Chapter 6

POLICY IMPACTS OF FOUR APPROACHES TO STANDARDIZATION

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The situation presented in the previous chapters is one of an industry which has been slowly evolving toward a greater degree of similarity in its products. Stringent standardization is very difficult in the commercial nuclear industry where the tasks of design, supply and construction, operation, and regulation are undertaken by multiple and often independent organizations. Nevertheless, the designs formulated by the nuclear steam supply system (NSSS) vendors and architect-engineer (AE) firms are slowly converging toward a single design for each company. Several utilities and utility consortia have attempted to construct multiple reactors based on a single design. The Nuclear Regulatory Commission (NRC) has for some years defined special licensing for four categories of "standard" plants defined in chapter 4. These steps have been taken voluntarily over a 10-year period, because the industry perceives they will produce lower costs, shorter licensing times, and more reliable plants. Increasingly, both Government and industry personnel have concluded that a more rapid move to standardization may increase the safety of nuclear plants. They also recognize that the industry will not move more rapidly toward standardization unless external forces push it in that direction. Four representative approaches to standardization are used here to provide a framework for this analysis.

FOUR APPROACHES

Acceleration of Present Policies. –An incentive program to accelerate the present trends in the industry could reduce the number of designs substantially. In the first place, such a program could reduce the number of designs to one for each designer— i.e., 4 NSSS designs and 4 to 12 balance-of-plant (BOP) designs, depending on the number of AEs that remain active in the nuclear field. Only a few AEs have developed BOP designs for the boiling water reactor (BWR) and General Electric Co. 's (GE) completed design for a nuclear island approach based on the BWR make it likely that future BWRS will be of one design. For the pressure water reactors (PWRS) produced by the other three vendors, each AE would have basically the same BOP design tailored to meet the various interface criteria. Thus, the possible number of different reactor plants would be in the range of 5 to 13. The lower number could result if the utilities agreed on design features and specific criteria for a standard BOP. Any AE could design a BOP conforming to these agreed-on criteria and the existing regulatory requirements. NRC could then offer one-step licensing for any utility referencing this "standard" in a license application. The time to implement this level of standardization would equal the time to formulate the criteria and implement one-step licensing– about 1 to 3 years.

Procedural and Organizational Standardization.– One advantage of standardization would be that it would allow personnel training, operating procedures, terminology, etc., to be specified in greater detail for a larger body of plants. Adoption of more universal practices would allow operators of different plants to learn more from the experiences of one another and would facilitate audits. Even without identical hardware, for the existing generation of powerplants, the "software" practices could be made more alike. NRC has some standards for such practices and private groups, such as the Institute for Nuclear Power Operations (IN PO) and the Nuclear Safety Analysis Center (NSAC), are currently evaluating operating practices with a view toward upgrading them. If the Government wished to do more, a starting point would be to examine NRC's current standards to see if they could be more precisely specified and more universally applied. An examination of the West German standardized training and certifications program for nuclear powerplant personnel discussed earlier, might be appropriate.

Standardization of the NSSS Design Plus a Safety Block. –One of the major reasons or standardization is to allow more attention to a smaller number of designs and especially to safety-related systems (e. g., auxiliary feedwater and containment solation systems). One possible approach to standardization is to define those portions of the BOP that are necessary to bring the reactor safely to a cold shutdown condition and to allow only four variants (one for each NSSS) of this so-called "safety block. " Under this approach, the safety block would include 25 to 50 percent more equipment and hardware than the present NSSS. This version of standardization represents a significant deviation from the current mode of doing business and would require either a redefinition of responsibilities as now specified by NRC and perhaps some legislative action. To achieve this level of standardization, either the Government or industry would have to define what components belong in the safety block, subject the particular designs to some criteria of safety and reliability, and transfer responsibility for them from the AE firms to the NSSS vendors or to a design team composed of both.

