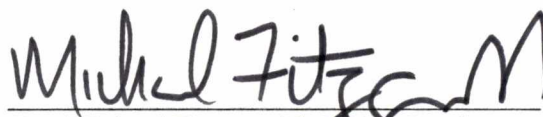
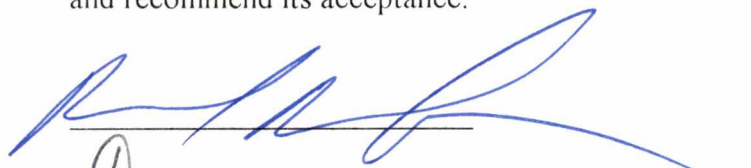
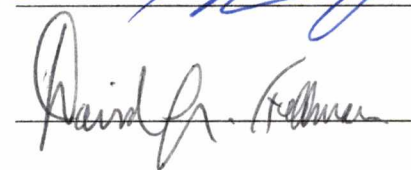


To the Graduate Council:

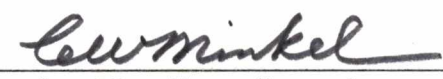
I am submitting herewith a thesis written by Thomas Newton McGalliard entitled "Below Regulatory Concern and Enhanced Participatory Rulemaking: The Changing Policy Process." I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Political Science.


Dr. Michael Fitzgerald, Major Professor

We have read this thesis
and recommend its acceptance:

Accepted for the Council:


Associate Vice Chancellor and
Dean of The Graduate School

BELOW REGULATORY CONCERN AND ENHANCED PARTICIPATORY
RULEMAKING: THE CHANGING POLICY PROCESS

A Thesis

Presented for the

Master of Arts

Degree

The University of Tennessee, Knoxville

Thomas Newton McGalliard

August 1995

DEDICATION

This thesis is dedicated to all the special
people in my family both living and departed who have urged me
to follow my dreams and confront new challenges.

ACKNOWLEDGMENTS

I would like to thank my principal advisor, Dr. Mike "Doc" Fitzgerald, for helping me through the thickets of graduate school. Without his tough-love I never would have made it. I also would like to thank Dr. David Feldman and Dr. Michael Gant for their guidance and patience. Kudos to Dr. Jack Barkenbus and the whole gang at the Energy, Environment, and Resources Center. You folks provided me with the opportunity for graduate school and meaningful work experience. I know it will pay off. A special thanks to Bruce Clemens for being such a terrific boss. Good luck to you as you pursue your own dreams. Finally, thanks to Dr. Saul Bachner for suggesting that graduate school would do me a world of good.

ABSTRACT

This thesis explores the federal government's attempt to establish residual radioactivity standards. In particular, it seeks to explain the failure of the Nuclear Regulatory Commission's below regulatory concern (BRC) policy and describes the attempt to set residual radioactivity criteria through enhanced participatory rulemaking.

It is the contention of this thesis that BRC failed because of changes in the public policy process. New variables including the growth of government, a diffusion and decentralization of governmental authority, the interest group explosion, the expansion of citizen participation in decision making, the mass media, and a lack of trust in major institutions have made it more difficult than ever before to establish public policies for risk management issues that are both effective and acceptable. The Nuclear Regulatory Commission ran headlong into these new forces with its attempts to set residual radioactivity policies and its BRC policy eventually proved to be politically unacceptable. In the end, the NRC attempted a radically new decision making process based upon the idea of stakeholder involvement in order to promulgate effective and acceptable standards.

