possibility of unexpected problems arising increases. Critics (Berman, 1980; Elmore, 1979; Lipsky, 1978; Palumbo, Maynard-Moody, & Wright, 1983; Thomas, 1979) of that literature, however, have contended that implementors have a greater knowledge than their superiors of multiple and contradictory demands and of conflicting legal, political, professional, and bureaucratic imperatives at the point of delivery (Rein & Rabinowitz, 1978), that denial of adequate autonomy is likely to affect the disposition of implementors negatively, and that their dispositions are often critical to assuring a policy's success (Edwards, 1980; Van Meter & Van Horn, 1975). According to Fidler and Johnson, implementors can engage in "routine, mechanical operationalization" (1984: 704), which can sabotage or impede successful implementation, if they are not given the opportunity to make modifications that are based on their experience.

Bourgeois and Brodwin (1984: 241–242) identified five models of implementation, including a "commander" model that roughly corresponds to a rule-bound approach and a "crescive" model that roughly corresponds to an autonomous approach. The commander model has a strong normative bias toward central rule-making and enforcement; the crescive model draws on managers' natural inclinations to develop opportunities as they see them in the course of day-to-day management. Bourgeois and Brodwin (1984: 260–261) maintained that although none of the approaches that they identified is correct in all situations, greater use should be made of the crescive model, especially in environments characterized by frequent change (cf. Mintzberg, 1978; Nutt, 1983).

Linder and Peters (1987: 462) summarized the literature on implementation by arguing that two schools, embracing approaches similar to either the rule-bound approach or the autonomous approach, have emerged. The first views implementation problems from the vantage point of a central authority who wants to see subordinates follow rules to carry out his or her policies. The second accepts that people in the lowest echelons of an organization exhibit autonomy by redefining policies during the course of implementation. Rather than a command-and-control perspective, the autonomous approach emphasizes that bargaining takes place and that changes in policies occur during implementation (Linder & Peters, 1987: 462). The autonomous approach is closely aligned to an evolutionary view in which policies unfold rather than being centrally imposed (Majone & Wildavsky, 1978).

Several empirical studies (Beyer & Trice, 1978; Guth & Macmillan, 1986; Maynard-Moody, Musheno, Palumbo, & Oliverio, 1987) have supported the view that autonomy is often needed to facilitate implementation. Beyer and Trice concluded that "if upper management wants better performance [in implementing policy] . . . , it will have to grant . . . more influence in decisions; . . . directors will have to grant more autonomy to their subordinates" (1978: 264). They reasoned that people are unlikely to take responsibility for implementing something new unless they have discretion and are accustomed to taking responsibility. Guth and Macmillan found that if general management imposes its decisions, "resistance by middle management can drastically lower the efficiency with which the decisions are implemented, if it does not completely stop them from being implemented" (1986: 321). Middle managers who believe that their self-interest is being compromised can redirect a strategy, delay its implementation, or reduce the quality of implementation. Maynard-Moody and colleagues found that "empowered street-level workers of decentralized human service organizations play a more substantial role in the successful implementation of social policy than do less empowered workers in highly bureaucratic organizations" (1987: 1).

Only Nutt (1986, 1987) appeared to find mixed support for autonomy. In the innovations he analyzed, upper managers had the highest success rates in installing planned changes in organizations when they justified the need for change and played a critical role in formulating a plan, illustrating how performance could be improved, and showing how the plan would improve performance.

INNOVATIONS IN THE NUCLEAR POWER INDUSTRY

In *Normal Accidents: Living with High-Risk Technologies*, Perrow suggested that a major dilemma in the organization and management of nuclear power plants is how to balance rule-bound and autonomous approaches:

> High risk systems have a double penalty; because normal accidents stem from the mysterious interaction of failures, those closest to the system, the operators, have to be able to take independent and sometimes quite creative action. But because these systems are so tightly coupled, control of operators must be centralized because there is little time to check everything out and be aware of what another part of the system is doing. An operator can't just do her own thing; tight coupling means tightly prescribed steps and invariant sequences that cannot be changed. But systems cannot be both decentralized and centralized at the same time (1983a: 10).

In a paper published the same year as *Normal Accidents*, Perrow (1983b) developed some of the arguments for operator autonomy. He maintained that efforts to centralize authority and to control the actions of operators—reducing their role to passive monitoring so that they no longer have significant decisions to make—end up deskilling the operators and increasing the chances of error. Such efforts encourage low system comprehension, low morale, and an inability to cope with anything but the most routine conditions. Autonomy is needed to encourage a high level of commitment and knowledge. Similarly, Weick (1987: 122–123) highlighted the importance of autonomy but suggested that a balance between autonomy and rules is necessary to achieve reliability in high-risk technologies.

Hypotheses

On the basis of the empirical literature, it appears that the more that managers exercise choice within a situation of constraints (cf. Hrebiniak & Joyce, 1985), the better the outcomes will be.

> *Hypothesis 1: When managers retain autonomy, externally induced innovations will be positively related to the safety of nuclear power plants.*

The concept of self-perpetuating organizational cycles (Masuch, 1985) is relevant here. Masuch maintained that in trying to avoid undesired outcomes, organizations actually can contribute to them. If the prior safety record of a plant is poor, managers will feel that they have little latitude: they have to carry out rules precisely as they have been written. The tendency of nuclear power plant managers and regulators to become more rule-conscious when a plant has had a number of unsafe events may explain rule-bound behavior. On the other hand, if the prior safety record of a nuclear power plant is good, its managers are likely to enjoy increased discretion. Regulators are less likely to intervene in day-to-day decision making, which may partially explain autonomy.

Two cycles are likely to exist in implementing externally induced innovations.

> *Hypothesis 2: Organizations with poor safety records respond with rule-bound behavior, a response that perpetuates poor safety outcomes.*
>
> *Hypothesis 3: Organizations with good safety records retain their autonomy, a response that reinforces their strong safety records.*

Evidence for the existence of a vicious (Hypothesis 2) and a beneficent (Hypothesis 3) cycle comes from an examination of safety review innovations introduced by the Nuclear Regulatory Commission (NRC) at nuclear power plants after the accident at Three Mile Island.