Critics of the approach suggest this transfer of responsibility for safety systems, normally under the control of the AE firms, may place a burden on some of the NSSS vendors for which they are neither qualified nor prepared and thereby significantly alter the present structure of the nuclear industry. Some of the essential safety systems (e. g., the containment) require design and construction skills for which the AEs are uniquely qualified. The safety-block approach is similar to that proposed by GE, with its "nuclear-island" concept; this would take about 3 to 5 years to implement.

One Single-Standard Plant. –The ultimate in standardization would be to select only one plant design according to which all future reactors would be built. Such standardization would have to be accomplished by legal statute and would completely alter the present structure of the commercial nuclear industry. To implement this concept of standardization one must decide who would have overall responsibility for the design, what the design criteria should be, and what would be the criteria and time scale for incorporating modifications into the standard design. It would require from 6 to 10 years to design and an equivalent time to construct this single, national reactor.

Even for a single-design approach, site-specific factors such as seismology, meteorology, and hydrology would require modifications in some of the reactor plants.

SAFETY BENEFITS

Almost all of the potential safety benefits of standardization are proffered on the basis of intuition rather than experience. Few relevant examples of standardization exist, and none demonstrate unambiguously that the safety achieved results from the standardization rather than from other factors — e.g., the safety record of the naval nuclear reactors program probably results as much or more from the U.S. Navy's central control and other factors as from any similarity among its various reactor plants. Some of the arguments for the safety benefits may break down in the extreme case of standardization — e.g., the one single-standard plant concept is seen by some as an opportunity for a fresh objective look at commercial reactor design while it is viewed by others as a dangerous commitment to a possibly flawed, single design. The following discussion is an examination of the arguments in favor of standardization and the extent to which these arguments apply to the four previously defined approaches to standardization.

Enhanced Design Review. –Most people in the nuclear industry or within NRC concur that the attention given to a particular design should increase as the number of designs decreases. The incentive program towards standardization should allow more concentration of attention within the designer firms. Moving towards a safety-block concept or single-standard design would primarily benefit regulators such as NRC by greatly reducing the number of different reactors it would have to understand and regulate. Those advocating a single national design feel that its major advantage would be the design attention devoted to it. Designers could start afresh, yet benefit from the experience gained during the many years of operation with light water reactors (LWRS). Similarly, design attention to a safety-block design may lead to a safer product. One should keep in mind that the quality of attention paid to a design is as important as the quantity of designers or safety analysts studying it. It is also possible that the reduction in the number of reactor designs might merely result in a proportional reduction in the number of designers.

A design-review mechanism known as probabilistic risk assessment (PRA) has received considerable attention since the Three Mile Island (TMI) accident. The use of this technique in assessing auxiliary feedwater system reliability was discussed earlier in chapter 3. On a larger scale, PRA involves the steps of identifying hazards, hazardous activities and accident sequences, and quantifying the probability of accident sequences and the magnitude of their consequences. The determination of risk for a nuclear plant involves all parts of the plant and its operation. The NSSS, the BOP (e. g., the control room, containment, power conversion system, and electrical systems), and utility-operator aspects (i. e., the operating and maintenance procedures and the electrical grid), all are important in determining overall plant accident risks.

What sequences dominate risk can be strongly dependent on the details of plant design and operation. Subsequent to the **reac**tor safety study (RSS) (WASH-I 400) which considered two reactors in detail, NRC sponsored an RSS methodology applications program which looked at four additional reactors. While the results of this work have not been published, preliminary results indicate that considerable differences in accident sequences exist compared to the one considered in WAS H-1 400. These differences are due to:

- safety systems unique to the plant studied;
- safety systems performing functions different than in WASH-1400; and
- multiple success options for a given function requiring different levels of system success.

Not only were unique plant sequences found, preliminary results indicate that the dominant sequences vary from plant to plant.

Therefore, the major impact of standardization on probabilistic risk assessment would be to avoid industry manpower limitations in the evaluation of all plants to the degree needed to maximize plant reliability and safety. The fewer number of plants needing evaluation the greater the quality and detail of the risk assessment for a given amount of resources. In addition, a greater understanding of the insights particular to risk assessment would be obtained. In retrospect, the RSS (WASH-1400) yielded considerable insight to the TM1-type accident (e. g., a small break, loss of coolant accident), to the recent Browns Ferry partial scram and to the contributions of human errors to reactor accidents in general. If it were applicable to all reactors, these design problems might have been anticipated and therefore prevented by early corrective action.

