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Improvements in the Regulatory Process: a Prescription for Regulatory Stability and Predictability

Presented by

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Good afternoon, ladies and gentlemen. I am pleased to join you on this concluding day of the 1993 NRC Regulatory Information Conference to discuss with you a regulatory related issue of common concern. You have heard a lot these past two days in sessions on current regulatory trends, operational safety issues, and regulatory reviews. Later this afternoon, you will be updated on license renewal in a concluding plenary session. In short, the regulatory pot continues to bubble with many ingredients.

I would like to discuss with you today a somewhat philosophical issue common to all energy technologies. How can one ensure continued development and innovation in nuclear technology while retaining effective public regulatory oversight of the results of these creative processes? Assurance of public safety through regulation and the advancement of technology may appear not only unrelated, but contradictory. I think they are connected, and I wish to share with you some of my thoughts on how technology and regulation can be mutually supportive.

It has been my experience that extraordinary difficulties are posed in providing adequate assurance of safety to the public and the environment through both regulation (legal requirements) and application of science (technology and human factors). There is an inevitable tendency for regulatory processes to become bureaucratized, particularly if the regulated activity has experienced rapid growth, is of substantial size and economic value, and involves significant health, safety and environmental issues. These attributes characterize the U.S. commercial nuclear program.

Projections of Future Primary Energy Transitions

Theodore Modis in a new book, Predictions (Simon & Schuster, 1992) discusses the powerful prediction capabilities of "S-shaped" curves of cumulative growth, called logistic functions, for future growth of a variety of human activities including use of primary energy forms such as nuclear power. His discussion of energy is based largely on research performed at the International Institute for Applied Systems Analysis (IIASA) in Austria, where Cesare Marchetti and co-investigators have applied the earlier pioneering theory of technological substitution by Mansfield (1961) and Fisher and Pry (1970) to similar substitution of primary fuels -- wood, coal, oil, natural gas, uranium (nuclear), and future solar and fusion technologies by means of logistic functions.

The Fischer-Pry economic model has become a standard reference in the field of technical substitution and is well suited to describing the substitution of competing energy systems. The substitution path of the new energy technologies follows an S-shaped logistic function curve characterized by slow initial growth followed by more rapid growth, then decreasing after attaining a 50 percent functional share or market capture.[1] The IIASA energy model has been tested extensively against validated national data bases from thirty different countries for five primary energy forms --wood, coal, oil, natural gas, and uranium (nuclear). The quality of prediction of historical trends in all but a few countries was found consistently very good.

A comparison of actual historical substitutions of primary energy forms in the U.S. involving wood to coal, coal to oil, and oil to natural gas with IIASA model projections has shown excellent agreement, while relatively recent substitutions of oil and gas to nuclear energy remain to be confirmed. It is interesting to note however that IIASA projects continued long term development and use of commercial nuclear energy in the U.S! According to the IIASA model, nuclear power will continue on its logistic growth path and will peak in about a century, at which time it will account for approximately 60 percent of all U.S. primary energy supply, leaving the remaining approximately 40

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[1] The logistic function, first described by P. F. Verhulst in 1845, is derived by specifying that the rate of growth in some phenomenon is proportional to both the amount of growth already accomplished and by the amount of growth remaining to be accomplished.

percent share to be provided in equal contributions by natural gas and "solfus", a futuristic energy combination of fusion and solar energy. I leave to you to decide whether the normalized logistic functions of U. S. primary energy substitutions by Marchetti and Modis are reliable predictors of our future energy developments!

Lessons from the Future

Whatever the future outcome for nuclear, I believe the IIASA research on the dynamics of primary energy development and substitution provides some important insights for us today:

-- First, laws that govern growth and competition among various species can also describe human activity which in turn has led to the search for invariants -- universally valid constants manifested by indicators that do not change over time and that represent some kind of equilibrium.

-- Primary energy transitions to new energy technologies are one such indicator, and such energy transitions require time for social acceptance.

-- In the early stages of energy transitions, all costs of new innovative energy forms are not internalized which, when they are later, slows the initial introduction rate.

-- Also in the early stages, the time required to develop such institutional processes as education to support the implementation of the new energy form usually is not realized or accounted for.

-- Usually in the early stages where issues of public safety are involved, the necessity for development of public regulation as a credible, disciplined, and deliberate process to assure safety is not recognized.

-- Finally, lacking a robust regulatory process, a small "skeptical elite", as Alvin Weinberg has coined the term, can develop and influence the opinions of the population as to the risks and benefits of the new energy form.

These effects tend to slow the initial rates of introduction of new energy technologies. In our country, the principal issues which have constrained development of nuclear power have been public distrust of the technology due to public concerns about plant safety, disposition of radioactive wastes, linkage of the technology to nuclear weapons, and human fallibility associated with the operation of nuclear plants and processes. Recently, the economic costs of nuclear energy have become of equal concern.

The Cultural Divide Between Technological and Public Regulation Processes

The professional fields of energy science and public regulation differ in what each profession demands of its practitioners. Energy science, with its dependence on individual innovation and creativity, emphasizes spontaneity and lack of restraint in thinking on the institutional processes involved. Creativity and innovation are expected to thrive in an unstructured institutional environment, one which nurtures individual contributions and thought, and in which time constraints and schedules are not of great significance.