Background on the Three Mile Island Study

The NRC, industry, public interest lobbyists, and academics thoroughly studied the incident at Three Mile Island, one of the worst industrial accidents in history. Some of that work was quite pessimistic about the prospects for safety in the nuclear power industry. Ford (1981), for example, found inertia and unwillingness to change. Perrow (1983a) suggested that accidents were inevitable and that little could be done to prevent them. Many analysts (Perrow, 1983b) attributed what went wrong to human error (Egan, 1982). Apparently, as a result of repeated assurances that the technology was safe, there was a mindset that the equipment was infallible and a preoccupation with the technical aspects of nuclear power, rather than with the human dimensions (Sills, Wolf, & Shelanski, 1982). Institutional and organizational inadequacies were said to have contributed as much to the accident as mechanical breakdowns.

According to investigations of the accident, one of the reasons it took place was that lessons had not been learned from similar events that had occurred at other nuclear power plants (Rogovin, 1979). Even before the Three Mile Island accident, there was concern about an increase in the number of unsafe events at nuclear power plants. The occurrence of such events had outpaced the growth in the number of new nuclear power plants, escalating from about 90 a year in 1970 to more than 3,000 a year in the late 1970s (Del Sesto, 1982).

The NRC introduced independent safety engineering groups after the Three Mile Island accident (Office of Nuclear Reactor Regulation, 1980) to deal with this problem. It proposed that all newly licensed power plants should have such groups in order to learn appropriate lessons and to implement prevention strategies. Neither the nuclear power industry nor the utilities within it sought the introduction of safety review groups; such groups had been thrust upon them by the NRC because of the unfortunate Three Mile Island accident.

This structural innovation, which the NRC developed in revised standard technical specifications, was unique in at least three ways. First, there was a focus on safety incidents and their prevention, that is, on examining safety incidents at the plant involved and at other, similar plants, to discover ways to improve safety. Second, the NRC for the first time proposed that newly licensed nuclear power plants have a full-time safety review staff—the independent safety engineering group—which was to be composed of five engineers (it was unclear why the NRC chose that number). Third, the NRC proposed that the five engineers be independent of nuclear power production; they were to be on-site reporting to someone off-site who was not in the chain of command for power production.

Four dimensions proposed by Beyer and Trice (1978) can be used for assessing the extent of the change in practice that the innovation represented. The new resources required were evidence of the *magnitude* of the task. The safety groups were expensive additions, as the five full-time engineers could cost a nuclear power plant more than half a million dollars annually. The independent safety groups also had a *pervasive* character because, as developed in the standard technical specifications, a group's full-time engineers were supposed to devote exclusive attention to examining safety incidents and to suggesting ways to prevent them. The presence and functioning of a safety group was supposed to make all employees at a plant become more safety conscious. The *novelty* was that safety engineers outside the chain of command for nuclear power production were interacting with operators and production workers and trying to influence their behavior. Clearly, the innovation was extensive.

The only aspect of the safety group's innovativeness that was not evident was its *duration*: how long would the NRC be committed to the innovation in the form in which it was proposed? Soon after requiring that newly licensed plants implement an independent safety engineering group, the NRC initiated a study to review the groups and other safety review procedures at nuclear power plants to determine if safety review groups should be extended to all power plants or if safety review systems at nuclear power plants should be revised in some other way.

METHODS

In analyzing the approaches nuclear power plants took toward implementing independent safety engineering groups, this study used both qualitative and quantitative methods. The NRC establishes standard technical specifications when it regulates nuclear power; individual plants then are allowed to customize those requirements in individual technical specifications that the NRC must approve. The technical specifications of individual power plants and interviews held at some of those plants were used to classify the implementation approaches, which were then related to safety outcomes and other measures of nuclear power plant performance.

The data were collected at the end of 1981, when the United States had 72 licensed nuclear power plants. The accident at Three Mile Island took place in April 1979. After numerous reports about the accident had appeared, the NRC established the safety review group requirement in September 1980 (Office of Nuclear Reactor Regulation, 1980). To add the five full-time engineers the requirement mandated necessitated a long lead time because of shortages of skilled people in the nuclear power industry. Moreover, the adjustment of nuclear power plants to the post-Three Mile Island situation was long and complex because of the many other changes that the NRC required: the Three Mile Island Action Plan had over 100 items. This research took place between September 1981 and September 1982 and reflected the state of implementation at that time.

In carrying out the research, a team of analysts and I compared the administrative sections of the technical specifications of 24 nuclear power plants with the administrative section in the NRC's standard technical specifications. The six plants that had been licensed after Three Mile Island were chosen for close scrutiny, as were 18 other randomly selected plants. Through the mediation of the NRC, we conducted interviews at 13 of the 24 plants whose technical specifications we had examined. The interviews confirmed the impression of rather slow adjustment by plants in the post-Three Mile Island period. They also showed that in many cases the technical specifications were incomplete or inaccurate. Thus, the interviews provided a check on the technical documents, and the analyses reported here are confined to the 13 plants for which interview data were available. Six of those plants were licensed after the accident and seven were licensed before it.

The plants were located in the eastern, midwestern, and southern United States. They had different reactor types (pressurized water or boiling water), reactor suppliers (Westinghouse, Babcock and Wilcox, or General Electric), architectural engineers, dates of initial commercial operation, and electrical power generating capabilities. The utility systems to which they belonged differed in their structure, size, and profitability.

Three days were spent at most of these facilities, with visits to both the corporate office and the plant site. To assure objectivity, interviews were conducted by a team that included me and at least one person with a disciplinary background different from mine. Usually that person was an engineer with some nuclear power training. In most cases the members of the team did separate interviews. We carried out 80 open-ended interviews with safety review staff members at 13 plants between February and September 1982.