Increased Awareness and Applicability of Operational Experience. –This possible safety benefit should be realized to various degrees for any of the four approaches to standardization. Naturally, the fewer the differences among reactors, the more the overlap of experience. The accident at TM I provides a positive example, by which reactors of similar design have learned to watch for a similar sequence of events. On the other hand, many incidents—

'Nuclear Regulatory Commission, "Reactor Safety Study An **Assessment of Accident Risks in Commercial Nuclear Powerplants, " NUREG-75/014, WAS H-1 400, October 1975**

such as the Brown's Ferry partial scram — are still caused by specific piping or instrument errors which may be peculiar to that plant alone.

One central mechanism by which various nuclear plant operators learn from the experience of others is by the Licensee Event Reports submitted to NRC.[2] The greater the similarity among plants—even if it is only more similar terminology or procedures—the easier it should be to understand these events and to decide to which other plants they potentially relate.

There is no inherent reason why operators of custom plants should learn as much from operating standard plants as other plants, but more interpretation is required to decide where each experience is relevant. It has been reported that an incident at the Davis Besse plant, was a precursor to the TM I accident, but no warning was issued. Standardization would not eliminate such omissions automatically but could ease the burden of deciding which reportable events were especially important to which plants.

The feedback provided by the naval nuclear reactors program is a key element in the safety of their program, and it is achieved despite considerable variation among naval reactors. Currently, NRC and the industry are striving to improve the feedback of plant experience. NRC has established the Office for Analysis and Evaluation of Operational Data. The Office reviews all reportable events from reactors and users of byproduct material. NSAC has created a communication and evaluation network used by operators of commercial reactors to inform one another of significant operational occurrences.

Regardless of the organization, one of the difficulties experienced with reviewing operating data is that of interpreting the relevance of a specific component failure at one plant to the safety of another plant using a similar but not identical component. The interpretation may be easier if the component used is identical in all plants, but the plants themselves differ significantly. Experience to date has shown that emphasis on feedback of operating data by the reactor vendors **(GE,** in particular) has markedly improved plant availability. One characteristic of responsible plant management is its willingness and ability to identify and to correct the generic or recurrent problems underlying all unusual occurrences in its nuclear powerplants. In a more standardized nuclear industry there would be no question about the importance of taking the broad view of all identified problems. A more standardized industry would potentially permit a relatively small group of experienced engineers to review the data generated by operating experience, looking for the generic implications of apparently "random" failures. At present, the heterogeneous nuclear industry provides generic assessment of operating experience by means of various user groups. Examples include the BWR Mark I containment owners' group; and the GE, Westinghouse, Babcock & Wilcox, and Combustion Engineering owner's groups; The formation of these groups results in part from an interest in the free flow of information on solutions to their common problems.

While increased standardization would further help in the identification and resolution of safety issues, it would also increase the risk of systematic oversight of potential problems. As a matter of policy, electric utilities plan diversity into their generating mix, both fossil and nuclear, and among the several reactor designs. This course has been amply vindicated by the many generic shutdowns that have occurred without loss of a major part of the nuclear generating capacity. A nonnuclear analogy would be the obvious consequence of having a standardized U.S. jumbo jet, such as the DC-10, grounded when a generic engine-mounting defect is discovered. The degree of nuclear standardization needed to produce optimum benefits is a subject for further evaluation.

The greatest increase in health and safety comes from the review and evaluation of operating and construction experience on one sin-

2 nuclear Regulatory Commission, "Reporting of Operating Information – Appendix, A Technical Specification," Regulatory Guide 116 (revision 4), August 1975

gle-plant design. However, the institutional barriers and the possibility of systematic oversight of safety problems may outweigh any safety benefits accrued through the feedback of data on one "accepted" design. With regard to procedural and organizational standardization, the benefit acheived through uniform reporting and review practices can be easily obtained with little if any disruption in the institutions regulating and operating commercial reactors.