TABLE OF CONTENTS

CHAPTER	PAGE
INTRODUCTION: A BASIS FOR POLITICAL CONFLICT	1
I. THE DESTROYER OF WORLDS AND THE PEACEFUL ATOM: THE DUALITY OF NUCLEAR ENERGY	13
II. RADIOACTIVE WASTE: THE ACHILLES HEEL OF NUCLEAR ENERGY	44
III. THE TRADITIONAL PUBLIC POLICY PROCESS	63
IV. THE CHANGING POLICY PROCESS	79
V. THE FAILURE OF BELOW REGULATORY CONCERN	121
VI. THE ENHANCED PARTICIPATORY RULEMAKING PROCESS	151
VII. LOOKING TO THE FUTURE	168
REFERENCES	181
VITA	202

LIST OF TABLES

TABLE	PAGE
1. RADIATION DOSE DEFINITIONS	18
2. NUCLEAR POWER REACTORS BY TYPE	33
3. THE REACTOR DEVELOPMENT PROGRAM OF 1952	38
4. LOW-LEVEL RADIOACTIVE WASTE POLICY ACT AMENDMENTS OF 1985	56
5. FEDERAL PROGRAMS REQUIRING INTERGOVERNMENTAL IMPLEMENTATION	87
6. LEGISLATIVE AUTHORITY FOR THE NUCLEAR REGULATORY COMMISSION	123
7. ENHANCED PARTICIPATORY RULEMAKING WORKSHOPS	158

LIST OF FIGURES

FIGURE	PAGE
1. ENERGY USAGE IN THE UNITED STATES	6
2. SOURCES OF RADIATION EXPOSURE	15
3. LINEAR THRESHOLD HYPOTHESIS	22
4. LOW-LEVEL RADIOACTIVE WASTE DISPOSAL IN 1992	48
5. THE TRADITIONAL PUBLIC POLICY PROCESS	65
6. A PUBLIC POLICY PROCESS IN A SHARED POWER WORLD	75
7. CONCEPTUAL FRAMEWORK OF GRIDLOCK IN RADIOACTIVE WASTE	118
8. THE CHANGING POLICY PROCESS	119
9. A STAKEHOLDER BASED PUBLIC POLICY PROCESS	165

INTRODUCTION

A BASIS FOR POLITICAL CONFLICT

They who have turned their attention to the affairs of men must have perceived there are tides in them. Tides very irregular in their duration, strength, and direction, and seldom found to run twice exactly in the same manner or measure.

John Jay

INTRODUCTION

Radioactive waste is a contentious social, economic, and political issue. As Deborah Mostaghel suggests: "If nuclear power was once the goose that laid the golden egg, nuclear waste is now the egg that nobody wants to hatch" (1994: 379). Attempts to establish radioactive waste and radiation protection policies such as the Nuclear Regulatory Commission's below regulatory concern initiative, illustrate the complexities of governing science and technology in the late twentieth century. The dynamics of the public policy process may have changed and the force of its permutations has made it more difficult than ever before to establish radiation protection, radioactive waste, and nuclear energy policies that are both effective and acceptable.

POLITICAL CONFLICT

Robert Dahl in his work, *Pluralist Democracy in the United States*, suggests that humanity continues to live in a world of conflict:

[H]owever strongly human beings are driven to seek the company of one another, and despite millennia of practice, they have never discovered a way in which they can live together without creating situations in which one individual wishes to follow a line of action that would make it difficult or impossible for someone else to pursue his own desires (1967: 5).

The Constitution of the United States was born on a wave of revolutionary conflict, begun after rule by the English monarchy was no longer considered a legitimate form of government for the New World. Following the successful completion of the Revolutionary War, state governments provided the foundation of the American governmental system as set forth in the Articles of Confederation. Alexander Hamilton, James Madison, and many others, however, soon realized that the Articles did not provide an adequate governmental base upon which a new, unified, country could long remain legitimate.

After several months in the long hot summer of Philadelphia, the Founders produced a Constitution. With the Constitution of 1787, the Founders developed a system in which the conflicts of politics, "the mischiefs of faction" could be mitigated. In the often quoted, "Federalist No. 10," James Madison describes two means of moderating the deleterious effects of faction; "one by removing its causes, the other by controlling its effects" (Madison, Hamilton, and Jay, 1982: 43). The first he rejected as adverse to the principles of free government; the American governmental system has been a testament to the second. Political conflict would be channeled through the institutions of a republican democracy. However, as the twentieth century comes to a close, "the mischiefs of faction" seem to be spilling outside the lines of formal institutions and established procedures.

