

## Editorial: The Atomic Future

# Commentary on the Dimming of the Atomic Future

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### The Presence

Almost 50 years ago, U.S. President Dwight Eisenhower announced the "Atoms for Peace" initiative with the hope that a vast array of new and emerging "nuclear" technologies would benefit mankind. As we end the twentieth century, are we seeing signs of a nuclear bankruptcy? There have been no nuclear power plants ordered in the United States in more than two decades, and in both Germany and Sweden the governments have said that all nuclear power plants will be phased out. Even in the United States, environmental and other special interest groups have long advocated the dismantling of existing plants and the imposition of a moratorium on new plant construction because of perceived safety problems associated with the generation of nuclear power and the disposal of the resulting radioactive wastes.

Despite the extensive accumulation of technical information on radiation effects and risks, expressed concern about the health and environmental consequences of exposure to radiation from nuclear power plants and medical applications continues to be based on limited selective information. Public awareness and perception has tended to focus on the existence of scientific uncertainty and not on the overall benefit and risk. Although the 1991 National Energy Strategy for the United States identified a continuing, and possibly increased, role for nuclear energy well into the next century, there is little vocal support for nuclear power generation. Deciding whether or not nuclear power is really important to any nation's energy system is ultimately a public policy decision. Therefore, it is vital that public information and education programs are available, and meaningful dialogue begun, on the benefits, risks, costs, and tradeoffs of the nuclear option, compared to alternative energy options. Above all, the public needs reliable and accurate information (and trust in government) in order to support decisions about the future of nuclear power.

### Benefits of Nuclear Technology

The general public has come to rely heavily on the uses and benefits of ionizing radiation technologies in almost every aspect of daily life. President Eisenhower's promise of harnessing the atom for peaceful purposes has been realized in fields such as biology,

geology, physics, chemistry, and medicine, in addition to their applications in health care, agriculture, manufacturing, and electric power generation. Nuclear power now generates about 20% of the electricity in the United States, 70% in France and Japan, and about 30% in Germany and the United Kingdom [1].

Nuclear medicine has produced hundreds of diagnostic and treatment techniques that have extended the average life span and provided new tools used in all frontiers of medical research. More than 20,000,000 diagnostic tests that use radioisotopes are conducted annually in the United States. More than any other technology, including refrigeration and chemical fumigation, ionizing radiation makes it possible to improve the world diet by preserving food and overcoming many debilitating pathogens and destructive insects in agriculture.

### Risks of Nuclear Technology

Despite the role of radiation technologies in everyday life, however, public reaction to radiation risks are generally not in agreement with the scientific understanding of these risks.

One of the main reasons for this reaction is concern about public health and environmental risks, which are often perceived as being much greater than they really are. This stigma underscores the importance of increasing the public's understanding of radiation risks relative to other hazards. An inadequate understanding about radiation risks prevents people from evaluating the credibility and content of the information they receive and from making informed independent judgments. The public is a critical stakeholder and plays an important role in nuclear utility and government decision making concerning radiation issues.

The health and environmental effects of exposure to ionizing radiation and radioactive materials are better known than the effects of most other hazardous materials. The harmful effects of high doses of radiation (above 0.5 sievert or 50 rem) delivered at high dose rates (greater than 0.1 sievert per day or 10 rem per day) have been documented from studies of Japanese atomic bomb survivors. Evidence of harmful effects is also apparent in studies of radium dial painters, radon-exposed workers in underground mines (e.g., uranium miners), radiologists, and other similarly exposed groups. There is very little controversy regarding the effects of high doses of radiation because clear evidence of these effects has been demonstrated in epidemiological studies of these exposed populations [1].

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At low radiation doses and dose rates, such as those associated with natural background radiation and most radiation applications, the risk of health effects is generally so small that it cannot be distinguished from natural incidence of cancers, birth defects and other effects not caused by radiation. Because extrapolation models are frequently used to go from the known risks at high radiation doses to low level exposures, there are different opinions regarding the models and predicted level of harm. With the continuing development of molecular biology, our understanding of cancer will become an essential part of the re-evaluation of radiation protection standards that is sure to follow from initiatives such as the Human Genome Project.