Improved Training for Plant Personnel

The impact of the approaches to standardization of improving plant training is easily analyzed by considering three of the concepts under one heading "hardware standardization. " The order of increasing hardware standardization would be:

1. acceleration of present trends;
2. NSSS plus safety block; and
3. single-plant design.

The other approach, procedural standardization, is considered by itself as the standardization of the management processes as distinct from hardware. In addition, other institutional factors not normally considered part of an idealized, formal training program must be taken into account.

The basis for the procedures for design, construction, and operation of a nuclear powerplant is the Code of Federal Regulations, industry standards, and NRC's rules and regulations. Each applicant for a license establishes a set of administrative procedures that implement the letter and intent of these rules and regulations. For an operating reactor, one part of there administrative procedures deals with the selection, training, and qualification of the plant's employees —e. g., these procedures describe the general employee training requirements as well as those for technicians and operators. Each member of the plant staff is subjected to some training with different degrees of intensity and depth according to the position filled. Currently, there is wide diversity in the training programs resulting from the way the utilities interpret the basic requirements when establishing their administrative procedures —e. g., the requirements for a licensed operator to requalify on a yearly basis include the performance of 10 major changes in the plant's status from the operator's console. Some utilities meet the requirement by simply counting the startups or shutdowns the operator has performed over the past year. Others send the operator to a plant simulator for as long as 2 weeks for intensive retraining. New requirements resulting from the accident at TM I have specified in detail the types of manipulations necessary for this requalification.[3] In addition, these manipulations will require the use of a plant simulator.

Greater standardization in operator training programs than what currently exists would ease the administrative burden on implementation and auditing of this new requirement. Also, the effectiveness of the requirement over the next few years would be easier to judge if the change were made from training programs which had more in common. Greater hardware standardization would make the detailed procedural level of these training programs more alike but would be unlikely to increase their effectiveness or ease the administrative burden.

Standardization of hardware would make selected improvements possible in training plant personnel. One area in which this could occur is the use of plant simulators. A simulator consists of a mockup of the control room with indicators, gages, and other instruments and devices driven by a computer. The operator's manipulations of the switches in the mockup are monitored by the computer, which simulates the reactions of the plant on the mockup instrumentation. If greater hardware standardization were used in the nuclear industry, more plant operators could use the same simulator and fewer plant-specific simulators would be needed. Standardization of the hardware would also increase the analytical capability of simulators to deal with off-normal transients when a transient occurs at one

[3]Nuclear Regulatory Commission, NRC Action Plan Developed as a Result of the T MI-2 Accident, N U R E G-0660, " May 1980

plant and operators at other plants need to be trained for possible reoccurrence of the same type of event. Another benefit is that the incorporation of an actual event into the simulator's computer would be easier –e.g., all actual transients could be incorporated into the simulator without the necessity of incorporating specific differences in plant operating characteristics resulting from different designs. The difficulty encountered by the various vendors in simulating the TM I accident on their own simulators (as an aid to operator training) was an example of of this.

However, all of these advantages must be viewed in the context of the existing mix of generation common to most utilities and regional differences in the utilities' service areas. The additions of several nuclear powerplants of standard design may not simplify the utilities training program if the current program is determined by the diversity in existing operating units. Among most electrical utilities, any "standard" plant would be *unique* as a source of power generation because it would be different from existing plants. It would complicate rather than simplify the existing training program. Unless a utility makes a substantial use of a single design in its operating system, the value of hardware standardization in improving the utility's training program will be minimal.

Procedural standardization in personnel selection, training, and requalification may be difficult if there are significant differences in State labor laws, union contracts, or State regulatory requirements. However, considering the current generation mix of each utility, this standardization approach appears to be the easiest to implement with substantial benefits in personnel training.