Questions were posed about why a particular method of safety review was chosen and how that method of safety review operated (see the Appendix). The questions covered the pre-Three Mile Island requirement that plants have plant and corporate safety review groups as well as the post-Three Mile Island requirement that newly licensed plants have an independent safety engineering group. As the interviews were designed as a check on the document analysis, they followed the format of the technical specifications, with questions about the rationale, mission, composition, major tasks, processes, output, and workflow relations of the safety review groups at a nuclear power plant. Although the questions were standardized, with their precise sequence and wording determined in advance, interviewers were encouraged to probe for additional responses and to obtain other types of feedback when appropriate.

Variables and Measures

On the basis of the document analysis, the interviews, and the other information that was available, I developed the following measures.

Implementation approaches. I relied on the documentary record and the interviews to construct a typology of implementation approaches. The primary distinction I made was between *rule-bound* behavior, operationally defined as compliance with the standard technical specifications, and *autonomy*, defined as customizing those guidelines through the adoption of unique, plant-specific characteristics.

To ensure coding reliability, I had at least three members of the research team play a role in the analysis. They independently classified the safety review systems of the plants they had visited on the basis of the documents examined and the interviews conducted. The documents were primarily the technical specifications, but during the site visits safety review staff often volunteered additional documents.

As a further check on this analysis, two steps were taken. First, I shared our classification of the plants with the NRC officials responsible for the independent safety group program. Second, I showed copies of the classification to the safety review staff members who had been interviewed. As Patton (1980) remarked, analysts can learn a great deal about the accuracy of their findings from their subjects' comments. Those checks indicated that there was a consensus among the nuclear power plant staff members, the analysts, and the NRC about the classifications made.

Safety outcomes. Reports of unsafe events, which the NRC receives in the form of "license event reports," are one of the main methods that nuclear power plants and the regulatory agency have for assessing safety.[1] Events attributable to human error, such as failure to follow a procedure, constitute anywhere from a third to a quarter of the total number of reports. Significant events involve serious deficiencies in major safety-related systems because of which the NRC may require that a nuclear power reactor be shut down. The main safety outcome that I used was the number of unsafe events attributable to human error that occurred in 1982. I assumed that events occurring in 1981 came before the implementation of the new safety review systems and that events occurring in 1982 came after implementation. Comparable records for the total number of human factor and the total number of signifi-

[1] See Osborn and Jackson (1987) and Olson, McClaughlin, Osborn, and Jackson (1984) for a discussion of license event reports and other methods of assessing nuclear power safety.

cant events in 1981 and 1982 were not available, because in the interval the NRC changed the way it defined those categories.

Other performance measures. There are drawbacks to using license event reports as a measure of safety. Some plants tend to report events more readily than others, and differences in amounts of on-line time and other operational features can affect a nuclear power plant's susceptibility to events. Because of those limitations, I examined other performance measures as well. The NRC has selectively assessed the management capabilities of nuclear power plants on the basis of various criteria. According to those assessments, if a plant is given a rating of 1, it means that management attention and involvement are "aggressive"; a rating of 2 means that management attention and involvement are "adequate"; and a rating of 3, that "weaknesses are evident." Those criteria, which do not depend on self-reporting by the plants, may be less prone to manipulation by plant managers than are license event reports. However, they are highly subjective inasmuch as they depend on the impressions formed by NRC staff members during fairly brief site visits. The NRC is aware of that limitation and, largely for that reason, has discontinued the management assessments. I, therefore, relied primarily on the license event reports and used the management ratings only in a supplementary fashion.

To correct for different amounts of on-line time and other operational features that can affect the number of events a plant has, I examined 1982 plant capacity ratings. Capacity ratings show the percentage of electric power that a nuclear power plant has generated in a particular period in comparison with the amount that it could generate given its overall capacity. This indicator is very important to nuclear power plant managers, and some even have instruments on their desks that provide them with up-to-the-minute reports of their progress.

Capacity ratings have significance for two reasons. First, a plant can have few events because it has been shut down for a significant period of time; that can occur because of technical problems, or it can be the result of a reduced demand for power. If a plant has been shut down for a long time, it will show up in low capacity ratings. The second reason for examining capacity ratings is that variations in the number of events can occur because of trade-offs that nuclear power managers make among different measures of performance. Conflict among competing performance goals has been noted by many scholars (Cyert & March, 1963; Dill, 1965; Miles & Cameron, 1982; Sonnenfeld, 1982). Safety can be jeopardized to increase productive efficiency, or productive efficiency can be sacrificed for the sake of safety. If a plant has sacrificed safety, a higher capacity factor combined with a lower safety rating may result.

Controls. Other factors besides the implementation approaches may have caused the variations in outcomes that occurred. I therefore introduced the following control variables into the analysis.

Age. Plants that were newer in terms of years of commercial operation in 1982 may have had more safety events because of start-up problems. Also newer plants may have had more violations because the NRC tends to impose additional rules over time. However, older plants may have had difficulties because of equipment obsolescence and maintenance failures.

Profitability. Utilities that were profitable in terms of return on equity in 1981–82 may have had the resources to be able to pay for increased safety; on the other hand, less profitable utilities may have had to make sacrifices to maintain plant safety.

Size. A large commitment to nuclear power, measured by net megawattage of operational nuclear capacity in 1982, may have meant possession of the overall technical resources necessary to run fairly safe plants; but a small commitment may have meant less bureaucracy and more flexibility and therefore an ability to manage nuclear power plants more safely.

Long-term debt. High debt measured as long-term debt in 1981–82, may have meant high spending on staff and other items related to safety, or it may have meant that a utility had little slack to pay for safety.

Analysis strategy. To determine if there were significant correlations between the two approaches to implementation and the other variables, an intercorrelation analysis of all the variables in the study was carried out. For Hypothesis 1, I compared the safety and performance outcomes of plants having rule-bound and autonomous approaches. To test for the significance of the differences between means, t-statistics were computed.

For Hypotheses 2 and 3, two determinations were necessary. (1) Did a plant's prior (i.e., 1981) safety record influence its implementation approach? (2) Did the implementation approach then affect the number of safety events attributable to human error in 1982? A probit analysis was necessary to test whether a plant's prior record affected its implementation approach because the dependent variable is dichotomous, with the approach either rule-bound or autonomous. To test whether the implementation approach affected subsequent safety outcomes with age, profitability, size, and long-term debt controlled for, I conducted a series of regression analyses including prior performance and, because of the small number of degrees of freedom available, various combinations of the other control variables.