SCIENCE AND TECHNOLOGY

In the late twentieth century, science and technology surrounds, and in many ways, determines numerous human behaviors. Industry, the many forms of the mass media, consumer goods, medicine, the list of scientific and technological advances is too long to fully develop. Though the list is lengthy, applications of science, and new technologies have not escaped the watchful eye of government.

Describing biotechnology and public policy, Richard Barke makes a passionate case for understanding the dynamic relations between science, technology, and government.

Human history does not reveal a long list of useful innovations being permanently shelved, no matter how great their potential for mischief; people and those who lead them generally choose "more" and "better" over "we'd better not." Because of scientific uncertainty about the results of experiments and the implications of experiments for deeply held values, elected officials and judges will be asked to decide whether the promises of biotechnology outweigh the risks of stumbling into the same destiny of the dinosaurs. Their answer will be one of the most fateful political decisions ever made (1986: 1).

At the interface of science, technology, and public policy lies a paradox, one which continues to hamper the effective governance of complex scientific and technological developments. This dilemma arises from the difficulties of reconciling scientific freedom and democratic governance.

A fundamental question remains: how can a western industrial democracy like the United States best balance the need for a healthy scientific republic with the imperatives to maintain a robust democratic republic--how can government shape a science and technology that is *for* the people? (Goggin, 1986: 3-4)

This paradox has resulted in a dynamic situation of evolving institutions, policy actors, and societal responses.

ENERGY

Science and technology offer many vantage points from which to explore government and public policy. None however may be as important or crucial to life as those decisions made in regards to energy. Energy is the engine behind modern human existence. Energy provides the power for advances in science and technology which in turn maintains the nation's national defense capability, health services, industrial base, transportation systems, and everyday domestic needs. From light switches to satellites, energy is the fundamental power source driving industrial societies.

Applications of energy have resulted in many positive benefits, but also new challenges. For example, little concern was given to environmental protection as the United States moved from a rural agrarian society to the status of an industrial superpower. Advances in detection and monitoring capabilities, and a sustained social movement have brought to light the downside of intensive energy usage. The combustion of fossil fuels results in the accumulation of greenhouse gases in the atmosphere leading to speculation that the planet may be headed towards a man-enhanced period of global warming. Acid rain, ozone depletion, chemical runoff, water and air quality, rainforest protection, and biodiversity, are just a few of the many environmental concerns receiving widespread attention.

The federal government of the United States plays a powerful role in the development of institutions, legislation, and regulations for the express purpose of effectively managing the tradeoffs between energy benefits and energy costs, including environmental quality. The universe of energy politics is complex, filled with policy

actors, pieces of legislation, regulations, and external social and economic forces.

Rosenbaum in reviewing energy policy finds it in a state of disarray:

In the past several decades business and government have found long range planning difficult; efficient and expeditious approaches to energy allocation cannot be confidently planned or predictably implemented when decision makers cannot count on a stable policy environment (1987: 18).

Rosenbaum's lamentations are understandable. To the careful observer energy policies appear disjointed, with excessive attention to the short-term. Yet energy problems have few if any short-term solutions. One element of the U.S. energy mix, nuclear energy, has problems that have been magnified by the unsympathetic public policy process of modern times.

NUCLEAR ENERGY

Nuclear energy remains an important contributor to America's energy resources. Although no new facilities have come on-line in many years, nuclear power plants continue to provide roughly 20% of our electrical energy, as shown in **Figure 1**.

Arguably the most difficult problems facing the nuclear power industry continue to be the questions that arise from the issues of radioactive waste management.

Radioactive waste is not the problem of nuclear power plants alone.