RELEVANCE TO A NATIONAL SAFETY GOAL

The question of the need for quantitative safety goals to ensure that adequate levels of nuclear powerplant safety are achieved is a longstanding one. The Atomic Energy Act of 1954 and the Energy Reorganization Act of 1974 established the legislative basis for NRC regulation to ensure the safe use of commercial nuclear power. In response to the legislative mandate, NRC regulations require, as a part of issuing a nuclear powerplant construction permit, that a finding be made that "the proposed facility can be constructed and operated at the proposed location without undue risk to the health and safety of the public'" and as a part of issuing an operating license that a finding be made "that there is reasonable assurance that the activities authorized by the operating license can be conducted without endangering the health and safety of the public. "5

The principles used by NRC are based on a "defense-in-depth" approach to the plant design. Reactor safety as practiced in accord with these principles is defined in NRC's regulations, safety guides, branch technical positions, and related industry standards. These provide an extensively documented licensing process that has helped the nuclear industry to achieve an impressive record with regard to public health and safety. In this process, many safety requirements and calculational methods have been identified. Following NRC rules establishes that plants adequately meet specific safety requirements and satisfy the requirements of the legislative mandate. This deterministic process is based on implied but unstated probabilities. For instance, a qualitative probabilistic judgment was made many years ago that the large rupture of a reactor pressure vessel in LWRS was unlikely enough that it did not have to be considered in the design. In the intervening years a quantitative basis has been provided to support that qualitative judgment, The NRC licensing process is now considering other factors that arise from accidents of greater severity than the design-basis accidents (DBA). Consideration of such

[4] CFR 1050, sec 5035
[5] CFR 1050, sec 5057

accidents will require a different type of analysis than the traditionally conservative approaches taken in the assessment of DBAs. The use of PRA techniques is rapidly coming into use for this purpose. Quantitative criteria for acceptable levels of risk, or safety goals, are needed if all the benefits of PRA are to be realized. PRA is an acceptable quantitative method of showing compliance with a well–defined safety goal.

U.S. activities relating to the establishment of a national safety goal are going on within the NRC, the Advisory Committee on Reactor Safeguards (ACRS), the nuclear industry in general, and the national technical and scientific community. There are also international activities in this area. Possible variations in goal forms that have been considered include: single v. multiple goals, quantitative v. qualitative goals, and individual v. societal goals.[6] The goal-setting process can be divided into two broad phases, the initial phase in which a wide range of goal elements and alternative strategies are identified, and the second phase in which the effort is directed toward winnowing down the elements and strategies for more indepth analysis and decisionmak ing.

in demonstrating compliance with any safety goal, a high level of confidence in the related risk assessments will be necessary. A high level of confidence will also be necessary to achieve public acceptance. PRA techniques are relatively new and there are too few ski l led practitioners for it to be applied routinely for reactor safety assessment. If design standardization were to result in a large reduction in the number of designs to be reviewed, PRA could be applied more comprehensively to show compliance with a safety goal. By the same token, as the development of PRA techniques continues, confidence in their application will increase and the number of skilled practitioners will become very much larger. It may then be possible to address a wider range of designs and this aspect of standardization would be less important.

6S Levine, "TM I and the Future of Reactor Safety, " Atomic In-Cfu$trlal Forum International Publ{c Affairs Workshop, Stockholm, Sweden,] une 1980

THE IMPACT OF STANDARDIZATION ON RESOLUTION OF GENERIC ISSUES

A December 1977 amendment to the Energy Reorganization Act of 1977 required NRC to submit to Congress a list of unresolved safety issues and plans for their resolution. Progress on resolution is to be included in NRC's annual report to Congress. Prior to that, NRC had developed task-action plans for a multitude of outstanding topics, many of which were not considered unresolved safety issues. 1 n January 1979, NRC submitted a report to Congress identifying 17 unresolved safety issues and their related task-action plans.[7] A more recent plan updates the status of these issues and plans.[8] The 17 issues are listed in table 6.