RESULTS

Implementation Approaches

I classified five plants as rule-bound and nine as autonomous. Because some plants were required to have an independent safety engineering group and others were not, the types of responses classified as rule-bound were: (1) Two plants had engineering groups exactly like those the NRC proposed. The NRC's standard technical specifications matched precisely what these nuclear power plants had adopted. This response was called obedience. (2) Plants licensed before the Three Mile Island accident did not have to have an independent safety group or equivalent. For those plants, rule-bound behavior meant doing what the NRC expected and little more; with very minor exceptions, their technical specifications precisely matched the applicable

NRC standards. To the extent that they modified their behavior after the Three Mile Island accident, they created subcommittees as appendages to their part-time safety groups (two plants) or added a single full-time safety review position (one plant). This response was called incremental adjustment (cf. Lindblom, 1959; Quinn, 1980).

These responses were classified as autonomous: (1) Some plants licensed after the Three Mile Island accident were in the process of creating a corporate nuclear safety review department with responsibility for both off-site review and on-site safety engineering. The head of this department had vice-presidential status and reported directly to a top utility executive. Because the purpose of this new safety review component was to build an entirely different type of organizational structure to achieve the intent of the NRC's guidelines, we labeled this response (found at two plants) modification.

(2) At two other plants the existing quality assurance function was combined with safety engineering. Managers at these plants decided on their own to add the five full-time safety engineers to their existing quality assurance staff. Doing so altered the nature of what the NRC intended. The distinction the NRC was trying to make was between the "policeman" role that quality assurance traditionally performed and the ability to challenge existing procedures that the independent group was supposed to carry out. This response, therefore, was called combination.

(3) Significant planned and actual alterations of safety review systems at plants licensed before the Three Mile Island accident were not required. When such plants made these changes, they were acting on their own initiative, in response to what they believed to be the lessons of the incident. Some of the plants planned for adoption of a safety review system, taking comprehensive steps to consider what they might do. Two plants, for example, did detailed studies that would have created an entirely different type of system. The proposed technical support group that they intended to create would have aided existing review groups as well as having responsibilities of its own. Partial staffing had started, even though implementation was not obligatory, with full staffing taking place only if an independent safety engineering group or equivalent were mandated. This response was called planning.

(4) A different response was to create a group like an independent safety engineering group that was the equivalent of what the NRC proposed, not because the NRC required it, but because management believed that such a group was necessary. To the extent that these plants complied with the NRC's proposal, they did so voluntarily, taking the initiative, and did not act because of NRC pressure or fear of NRC disapproval. The response of these two plants was called anticipation.

Obedience and anticipation. Although it is not possible to take full advantage of the qualitative analysis because there was so much material (cf. Marcus & Osborn, 1984), a revealing comparison summarizing some of the major differences between obeying and anticipating plants can be made. At the two plants that obeyed, the offices of the independent safety engineering group were located in a temporary structure in the parking lot, and group members had to obtain visitors' badges before entering the plants. The plants' staff maintained that the safety group's role had not been well defined, that it did not fit in with existing practices, and that it was not likely to have a major impact. The safety group was making many recommendations, but the plants were not adopting those recommendations. The plant manager pointed to a huge stack of papers in the corner of his office and said, "Do you know how many of these [recommendations] we have acted on?" Showing a space of about a quarter of an inch between his thumb and forefinger, he continued, "that much."

In contrast, at the plants that anticipated, safety review managers maintained that the group resembling an independent safety group had technical potential, was compatible with existing practices, and could have an important impact. Interviewees at such plants said that the group's members had "years of operating experience," were capable of understanding the plant's personnel, had an appreciation for "what was possible," and could "put in perspective" whether something was "significant." Their recommendations, both formal and informal, were accepted and were "promptly carried out."

The structures of the safety groups at these plants were similar. Both at the obeying and anticipating plants, there were five engineers on-site who reported off-site to someone in the corporate office. The primary emphasis of the independent safety group was on events at a plant and at other plants that might indicate ways to improve safety. The major difference between the two types of plants concerned their approach to implementation. Relinquishing freedom and control to an external agent (the NRC) when preferred states had been disturbed by an unwelcome surprise (the Three Mile Island Accident) created resistance, but independently tailoring a response to conditions at a plant resulted in acceptance and understanding.

Safety Outcomes

Table 1 presents the intercorrelations of all the variables in the study. As can be seen, autonomy is significantly correlated ($p < .05$) with a low occurrence of events in 1981 and 1982 and very significantly correlated ($p < .001$) with a low occurrence of human error events. These findings support Hypothesis 1.

There are also significant correlations between autonomy and high profitability, between low profitability and the number of events in 1982, and between low profitability and a high number of human error events. The overall number of events is significantly correlated with the overall number of human error events but not with the number of significant events; the reason may be that significant events represent a situation that has dramatically deteriorated, but human error events and general events represent precursor circumstances.

Significant correlations also exist between age and the number of events in 1981 and between long-term debt and the number of events in 1981. There are a number of ways to interpret these findings. Experience may be a factor in reducing the number of events, older technologies may be safer, or the correlation may simply represent increased reporting requirements that the NRC has imposed on newer plants. Plants belonging to utilities with high debt also had fewer events and in 1982 had fewer significant events. That finding could reflect a spillover effect on safety of a utility's long-term capital commitments.

Table 2 shows that the plants classified as autonomous outperformed the plants classified as rule-bound on nearly every performance indicator, with long-term debt the only exception. The smallest differences in outcomes are in the capacity ratings. Thus, it appears that productive efficiency was not sacrificed for the sake of safety, nor was safety jeopardized for the sake of productive efficiency.

The largest differences between the rule-bound and autonomous plants are in the number of human error events. Rule-bound plants had more than three times the number of human error events than the autonomous plants. Significant differences also exist with respect to events in 1981 and 1982 and with respect to profitability. Autonomous plants had fewer events and were generally more profitable. These findings support the hypothesis that autonomous implementation approaches do better than rule-bound approaches with regard to safety and other indicators.