### Safety of Nuclear Reactors

The normal operation of nuclear reactors can expose the public to small amounts of radiation through several pathways. These pathways may involve direct external exposure to small amounts of gamma radiation or internal exposures following the intake of radionuclides released into the environment. Population exposures to radiation emitted from existing nuclear power plants during normal operations have been estimated to be less than 0.1% of the total exposure from all natural and man-made radiation sources. Accordingly, overall risks to public health and the environment from radiation exposures from nuclear power plants and the associated nuclear fuel cycle are extremely low. Despite the scientific truth of this situation, individuals and groups have continued to express grave concerns over the safety of nuclear plant operations, primarily because of the unfounded fear of nuclear accidents and concerns about the ability to safely dispose of spent nuclear fuel.

U.S. nuclear power is a mature industry with an impressive safety record spanning 38 years [1]. Plants have accumulated more than 1,640 reactor-years of safe operation, and new reactors are being designed to be even safer. The underground mining and rail transport of coal for combustion is estimated to cause about 280 illnesses and injuries and 18 deaths per gigawatt-year. In comparison, the use of uranium fuel in nuclear power (mining, processing, transporting, and burning) is estimated to cause 17 cases of illness and injuries and one death per gigawatt-year. Therefore, from a health risk perspective, nuclear power presents a significant and safer option for current and future source of energy in the United States.

However, despite the reductions in health risks and the environmental advantages of nuclear power generation (including the avoidance of greenhouse gases and acid rain precursors), the public continues to show considerable concern over the safety of nuclear power facilities and proposed nuclear waste options. And clearly, permanently disposing of nuclear wastes safely is one of the more important environmental responsibilities that we face globally. These concerns have led to a highly variable, quickly changing, and increasingly restrictive regulatory environment. The continuing change in regulations, standards, and limits leads to a high level of economic unpredictability. The uncertainty has contributed to decisions to abandon plans to construct new nuclear power plants and has led to premature closing of plants that have already been constructed.

### Role of the Media and Role of Emotion

The general public relies primarily on the print and broadcast media for information on technological advancements and the impact of technologies on society. Journalists rely on a variety of

sources for technical information, including technical experts, public policy professionals, and environmental and special interest groups, they also seek the sensational. Science writers rely more on technical publications (e.g., reports of the U.S. National Academy of Sciences) and articles appearing in scientific or technical journals. Reporters not only focus on emerging information and discoveries that may have short-term or long-term impacts on society (e.g., the discovery of a potentially effective treatment for a fatal disease), but also on controversial issues because these sustain public interests. Reporting on nuclear issues is particularly attractive to news industry, perhaps because of its link with catastrophic events (such as the recent explosions of nuclear weapons by India and Pakistan), with the publicized controversy surrounding radiation effects, or with the perceived mysterious nature of radiation.

The judgment of the acceptability of risk can be influenced by emotion. The Three Mile Island nuclear power plant accident in 1979 and the Soviet Chernobyl accident in 1986 fueled a successful antinuclear power movement and established the safety of nuclear power as an issue of great public concern. In some segments of society, nuclear power is now considered a dangerous and high-risk energy source. Risk assessment based solely on emotion, however, may itself present a risk, if the emotions block the recognition of other possibilities of even greater risks. The need for a reliable and readily available supply of electricity is well recognized by the public. In considering nuclear power versus other options for meeting energy needs, equivalent comparisons need to be made, that is, benefits, risks, and costs of each option should be examined.

### Assessing Alternative Technologies

Concerns about the increased use of nuclear electric power often leads to proposals for alternative energies as benign solutions for growing power demands. While these popular concerns may be unwarranted, the expectations placed upon alternative energies may also be unrealistic. In the United States, the net summer electrical generating capability in 1997 was 780 gigawatts. This is equivalent to 3,120 250-megawatt generating units [2]. For those who have not toured such a facility, a 250-megawatt power plant is an impressive facility in size, complexity and cost. If the growth in demand is estimated at 1 percent per year through 2020, matching that growth will require the design, permitting, construction, operation, and maintenance of another 7.8 gigawatts of capacity every year, or 30 more 250-megawatt units (oil or coal-fired power plants). If wind is an alternative that meets 20% of the total demand, the design, fabrication, construction, commissioning, operation, and maintenance of 156,000 "decentralized" 1-megawatt wind turbines will be required. The placement and construction of so many wind machines will likely have as much impact on the environment as current technologies. And, while the goal of using renewable resources may be environmentally benign, the equipment and materials to capture and convert those resources is not. Solar power has similar shortcomings.