As a result of the many investigations of the TM I accident, NRC published an action plan in May 1980.[9] This report contains actions to be carried out by each nuclear plant owner and the NRC. One might consider these as generic safety issues; however, they are resolved issues in that specific action is called for. Also, these actions are applied to all operating plants, as well as those under construction. Thus, standardization would not have changed these action plans.

As an example of the effect of standardization on a safety issue, consider item 1 of table 6, "water hammer. " The phenomenon is similar to the banging of steam-heated radiators commonly found in old homes or office build-

'Nuclear Regulatory Commlsslon, " Identification of Unresolved Safety Issues Relating to Nuclear Powerplants, " NUREG-O51O, January 1979

"Nuclear Regulatory Commission, "Task Action Plan for UnreSOlVed Safety Issues Related to Nuclear powerplants, " NUREG-0649, February 1980

'Nuclear Regulatory Commission, "NRC Action Plan Developed as a Result of the TM I-2 Accident, " NUREG-0660, May 1980

Table 6.—Unresolved Safety Issues

1. Water hammer
2. Asymmetric blowdown loads on the reactor coolant system
3. Pressurized water reactor steam generator tube integrity
4. BWR Mark I and Mark II pressure suppression containment
5. Anticipated transients without scram
6. BWR nozzle cracking
7. Reactor vessel materials toughness
8. Fracture toughness of steam generator and reactor coolant pump supports
9. System Interactions in nuclear powerplants
10. Environmental qualification of safety-related electrical equipment
11. Reactor vessel pressure transient protection
12. Residual heat removal requirements
13. Control of heavy loads near spent fuel
14. Seismic design criteria
15. Pipe cracks in boiling water reactors
16. Containment emergency sump reliability
17. Station blackout

SOURCE: Nuclear Regulatory Commission.

ings. Occurrences have been attributed to rapid condensation of steam pockets, steam--driven slugs of water, pump startup with partially empty lines, and rapid-valve motion. Much of the problem might therefore be resolved by piping arrangement to assure filled lines and prevent steam pockets. This would, of course, be easier to resolve in standardized layouts as opposed to those of differing plant designs. Although there has been no release of radioactivity outside the plant's boundary because of a water-hammer incident, the frequency of such events and the potential safety significance of the systems involved caused NRC to consider the water-hammer problem significant. Were most plants of standardized design, modifications to prevent recurrence of many safety-related problems could be carried out more rapidly as fewer designs need be examined.

Resolution of another issue, related to containment emergency sump reliability, would also be quicker if designs were standardized. Although NRC has issued guidance for containment sump design and testing, there are still concerns about blockage of sump filters and loss of ability to draw water from the sump. With fewer designs to investigate, the emergency sump reliability issue could be settled much quicker.

The previous discussion indicates that standardization would have facilitated resolution of some of the unresolved safety issues and therefore improved nuclear powerplant safety. On the other hand, there are issues that would be unaffected by standardization. For instance, the disclosure by Virginia Electric Power Co. that asymmetric loads in the reactor vessel supports and vessel internals caused by a PWR pipe break could cause a safety problem, was the result of studies with computer codes using more detailed analytical models. In other words, advances in the state of the art uncovered a problem. In that case the discovery would have occurred at about the same time in the advancement of the technology, whether or not standardization had been implemented.

Finally, several situations have occurred where similarities in plant standardization resulted in many nuclear plants experiencing the same problem — a lesser degree of similarity (i. e., less standardization) could have limited the number of plants involved. One example of this was the realization that hydrodynamic loads on the suppression pool associated with loss-of-coolant accidents and safety-relief valve discharge were not considered in the design of Mark I and Mark II BWR containment. These loads affected 24 Mark I and 11 Mark II plants. Another example is the BWR nozzle-cracking problem associated with feedwater systems of many BWRS of similar design—18 of 21 units inspected had cracks in feedwater nozzles.

For the most part, these generic issues arose when operating experience or advances in the state of the art uncovered a problem, a discovery which would have occurred at about the same time in the advancement of the technology, with or without standardization. Resolution of some of the issues would be expedited if affected nuclear plants were more standardized, while resolution of other issues would not be affected had standardization been more prevalent.