To test for the existence of the hypothesized vicious and beneficent cycles (Hypotheses 2 and 3), I first made a determination about the effects of past events on implementation approaches. The probit analysis showed that the number of 1981 events correctly identified 85 percent of the implementation approaches (see Table 3). The adjusted R^2 value, .91, supports the hypothesis that a poor safety record leads to rule-bound behavior.

Table 4 shows the results of four regression analyses assessing the effect of the implementation approaches on 1982 performance. Different combinations were analyzed because the N is so small. The relationship between implementation approaches and human error events is strong, even after the introduction of the control variables. Implementation approach is the only variable with a significant value in each regression equation.

Thus, the probit analysis and regression results support Hypotheses 2 and 3. Plants with a poor 1981 safety record tend to respond in a rule-bound manner, a response that only perpetuates their poor safety performance, and plants with a strong 1981 safety record tend to respond in an autonomous way, a response that reinforces their strong safety record.

DISCUSSION AND IMPLICATIONS

After the Three Mile Island accident, nuclear power plants became pervious to outside forces; the NRC introduced new organizational arrangements for safety review management. Some power plants followed the guidelines the NRC established; others customized those guidelines to fit their individual circumstances. I called the former approach rule-bound and the latter approach autonomous and related those approaches to safety outcomes and

TABLE 1
Descriptive Statistics and Correlations Between Variables[a]

Variables	Means	Standard Deviations	1	2	3	4	5	6	7	8	9	10
1. Implementation approach[b]	0.62	0.51										
2. Events, 1981	66.00	29.33	−.75									
3. Events, 1982	69.85	38.84	−.83	.80								
4. Human error events	19.92	11.85	−.98	.69	.80							
5. Significant events	3.85	2.76	−.16	.52	.26	.03						
6. Management rating	1.73	0.42	−.41	.05	.25	.35	−.04					
7. Capacity rating	60.68	12.85	.10	.02	.32	−.05	.03	−.46				
8. Profitability[c]	12.59	1.57	.58	−.30	−.59	−.59	.18	−.54	−.02			
9. Age	6.92	4.86	.43	−.61	−.53	−.46	−.38	.29	−.40	−.13		
10. Size	1,948.30	994.89	.02	−.00	.03	−.11	.16	.35	.03	.26	−.21	
11. Long-term debt[d]	45.46	3.89	.35	−.57	−.39	−.19	−.59	−.47	.27	.30	−.10	−.23

[a] $N = 13$. Correlation coefficients above .49 are significant at $p < .10$; those above .57, at $p < .05$; those above .71, at $p < .01$; and those above .82, at $p < .001$.

[b] Rule-bound = 0, autonomous = 1.

[c] Profitability was measured as a percentage of return on average common equity.

[d] Long-term debt was measured as a percentage of year-end capitalization ratios.

TABLE 2
A Comparison of Rule-bound and Autonomous Implementation Approaches[a]

	Rule-bound		Autonomous			
Variables	Means	Standard Deviations	Means	Standard Deviations	t	p
Events, 1981	92.6	26.4	49.4	16.0	−3.71	.003
Events, 1982	109.2	33.1	45.3	12.7	−5.01	.000
Human error events	34.0	3.2	11.1	2.3	−15.08	.000
Significant events	4.4	3.8	3.5	2.1	−0.55	.590
Management rating	1.9	0.3	1.6	0.5	−1.50	.161
Capacity rating	59.1	17.9	61.7	9.8	0.35	.736
Profit[b]	11.5	1.6	13.3	1.2	2.35	.039
Age	4.4	2.2	8.5	5.5	1.57	.145
Size	1,922.4	568.9	1,964.5	1,229.3	0.07	.944
Long-term debt[c]	43.8	4.4	46.5	3.4	1.25	.238

[a] For the rule-bound plants, $N = 5$; for the autonomous plants, $N = 8$.
[b] Profitability was measured as a percentage of return on average common equity.
[c] Long-term debt was measured as a percentage of year-end capitalization ratios.

TABLE 3
Results of Probit Analysis of Effects of Past Safety Record on Rule-bound and Autonomous Implementation Approaches[a]

Independent Variables	Maximum Likelihood Estimates	Standard Errors	Maximum Likelihood Estimate/ Standard Error
Constant[b]	8.14	5.34	1.52
Past safety record[c]	−0.12	0.08	−1.52
Adjusted $R^2 = .91$			

[a] Percent predicted correctly = .85.
[b] Rule-bound = 0; autonomous = 1.
[c] The past safety record was measured as the total number of safety-related events in 1981.

various other measures of the performance of nuclear power plants and found that prior safety outcomes affected implementation approaches. Poor safety performance restricted choice. It yielded rule-bound approaches that perpetuated poor safety outcomes. A good record, on the other hand, opened a zone of discretion. It preserved autonomy, which resulted in continued strong safety performance.

Autonomy is the outcome of a good safety record and contributes to a good safety record. That is the essence of a self-perpetuating cycle—it is hard to break. If poor performers are given more autonomy, this analysis suggests, their safety record is likely to improve; but this analysis also suggests that they are not likely to be given more autonomy precisely because they are

TABLE 4
Results of Regression of Human Error Events on Implementation Approach and Other Variables[a]

Independent Variables	Controlling Prior Events	Controlling Age and Profits	Controlling Size and Long-term Debt	All Six Variables
Constant	37.60	43.83	14.93	28.65
	(3.83)	(8.78)	(6.84)	(22.60)
Implementation approach[b]	24.54*	−20.48*	−24.09*	−22.71*
	(2.28)	(2.42)	(1.10)	(1.10)
Events, 1981	−0.39			−0.18
	(0.39)			(0.65)
Age		−0.24		−0.21
		(0.21)		0.28
Profitability		−0.76		−0.57
		(0.71)		(0.54)
Size			−0.74	−0.82
			(0.54)	(0.81)
Long-term debt			0.47*	0.36
			(0.15)	(0.34)
Error term	2.66	2.70	1.80	1.98
	(0.52)	(0.53)	(0.35)	(0.39)
Adjusted R^2 ($N = 13$)	.95	.95	.98	.97
F (entire equation)	114.07*	74.01*	170.29*	70.73*