### Impact of Antinuclear Activists

The March 1997 civil protest in Gorleben, Germany, against the transport of radioactive waste by rail and truck a few hundred kilometers from southern Germany to Gorleben in northern Germany for storage, represents a worst-case scenario for

demonstrations associated with radioactive wastes. Demonstrations are political statements. The demonstrators at Gorleben believed that they were morally right in any attempt to save the earth from "nuclear destruction" [3]. As Futurist Robert Jungk noted in referring to the Gorbelen protest: "Antinuclear activists come from a different frame of reference – use of nuclear energy is directly connected to reduction of civil rights and the reduction of democracy" [4]. The fact that a small vocal minority forces their choices for future energy options on the majority seems to be irrelevant to the discussions. Indeed, the impact of this protest appears to have influenced the present German Government to abandon nuclear power and instead support renewable, decentralized energy sources.

## Conclusions

Communication is a process of negotiation. When and if the needs of the public are to be met by governments, the public must articulate what those needs are. Unfortunately, as we have so frequently found, the many groups and individuals that comprise "the public" espouse conflicting views and display large variations in knowledge, i.e., the public understanding of science remains fragmented. Nordhaus [5] in assessing Sweden's nuclear dilemma noted that choices entail consequences and "it's far easier to be against nuclear power, or for reductions of greenhouse gas emissions, if one hasn't considered the sacrifices that the choices imply". In a democracy, it would be ideal if public interaction resulted in an insightful decision, but more likely it ends without consensus, and government officials are driven to make "political" decisions that are not for the "general and future good", but rather only for today! It would be wiser for governments and all decision makers to ask the question: "what will this decision mean to my children's children?" In the absence of such answers governments continue to struggle with the decision making process. Governments must have a sound, thoughtful, scientifically informed voice. In the United States, the U.S. House of Representatives Science Committee's new report on National Science Policy

[6] calls for a fourth role for science and engineering, in addition to national security, health, and the economy: "that of helping society make good decisions". This role will take on increasing importance, particularly as the global community face increasingly difficult decisions related to the environment. For nuclear power to remain a viable alternative for meeting the demands for future energy, we must call upon the best of our science and engineering professions to collect and analyze the data, and to evaluate the total impacts. With a world population continuing to grow and with ever increasing insults upon our climate and environment, it would catastrophic to mankind if the benefits of an atomic future do not become reality.

## References

- [1] YOUNG, A.L., Chairman (1994): Balancing Radiation Benefits and Risks: The Needs of an Informed Public. Report ORAU 94/F29. Committee on Interagency Radiation Research and Policy Coordination. Office of Science and Technology Policy, Executive Office of the President. Available from NTIS, 5285 Port Royal Road, Springfield, VA 22161, USA
- [2] SCHROEDER, N. (1999): Alternative energies expected to reap the same old environmental problems. *ASMENEWS* 18[3]:2. American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016, USA
- [3] WATSON, E.L. (1999): Smooth shipping: mitigating and avoiding conflict in shipping radioactive waste. *RADWASTE* 6[2]: 33-38
- [4] <http://users.michiana.org/greens/editorial/gorleben.htm>
- [5] NORDHAUS W.D. (1997): *The Swedish Nuclear Dilemma: Energy and the Environment. Resources for the Future*, Washington, DC. ISBN 0-915707-84-5
- [6] "Unlocking our future: Towards a new national science policy" (1998): Interim report, House Science Committee, Washington, DC, 24 September 1998, [www.house.gov/science/science\\_policy\\_report.htm](http://www.house.gov/science/science_policy_report.htm)

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