STANDARDIZATION AND ANTITRUST

As noted in chapter 3, the AEs normally enter into a contract with the utility to provide engineering services for the proposed nuclear plant including procurement of material for the BOP. However, the utility selects the NSSS from the four available vendors based on competitive bidding. The reactor, much like the turbine generator, is considered for the purpose of procurement as a large single piece of equipment. The utility normally does not involve itself with the selection of the vendor's supplier other than to assure they are qualified. In many cases, the vendor may have already completed procurement through existing contracts with its suppliers. On the other hand, the BOP equipment and materials are procured by competitive bidding for each plant to satisfy the State agencies regulating the utilities.

In order to perform safety reviews of proposed nuclear plants, the NRC staff prefers to have as much detailed design as possible. The level of detail provided by the vendors is sufficient for this purpose, even before actual construction of the plant begins. However, the AE cannot supply as detailed a design as can the NSSS vendor because the procurement of material and detailed design work has generally not been completed at the time the CP is issued.

The exclusion of any qualified supplier of plant equipment due to licensing requirements for a standard design is a breach of antitrust law. Increasing the level of detail in design for the BOP to the same level found in the NSSS would exclude qualified suppliers from the market place, due to the differences in business methods.

By taking into account the antitrust due process in the setting of standards for plant systems and equipment, the antitrust problem can be eliminated. Due process in standards-making according to the Department of Justice includes:[10]

- adequate notice of the proposed adoption of a standard;
- standards development meetings should be open to the public;
- the standards-setting body should have an affirmative obligation to seek consumer and small business opinion; and
- membership on standards development committees should represent a balanced cross-section of all affected parties.

The development of standards which specify sufficient detail to perform a safety review by knowledgeable engineers under the above guidelines should be sufficient to satisfy the concern over anticompetitive practices and protect the health and safety of the public. A subcommittee of the Atomic Industrial Forum is currently working on a proposed revision to the current NRC guidance on information required for a safety analysis report for single-stage licensing. In addition, at least two AEs and one vendor are considering similar proposals.

Of the four standardization approaches considered, the continuation of present policies with refinement already being considered by the industry is the least likely to create problems with antitrust. The safety-block concept would not create any more difficulties than the acceleration of present policies, although it would place more of the total plant under the design control of the vendors to the exclusion of the AE. However, the AE's role as an engineering services contractor would be affected since design work encompasses only about 10 percent of the total cost of the facility. The "national single design" could force one or more NSSS vendors from the marketplace. The specifications for the design could be written to allow the vendors to remain competitive suppliers under contract to the utility for equipment and systems. Each vendor would have to evaluate its interest in the supply business, based in part on the similarity of the national design components to its own. However, the single-design standardization approach has the greatest antitrust problems due

[10] John H Sherrefield, Department of Justice, "Standards for Standards-Makers (Washington, D C Department of Justice, American National Standards Institute, March 1978)

to the reduction of the NSSS vendors to suppliers and the possible exclusion of large portions of their product line from the national single-plant design.

UTILITIES AND STANDARDIZATION

A utility which operates and maintains a nuclear powerplant is uniquely responsible to the Federal and State Governments for the protection of public health and safety. In addition, the utility is responsible to the stockholders for the efficient operation of the plant and the protection of plant investment in equipment and fuel supply (i. e., the reactor's core). These are not mutually exclusive goals and measures which protect the core, increase plant availability, and protect the public. Because of this unique relationship between the utility, its stockholders, and government, nuclear utilities should actively participate in the formulation of any standard design or approach to standardization.

Over the past 25 years, some utilities that have purchased nuclear powerplants have had minimum influence on their design due in part to the lack of expertise in nuclear design engineering. Therefore, these utilities placed heavy reliance on the judgment of the AEs and vendors to protect their financial and regulatory interests. Other utilities, such as Duke Power and Tennesee Valley Authority have acted as their own designers and have maintained a strong influence in the design and construction of their plants. It is also this latter group of utilities which have maintained a strong commitment to standardization as evidenced by their recent construction record for duplicate plants. However, having only a few utilities committed to standardization may not be enough to reap its benefits if a resurgence in new plant orders occurs.