Radiopharmaceutical companies, hospitals, industry, research institutions, and federal

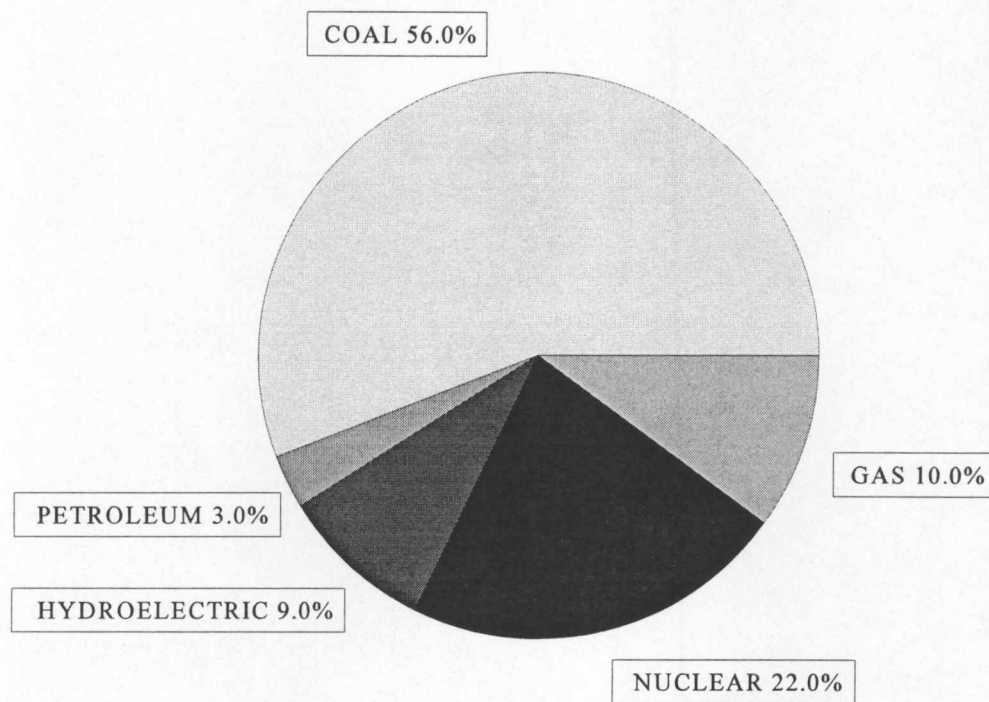


FIGURE 1 - ENERGY USAGE IN THE UNITED STATES

Source: U.S. Nuclear Regulatory Commission. 1994a. *Information Digest*. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

weapons and research facilities all generate significant quantities of low-level and high-level radioactive waste. Some industries such as petroleum companies, and fertilizer producers have realized a growing problem with naturally occurring radioactive materials (NORM), including contamination of extraction piping and equipment.

Radioactive waste also has become a volatile issue for large segments of the American public. Over the past thirty years, the American public has become increasingly skeptical and concerned with the reassurances of industrial and governmental spokesmen. Public opposition to new facilities, the NIMBY phenomenon (not in my backyard), and the NIABY syndrome (not in anyones backyard) has helped to cripple the development of new nuclear power plants and hazardous waste disposal facilities. Further, formerly external intervenor organizations, such as environmental and antinuclear groups, have become powerful voices in radioactive waste politics.

The problems of radioactive waste management are many and varied. One significant difficulty is the belief that future waste disposal costs and capacity constraints at the nation's waste disposal sites could cause some real problems. Moreover, as federal facilities in the Department of Energy's weapons and research complex, nuclear power plants, and other nuclear technology facilities are decommissioned, the existing disposal capacity could be severely strained. In theory, these issues may seem best left to experts in positions of authority, and away from the vicissitudes of politics. In reality however, radioactive waste is very much a political issue.

In response to the potential problems of cost and space, and with an eye on the need for decommissioning standards, the Nuclear Regulatory Commission issued a series

of policy statements commonly known as below regulatory concern (BRC). BRC was a reaction by the Nuclear Regulatory Commission to a growing belief in scientific circles that certain radioactive wastes were so minimally contaminated that those materials could be disposed of by means other than disposal in an NRC licensed, radioactive waste landfill. "Other means" was taken to entail disposal in an unlicensed municipal landfill, incineration, or recycle and reuse of products and materials. As the policy neared implementation, a scattered number of groups and individuals coalesced, and began to vigorously oppose the policy. Soon the rout was on and opposition to BRC burst into full flame. By the time the smoke had cleared, BRC lay dead in the arena of politics.