In the U.S., the profession of public regulation on the other hand requires frequent interactions among the regulated community, the public, Congressional staff, and public officials. Regulation is characterized by time constraints, organizational complexity, and the necessity for adherence to schedules and procedures. Organizational relationships and communication systems are often formal and complex. Professional activity must follow a structured process, and precedent observed as to previous practices and customs. Public participation in the regulatory process (public petitions, public hearings, public comments, etc.) -- while vital -- can contribute to delays in the process.

A problem with public regulation is its high potential for the stifling of individual creativity and initiative as a result of the process by which it is conducted. It is true that the two professional activities of technology development and public regulation to an extent involve different intellectual processes, individual behavior patterns, organizational structures, communication systems, and schedule considerations. There is the possibility however that commercial nuclear energy could be stifled through unwise regulatory practices.

Desirable regulatory attributes include stability, guidance, predictability, and fairness. I submit that as licensees, you also require these attributes to work effectively. Thus the regulator and regulated communities share common interests in this respect. The problem is that these desired attributes are generally contrary to innovation associated with technology development. The question I put to you is how can the "cultural divide" between technology development and public regulation be "bridged" to ensure both safety and public acceptance of nuclear energy? Can innovation be incorporated in the regulatory process, and if so, how?

First, we should recognize that there is a commonality of interest between technical enterprise such as nuclear plant operation and nuclear safety regulation. Second, I believe it is in the interest of licensees to improve the climate for creativity in the regulatory process, thereby preventing technological stultification. Enlightened regulation constitutes a "win-win" proposition through improved safety and reduced costs.

Bridging the Cultural Divide

So, how might we bridge the "cultural divide"? First, we should recognize that there is commonality of interests between technical industrial enterprises, their applied science underpinnings, and safety regulatory organizations -- public safety and convenience. Second, we should recognize that constructive proposals made to regulatory organizations could help prevent technological stultification and thus serve societal interests. Third, we should recognize that an underlying, or "root cause" reason for public concern with commercial applications of new artifacts of science and technology frequently stems from the public's belief that an inadequate understanding or an incomplete knowledge of the technology itself exists.

A new technology which is to be widely deployed and which presents potential public safety issues together with public benefits, should receive the active attention and inquiry of the very best of a country's technical community to understand thoroughly and assess all potential safety and institutional issues prior to its wide scale introduction. The educational process of learning of current results derived from science and engineering is essential to a healthy regulatory organization and its functioning. I suggest technical "bridges" be established between the industry and regulators such as the NRC. You should not wait to be asked; you should begin now. Public regulators need your assistance in this regard, even though they may not recognize it until it is almost too late!

The NRC's response to the need for openness and prevention of stultification, while not perfect, has been to require the following elements of its regulatory processes:

(1) The process itself must be open; all material related to a licensing process are available to the public.

(2) Consideration of public policy issues is itself a public process with public participation. Public comment on and agency analysis of these comments is required prior to issuance of prospective agency rules, changes to rules, Commission policy statements, and important regulatory guidance documents.

(3) On substantive public safety matters, such as reports, analyses, investigations, findings, etc., a balanced peer review process is employed by persons recognized for their objectivity and competence in the particular issue. The peer review group is carefully selected to represent a balance of societal opinion on the general subject area.

(4) The on-going work of the agency (NRC) itself is continually subject to review by a number of advisory committees which meet on a periodic basis composed of experts outside of government having competence in reactor design and operation, nuclear materials and waste repositories, medical applications involving radiopharmaceuticals, and nuclear safety research.

(5) The agency is actively involved in the development of engineering codes and standards by professional engineering societies, including the development of consensus standards and practices which form the bases for international engineering practices.

(6) Agency staff engage in technical exchange through participation in national and international technical meetings sponsored by engineering and professional societies and present technical papers at such meetings.

The NRC's efforts to "bridge" the two worlds of safety regulation and technology have only been partially successful, and further improvements are desirable. For example, recent initiatives in the field of medical application of radiopharmaceuticals have included establishing a "Visiting Medical Fellows" program under which physicians spend a one year "internship" at the NRC in an agreed upon medical research area involving medical applications of radioactive materials. Similar one year programs with established academicians as "Visiting Professors" in an appropriate field of applied science are encouraged at the NRC. In short, the NRC is attempting to extend "bridges" to the academic and technological community to bring the best and latest thinking in the various professional fields that lie within its statutory purview.

The Commission believes that an insistence of highest degree of professionalism in its staff is the single best measure to instill confidence in the public that the agency is competent to deal with the varied technical issues pertaining to peaceful applications of nuclear energy and to prevent technological stultification. For the technological substitution process to continue according to Marchetti's and Modis' immutable logistic functions, public acceptance of nuclear technology is essential.

Summary and Closure

Let me summarize the main points I have made.

(1) An effective marriage of nuclear technology and public regulation has not occurred due to conflicting requirements in the processes of technology and of regulation -- a "cultural divide" naturally exists between the two professional activities.

(2) Promising innovations in energy technologies may be needlessly impeded as a result of inefficient or inflexible public regulation. The experience and knowledge from the practice of technology should be made available to public regulators to meet societal interests.

(3) Examples as to possible means by which such assistance could be provided is available from experience in other professional fields; these initiatives are worthy of our collective consideration.

(4) Enlightened participation by professionals of energy technology in public regulation can be rewarding to the professionals involved, both personally and professionally.

(5) For the marriage of technology and public regulation to occur with its societal and individual benefits, you on the technology side must take the initiative.

I wish you a successful concluding conference this afternoon on License Renewal, a regulatory process which will demand the very best of all of us, and one which may well require innovation in the regulatory process. Thank you for your attention.