[a] Ordinary least squares regression used; unstandardized coefficients reported. Standard errors are in parentheses.
[b] Rule-bound = 0; autonomous = 1.
* $p < .01$

poor performers. That is the essence of a vicious cycle. Thus, I have presented evidence for the existence of a vicious cycle in which poorly performing nuclear power plants have their choices narrowed, which leads to continued poor performance, and evidence for the existence of a beneficent cycle in which nuclear power plants with stronger performance retain their autonomy, which perpetuates their strong safety performance. The findings suggest that the potentially most dangerous plants are the least likely to benefit from the innovations introduced by the NRC after the Three Mile Island accident and that the least dangerous plants are the most likely to benefit. Thus, in the short run, the performance gap between the strong and weak plants increases.

As was shown in the literature section, many studies of the implementation process have been carried out. Most of them have focused on social policies. Although an older tradition (Duncan, 1976; Pressman & Wildavsky, 1974; Wilson, 1963) suggests that rule-bound behavior is necessary during implementation, most recent studies (Bourgeois & Brodwin, 1984; Guth & Macmillan, 1986; Lipsky, 1978) have put greater emphasis on autonomy.

This study addressed how an externally induced innovation affects the organization and management of a high-risk technology and showed that autonomy is needed. The more managers exercise choice within a situation of constraints, the better the outcomes are.

Thus, this study's results are consistent with the results obtained in research examining implementation of social programs (Beyer & Trice, 1978; Maynard-Moody et al., 1987). Implementation is likely to be more effective when policy implementators are free to design and determine the specifics. The reasons include the following: (1) Policy formulators may not possess sufficient information at the level at which policy is carried out. Implementors are likely to have greater knowledge at the point of delivery, where there are multiple and contradictory demands. (2) Efforts to centralize authority and control the actions of implementors may deskill those who carry out policy and increase chances of error. Such efforts may encourage low system comprehension, low morale, and an inability to cope with anything but the most routine conditions. Autonomy is needed to encourage high levels of commitment and knowledge. (3) In particular, the disposition of implementors is likely to be negatively affected if they are not granted a sufficient level of autonomy, and it is their dispositions that are often critical to assuring a program's success.

Autonomy is needed for organizations to go beyond mere formal compliance to identification and internalization (cf. Kelman, 1961). In this respect, it resembles market-driven processes, which rely on individual initiative and competence to achieve objectives that cannot be accomplished by central direction. The peculiar advantage of market-like processes is their dependence on search, trial and error, and experimentation at the point of delivery, where specialized knowledge and skills are needed (Schultze, 1983). If implementors have flexibility to customize external demands, implementation is likely to be with the spirit, not the letter, of the law, and particular outcomes are likely to be enhanced.

Managers therefore should be aware of the possible consequences of blind acceptance of external dictates, and regulators should take heed of companies that strictly obey the law. These companies may not achieve the results the regulators intend.

Of course, there are important limitations to our findings. The small number of plants studied, the use of judgment in coding the implementation approaches, and the possibility that reports of events were inaccurate all limit the generalizability and validity of the findings. Additional research on the implementation of externally induced innovations after crises like the accident at Three Mile Island and on the organization and management of high-risk technologies like nuclear power needs to be done.

REFERENCES

Andrews, K. R. 1971. ***The concept of corporate strategy.*** New York: Dow Jones-Irwin.

Bardach, E. 1977. ***The implementation game.*** Cambridge, Mass.: MIT Press.

Bateson, G. 1979. ***Mind and nature.*** New York: E. P. Dutton.

Berman, P. 1980. Thinking about programmed and adaptive implementation: Matching strategies to situations. In H. Ingram & D. Mann (Eds.), ***Why policies succeed or fail:*** 205–231. Beverly Hills, Calif.: Sage Publications.

Beyer, J. M., & Trice, H. M. 1978. ***Implementing change: Alcoholism policies in work organizations.*** New York: Free Press.

Bourgeois, L. J. 1984. Strategic management and determinism. ***Academy of Management Review,*** 9: 586–596.

Bourgeois, L. J., & Brodwin, D. R. 1984. Strategic implementation: Five approaches to an elusive phenomenon. ***Strategic Management Journal,*** 5: 241–264.

Burgelman, R. A. 1984. Managing the internal corporate venturing process. ***Sloan Management Review,*** 25(2): 33–48.

Child, J. 1972. Organization structure, environment and performance: The role of strategic choice. ***Sociology,*** 6: 2–22.

Crozier, M. 1964. ***The bureaucratic phenomenon.*** Chicago: University of Chicago Press.

Cyert, R. M., & March, J. G. 1963. ***A behavioral theory of the firm.*** Englewood Cliffs, N.J.: Prentice-Hall.

Del Sesto, S. L. 1982. The rise and fall of nuclear power in the United States and the limits of regulation. ***Technology in Society,*** 4: 295–314.

Dill, W. R. 1965. Business organizations. In J. C. March (Ed.), ***Handbook of organizations:*** 1071–1114. Chicago: Rand-McNally & Co.

Downs, A. 1967. ***Inside bureaucracy.*** Boston: Little, Brown & Co.

Duncan, R. B. 1976. The ambidextrous organization: Designing dual structures for innovation. In R. H. Kilmann, L. R. Pondy, & D. P. Slevin (Eds.), ***The management of organization design: Strategies and implementation:*** 167–187. New York: Elsevier-North Holland Publishing Co.

Edwards, G. C. 1980. ***Implementing public policy.*** Washington, D.C.: Congressional Quarterly Press.

Egan, J. R. 1982. To err is human factors. ***Technology Review,*** 85(2): 23–31.

Elmore, R. F. 1979. ***Mapping backward: Using implementation analysis to structure policy decisions.*** Paper presented at the annual meeting of the American Political Science Association, Washington, D.C.

Ettlie, J. E., & Rubenstein, A. H. 1981. Stimulating the flow of innovations to the United States automotive industry. ***Technological Forecasting and Social Change,*** 25(1): 33–55.