Recognizing that BRC had been stopped cold, the NRC initiated an enhanced participatory rulemaking process. This rulemaking was designed to involve interested parties in the development of decommissioning criteria for NRC-licensed facilities. More importantly, the process would start from scratch. Interested parties would be involved from cradle to grave in the development of standards.

METHODS

In this thesis, the American public policy process will be explored through a focused examination of the below regulatory concern initiative. The American policy process has significantly changed. New variables, such as the tremendous growth in government since World War Two, a diffusion of governmental authority, the interest group explosion, and a decline in the legitimacy of governmental institutions are affecting the public policy process. Moreover these forces are making it more difficult to establish

both effective and acceptable policies for complex and controversial scientific issues such as radioactive waste management.

The below regulatory concern initiative had the full force of law behind it stemming from Section 10 of the **Low-Level Radioactive Waste Policy Act Amendments of 1985**; however, as the initiative approached implementation, a firestorm of criticism and opposition erupted. Eventually, the authority to implement the BRC policy, as it was designed, was revoked in the **Energy Policy Act of 1992**.

The basic research question of this thesis asks: *why did the below regulatory concern initiative fail?* From this query, answers to related questions will be sought.

1. What have political scientists and other observers of the American political system said about the effects of: (1) the growth of government; (2) a diffusion of governmental authority; and (3) a decline in the legitimacy of institutions as related to the establishment of effective and acceptable public policies? How did these changes affect the BRC initiative?
2. How has radioactive waste decision making been affected by the interest group explosion of the last three decades and the environmental movement? What part did interest groups, especially environmental and antinuclear organizations play in the failure of the BRC initiative?
3. How have regulatory decision makers reacted to the new dynamics of the public policy process and what does this entail for controversial radioactive waste management issues? Is NRC's enhanced participatory rulemaking process a harbinger of new methods for involving the public and interested parties in controversial radioactive waste policies such as BRC?

Chapter 1 of this thesis focuses on the historical development of nuclear energy from the discovery of radiation to the recent applications of nuclear technology. **Chapter 2** is devoted to a discussion of radioactive waste, including a historical look at waste

management practices. Radioactive waste legislation and institutions with appropriate regulatory responsibilities also are examined. Finally, this chapter describes the main points of the NRC's below regulatory concern policy statements. **Chapter 3** reviews relevant literature on public policy and the traditional public policy process. **Chapter 4** describes the variables that are affecting policy making in the late twentieth century including: the growth of government, a diffusion of governmental authority, the effects of the mass media, the role of public participation, the interest group explosion, and the distrust of governmental institutions. **Chapter 5** discusses the failure of the Nuclear Regulatory Commission's below regulatory initiative through the lens of a changed public policy process and offers a conceptual model that better illustrates the gridlock of nuclear waste politics. **Chapter 6** presents "lessons learned" as evidenced by the Nuclear Regulatory Commission's "enhanced participatory rulemaking" process. **Chapter 7** offers conclusions about the Nuclear Regulatory Commission's attempt to establish radiological criteria for decommissioning by using an enhanced participatory rulemaking process.

Below regulatory concern has not been the focus of any political science literature. In seeking to develop an adequate topic for this thesis I looked for a "gap" in the literature. Below regulatory concern has received little attention from the social sciences outside of an article focused mainly on the legal aspects of the policy (Ashe, 1993), a chapter in what is primarily a technical book on low level radioactive waste (Gershey, Klein, Party, and Wilkerson, 1993) and a number of popular press articles. The idea that a level of radiation below which regulation is unwarranted has been the focus of

a number of technical papers and government documents. However, social scientists in general and political scientists in particular have neglected BRC.

The below regulatory concern failure spawned new developments in regulatory decision making. Public participation in developing policies especially in those areas that involve hazardous materials, facility siting, and radioactive waste has increased in recent years. Learning the lessons of below regulatory concern forced several federal institutions to rethink their procedures for acquiring and processing public and affected interests' input into decision making.