A utility organization could, over the next 2 or 3 years, develop standards and criteria for new plants which incorporate the cumulative operating experience of the industry. These criteria should concentrate on safe, conservative designs and reemphasize the past practice of simply meeting licensing requirements. This effort would result in a set of criteria for everyone (e. g., designers, operators, and regulators) and lend consistency to their actions, Common, understandable objectives could be established which concentrate on the real issues of safety and reliability. The effort should include input from AEs, vendors, and perhaps NRC. Inclusion of NRC should be limited to their role as regulators not designers or operators.

Once the criteria are set, standard designs could be developed. Future construction dockets could then be limited to these designs and thereby allow the marketplace to limit the number. Single-stage licensing would be a considerable inducement to the whole process.

FEASIBILITY

Of the approaches to standardization considered, the acceleration of present trends and procedural standardization are the most feasible to achieve. These approaches work within the existing structures and motivations of the commercial nuclear industry. Organizations such as NSAC and INPO have already been established as a result of the TM I accident and are in excellent positions to develop and promote these forms of standardization. In addition, these institutions were established by the utilities and the utilities are solely responsible for their success or failure. Such utility organizations could fill the role described previously for the development of design standards and criteria. The burden for standardization should rest with the utilities as they are ultimately responsible for commercial nuclear power and also have the most to lose in the event of an accident.

As discussed earlier, trends in the industry over the past 25 years have led to some standardization. This trend can be greatly accelerated by implementing single-step licensing (or NRC's standard-design approval) and regulating the industry in a consistent well-defined fashion. The development and implementation of a safety goal would certainly assist the regulation of the industry. However, its absence should not deter the development of the standards and criteria necessary for the next generation of nuclear powerpl ants.

Under the safety-block concept, the vendor, either alone or in conjunction with an AE, would develop and obtain regulatory approval of a standard design which consolidates in a single design certain parts of the plant which traditionally have been split between the vendor and the AE. This would enable one designer or design group to have total system responsibility for the entire nuclear part of the plant and to better anticipate the impact of various events on the entire plant. This approach would eliminate a number of interfaces that create difficulties in design and licensing, since all the systems crucial for licensing would be inside the safety-block portion of the plant. Approval of the power-generating systems should be wholly routine. The safety block approach should therefore facilitate the licensing process and allow a more thorough design approval to take place. In either case, the AE firms would retain the bulk of their function. This concept would require the vendor and perhaps the AE to expand their scope of design responsibilities and accept the resulting additional liability, The utility, therefore, would have to accept a lower degree of involvement than under the acceleration of present policies.

The single-standard design would require creating an entirely new design organization. This has the very real possibility of disrupting the existing institutions which design, construct, operate, and regulate nuclear plants. Given the possibility of replicating an undetected safety flaw in all the plants of a single-standard design and the necessity of relating operating experience to the mixed set of plants already in place, the safety benefits of such an approach are doubtful. The single-design approach has the greatest problems with antitrust as well. The existing Atomic Energy Act would have to be drastically modified to enforce this approach and would transfer the incentive and responsibility for design improvements from the industrial participants, who now have the responsibility, to an umbrella design organization. There is no private industry in the United States that has undergone such a radical change. The net effect of imposing a single design on the utilities is impossible to judge.

An alternative approach is to have a separate body go ahead with the design of a "national reactor" or "yardstick" design, even without a commitment to actually build them. This exercise would allow a comparison with existing designs and possibly would bring improvements to them. Such a design would have to recognize the problems associated with combining components or systems in ways not previously done and without any operational experience base for its performance. Such a yardstick could more easily be achieved by tightening the existing criteria to meet the utilities requirements for availability, reliability, and safety. This yardstick could then be used outside the licensing and regulatory framework to measure the relative weaknesses or strengths of existing designs.

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