Fidler, L. A., & Johnson, J. D. 1984. Communication and innovation implementation. ***Academy of Management Review,*** 9: 704–711.

Ford, D. F. 1981. ***Three Mile Island.*** New York: Penguin.

Gricar, B. 1983. A preliminary theory of compliance with OSHA regulation. In L. Preston (Ed.), ***Research in corporate social performance and policy,*** vol. 5: 121–141. Greenwich, Conn.: JAI Press.

Guth, W. D., & Macmillan, I. C. 1986. Strategy implementation versus middle management self-interest. ***Strategic Management Journal,*** 7: 313–327.

Hill, C. T., & Utterback, J. M. (Eds.). 1979. ***Technological innovation for a dynamic economy.*** New York: Pergamon Press.

Hrebiniak, L. G., & Joyce, W. F. 1985. Organizational adaptation: Strategic choice and environmental determinism. ***Administrative Science Quarterly,*** 30: 336–349.

Kanter, R. M. 1985. Supporting innovation and venture development in established corporations. ***Journal of Business Venturing,*** 1(2): 47–60.

Kanter, R. M. 1986. ***When a thousand flowers bloom: Structural, collective, and social conditions for innovation in organizations.*** Working paper, Harvard School of Business, Boston, Mass.

Kelly, P., & Kranzberg, M. 1975. ***Technological innovation: A critical review of current knowledge.*** Washington, D.C.: National Science Foundation.

Kelman, H. C. 1961. Processes of opinion change. ***Public Opinion Quarterly,*** 25: 608–615.

Lawrence, P. R., & Dyer, D. 1983. ***Renewing American industry.*** New York: Free Press.

Leonard-Barton, D., & Kraus, W. A. 1985. Implementing new technology. ***Harvard Business Review,*** 63(6): 102–110.

Lindblom, C. E. 1959. The science of muddling through. ***Public Administration Review,*** 19: 79–88.

Linder, S. H., & Peters, B. G. 1987. A design perspective on policy implementation: The fallacies of misplaced prescription. ***Policy Studies Review,*** 6(3): 459–475.

Lipsky, M. 1978. Standing the study of public policy implementation on its head. In W. D. Burnham & M. W. Weinberg (Eds.), ***American politics and public policy:*** 391–402. Cambridge, Mass.: MIT Press.

Majone, G., & Wildavsky, A. 1977. Implementation as evolution. In J. Pressman & A. Wildavsky (Eds.), ***Implementation***: 118–136. Berkeley, Calif.: University of California Press.

Marcus, A. A. 1980. ***Promise and performance: Choosing and implementing an environmental policy.*** Westport, Conn., and London: Greenwood Press.

Marcus, A. A., & Osborn, R. N. 1984. ***Safety review at nuclear power plants.*** Report prepared for the Nuclear Regulatory Commission Office of Human Factors Safety. Washington, D.C.: Nuclear Regulatory Commission.

Masuch, M. 1985. Vicious cycles in organizations. ***Administrative Science Quarterly***, 30: 14–33.

Maynard-Moody, S., Musheno, M., Palumbo, D., & Oliverio, A. 1987. ***Streetwise social policy: Empowering workers to resolve the dilemma of discretion and accountability.*** Paper delivered at the annual meeting of the American Political Science Association, Chicago.

Meyer, A. 1982. Adapting to environmental jolts. ***Administrative Science Quarterly,*** 27: 515–537.

Miles, R. H., & Cameron, K. 1982. ***Coffin nails and corporate strategies.*** Englewood Cliffs, N.J.: Prentice-Hall.

Mintzberg, H. 1978. Patterns in strategy formation. ***Management Science***, 24: 934–948.

Nutt, P. C. 1983. Implementation approaches for project planning. ***Academy of Management Review,*** 8: 600–611.

Nutt, P. C. 1986. Tactics of implementation. ***Academy of Management Journal,*** 29: 230–261.

Nutt, P. C. 1987. Identifying and appraising how managers install strategy. ***Strategic Management Journal***, 8: 1–14.

Office of Nuclear Reactor Regulation, Division of Human Factors Safety. 1980. ***Guidelines for utility management.*** NUREG 0731. Washington, D.C.: Nuclear Regulatory Commission.

Olson, J., McClaughlin, S., Osborn, R. N., & Jackson, D. H. 1984. ***An initial empirical analysis of nuclear power plant organization and its effect on safety performance.*** Washington, D.C.: Nuclear Regulatory Commission.

Osborn, R. N., & Jackson, D. H. 1987. ***Leaders, riverboat gamblers, or purposeful unintended consequences in complex dangerous technologies.*** Working paper, Wayne State University, Detroit, Mich.

Palumbo, D. J., Maynard-Moody, S., & Wright, P. 1983. ***Measuring degrees of successful implementation: Achieving policy versus statutory goals.*** Paper prepared for presentation at the Western Political Science Association meetings, Seattle.

Patton, M. 1980. ***Qualitative evaluation methods.*** Beverly Hills, Calif.: Sage Publications.

Perrow, C. 1983a. ***Normal accidents: Living with high-risk technologies.*** New York: Basic Books.

Perrow, C. 1983b. The organizational context of human factors engineering. ***Administrative Science Quarterly*** 28: 521–541.

Pressman, J., & Wildavsky, A. 1974. ***Implementation.*** Berkeley, Calif.: University of California Press.

Quinn, J. B. 1980. ***Strategies for change: Logical incrementalism.*** Homewood, Ill.: Richard D. Irwin.

Rein, M., & Rabinovitz, F. F. 1978. Implementation: A theoretical perspective. In W. D. Burnham & M. W. Weinberg (Eds.), ***American politics and public policy:*** 307–335. Cambridge, Mass.: MIT Press.

Rogers, E. M. 1982. ***Diffusion of innovation*** (3d ed.). New York: Free Press.

Rogovin, M. 1979. ***Report of the president's commission on the accident at Three Mile Island.*** Washington, D.C.: Nuclear Regulatory Commission.