Below regulatory concern also is relevant to the Department of Energy (DOE). DOE controls roughly 400,000 tons of radioactive scrap metal that has been generated as a result of activities in the Department's complex. As facilities have been decommissioned, decontaminated, and dismantled, much of the valuable metal has been stockpiled at open-air waste accumulation sites. DOE is expending a tremendous amount of resources trying to decide whether to dispose of or recycle its radioactive scrap metal. One of the underlying problems, is the lack of nationally applicable standards to guide the recycle and reuse of RSM. BRC would have provided such a standard. Though DOE is not subject to NRC regulations, private sector decontamination industries are, and these organizations would actually clean the metal.

The correct road for U.S. energy policy to follow has generated a diverse array of opinions. I think it is critical to state up front my particular biases. I strongly believe that energy efficiency, conservation, and alternative sources are crucial elements of an energy policy. Moreover, I feel that improving and expanding the array of energy technology is

critical and that environmental protection should accompany energy developments. The natural environment houses many spectacular marvels, places to see and enjoy. The old troubadour, Walt Whitman says it best in his poem, *Song of the Open Road*:

Traveling with me you find what never tires
The Earth never tires;
The Earth is rude, silent, incomprehensible at first--Nature is rude and
incomprehensible at first;
Be not discouraged--keep on--there are divine things well envelop'd
I swear to you there are divine things more beautiful than words can tell
(Whitman, [1856] 1973: 161).

I tend to diverge with most of my friends in the environmental and antinuclear movement with regards to nuclear energy. I am willing to give nuclear science a chance to once again prove its mettle. The questions and concerns about nuclear science are real as is the promise of improving technology for the betterment of all.

CHAPTER I

THE DESTROYER OF WORLDS AND THE PEACEFUL ATOM: THE DUALITY OF NUCLEAR ENERGY

Many people regard the atomic discoveries of recent years as part of a nightmare that disrupts the peaceful dreams of civilized man. I do not believe history will see them in that light. We have gained control over natural forces that can advance civilization, even within a single generation, to a point which man has never attained before. I believe firmly that our knowledge of the atom is intended by the Creator for the service and not the destruction of mankind.

Lewis Strauss

INTRODUCTION

From the discovery of radiation to the current stalemate of nuclear power, the history of nuclear science is a story of hope for the betterment of mankind and one of fear. Even the earliest scientists studying radiation believed that someday the secrets of the atom would help build the cities of the future and propel humankind into a new era of technological advancement. However, the atomic bombing of Hiroshima and Nagasaki revealed the destructive power of the atom. And Three Mile Island and Chernobyl have shown that the technological achievements of the peaceful atom can go terribly wrong.

This chapter introduces the reader to the basic concepts of radiation. It also discusses the development of nuclear science from the discovery of radiation to modern technological applications. Retelling the story of nuclear science reveals the two images, hope and fear, that form the duality of nuclear energy, with fear holding the stronger hand today.

RADIATION

"Few scientific issues arouse so much public controversy as the effects of radiation," begins a booklet published by the United Nations Scientific Committee on the Effects of Atomic Radiation (Lean, 1985: 5). Life on planet earth has evolved in a bath of naturally occurring radiation, and by far most human exposure comes from naturally occurring sources. A large portion comes from cosmic rays striking the earth. The earth's crust contains rocks with sources of radiation including uranium-238 and thorium-232. Where a person lives, what a person eats, and how many airplane trips a person takes effects the amount of radiation to which an individual is exposed. Despite these indisputable facts radiation remains a complex and controversial issue. **Figure 2** illustrates the primary natural and man-made sources of radiation exposure.

THE ATOM

Electrons, protons, and neutrons form the basic building blocks of atoms (Moeller, 1994). An electron is a negatively charged particle with a very small mass. Protons, the positively charged particles of an atom are roughly 2000 times the mass of electrons. Neutrons, as the name reflects, are neutral particles, roughly equal in mass to a proton and an electron combined (Moeller, 1994).