Rothman, J. 1974. ***Planning and organizing for social change.*** New York: Columbia University Press.

Rothwell, R. 1981. Some indirect impacts of government regulation on industrial innovation in the United States. ***Technological Forecasting and Social Change,*** 25(1): 57–80.

Rothwell, R., & Zegveld, W. 1985. ***Reindustrialization and technology.*** New York: M. E. Sharpe.

Schon, D. A. 1971. ***Beyond the stable state.*** New York: Norton.

Schultz, R. L., & Slevin, D. P. 1975. ***Implementing operations research/management science.*** New York: American Elsevier.

Schultze, C. 1983. Industrial policy: A solution in search of a problem. ***California Management Review,*** 25(4): 27–52.

Schweitzer, G. E. 1977. Regulations, technological progress, and societal interests. ***Research Management,*** 18: 13–17.

Sills, D., Wolf, C. P., & Shelanski, V. (Eds.). 1982. ***Accident at the Three Mile Island nuclear power plant: The human dimensions.*** Boulder, Colo.: Westview Press.

Sonnenfeld, J. 1982. ***Corporate views of the public interest.*** Cambridge, Mass.: Auburn House.

Strebel, P. 1987. Organizing for innovation over an industry cycle. ***Strategic Management Journal,*** 8: 117–124.

Sturdivant, F., Ginter, J., & Sawyer, A. 1985. Manager's conservatism and corporate performance. ***Strategic Management Journal,*** 6: 17–38.

Terreberry, S. 1971. The evolution of organizational environments. In J. G. Maurer (Ed.), ***Readings in organizational theory: Open system approaches:*** 58–75. New York: Random House.

Thomas, R. D. 1979. Implementing federal programs at the local level. ***Political Science Quarterly,*** 94: 419–435.

Van de Ven, A. H. 1986. Central problems in the management of innovation. ***Management Science,*** 32: 590–607.

Van Meter, D. S., & Van Horn, C. E. 1975. The policy implementation process: A conceptual framework. ***Administration and Society,*** 6: 445–488.

Weick, K. E. 1987. Organizational culture as a source of high reliability. ***California Management Review,*** 29(2): 112–127.

Wilson, J. Q. 1963. Innovation in organization: Notes toward a theory. In J. Thompson (Ed.), ***Approaches to organizational design:*** 193–218. Pittsburgh: University of Pittsburgh Press.

Zaltman, G., & Duncan, R. 1977. ***Strategies for planned change.*** New York: Wiley-Interscience Publications.

Zaltman, G., Duncan, R., & Holbeck, J. 1973. ***Innovations and organizations.*** New York: John Wiley & Sons.

Zander, A. 1977. ***Groups at work.*** San Francisco, Calif.: Jossey-Bass.

APPENDIX

The outline of the major questions used in the interview guide follows. The actual guide also included one or more probes after most questions. Further details can be obtained by contacting the author.

1. Safety review structure. The standard technical specifications say that the methods of independent review and audit may take many forms: the license may utilize a standing committee or it may assign the function to a separate organizational unit. At your plant, the decision has been made (a) to utilize standing committees, or (b) to assign the function to a separate unit.

a. Rationale. Why was this method of review chosen?

b. Advantages and disadvantages. In your opinion, what are the advantages and disadvantages of this method?

2. Plant review group. Let's turn to the plant safety review group. Can you tell us a little about its history?

a. Rationale. Why was it formed?

b. Mission. What is its mission? Is it achieving its mission?

c. Composition. What is its composition? How are individuals selected?

d. Major tasks. What are the major tasks it carries out? What other tasks should it undertake?

e. Process. Describe how the safety review group performs its task.

f. Output. What are the products of the committee's work? List items like reviews, reports, rules, and meeting minutes that the committee issues. (Try to obtain selected copies of these items.)

g. Workflow relations. Who does the committee report to, that is, to whom does it submit its output? Who else should receive its output?

h. Impact of plant safety. Assess the impact of the group on plant safety. Describe its impact.

i. Possible changes. What are the most important changes in mission, composition, tasks, procedures, or powers that would improve the performance of the committee? Discuss.

3. Utility review group. Let's turn to the utility review group. Can you tell us a little about its history?

a. Rationale. Why was it formed?

b. Mission. What is its mission? Is it achieving its mission?

c. Composition. What is its composition? How are individuals selected?

d. Major tasks. What are the major tasks it carries out? What other tasks should it undertake?

e. Process. Describe how the utility review group performs its tasks.

4. ISEG. (This section only applied if a plant had an independent safety engineering group or the equivalent.) Let's discuss ISEG (or the ISEG-equivalent). Can you tell us a little about its history? Has it performed useful functions?

a. Rationale. Why was it formed?

b. Mission. What is its mission? Is it achieving its mission?

c. Composition. What is its composition? How are individuals selected?

d. Major tasks. What are the major tasks it carries out? What other tasks should it undertake?

e. Process. Describe how ISEG performs its tasks.

f. Output. What are the products of ISEG's work? List items like reviews, reports, rules and meeting minutes that ISEG issues. (Try to obtain selected copies of these items.)

g. Workflow relations. Who does ISEG report to, that is, to whom does it submit its output? Who else should receive its output?

h. Impact on plant safety. Assess the impact of ISEG on plant safety. Describe its impact.

i. Possible changes. What are the most important changes in mission, composition, task, procedures, or powers that would improve the performance of ISEG? Discuss.

5. Possible ISEG. (This section only applied if a plant did not have to have an independent safety group or the equivalent.) Discuss the possible functions that could be performed by an ISEG. Would an ISEG perform useful functions?

a. Formation. How would an ISEG be formed?
b. Mission. What would be its mission?
c. Composition. How would it be composed?
d. Major tasks. What major tasks would it perform? What other tasks should it undertake?
e. Agenda. How would issues get on its agenda?
f. Analysis. What kind of analysis would it do?
g. Powers. What powers would it have?
h. Output. What would be its outputs?
i. Workflow relations. To whom would it report?
j. Impact on plant safety. What impact would it have on plant safety?
k. Impact on current practices. How would it affect current safety review practices?

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