The nucleus of an atom contains both neutrons and protons. Like planets circling the sun, electrons orbit the core of an atom. Knowing the number of protons in an atom's nucleus allows one to distinguish the different elements. Atoms of a particular element all have the same number of protons, but can have different numbers of neutrons. Atoms

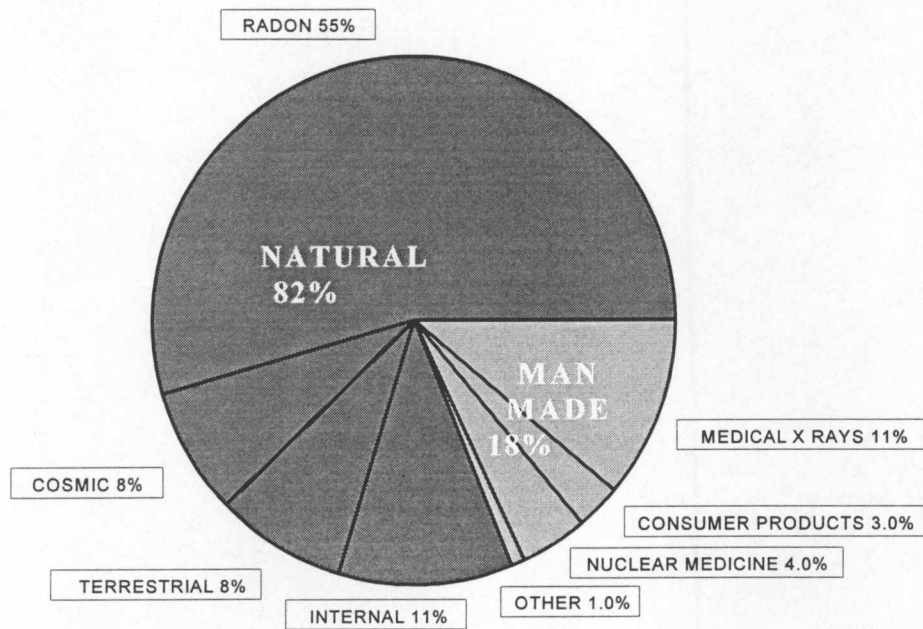


FIGURE 2 - SOURCES OF RADIATION EXPOSURE

Source: U.S. Nuclear Regulatory Commission. 1990a. *Below Regulatory Concern*. NUREG/BR-0157. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

with different numbers of neutrons in relation to a fixed number of protons are called isotopes (Moeller, 1994).

Several atoms are radioactive because they try to reach a point of stability. In the quest for stability, these atoms toss out particles. Some elements are stable; however most are unstable and "relentlessly attempt to become something else" (Lean, 1985: 8). These unstable elements are called radionuclides and the process of becoming something else, radiation. Thus, radiation is the emission of energy brought about by the decay of nuclides.

Radionuclides emit different types of radiation. *Alpha* radiation is the casting out of two neutrons and two protons by an unstable atom (Moeller, 1994). Alpha radiation does not have significant penetrating power and is capable of being stopped by a piece of paper. *Beta* radiation is the result of the ejection of electrons. In the quest for stability, some atoms such as those of uranium will "split into two fragments or two smaller atoms" (Moeller, 1994: 3). This splitting is fission, which is "the heart" of much of nuclear physics (Moeller, 1994: 3). Beta radiation has more penetrating power than alpha radiation and can penetrate a few centimeters beyond the human epidermis. *Gamma* radiation can occur simultaneously with either alpha or beta radiation. Gamma radiation is a release of energy from the nucleus of an atom that has reconfigured following the ejection of alpha or beta particles (Moeller, 1994). Gamma radiation has significant penetrating power and requires heavy shielding such as lead or concrete to block its energy.

A number of methods have been developed as measures of the instability of atoms. The curie and the becquerel are two. A curie is a measure of frequency of decay that equals the release of alpha or beta particles at a rate of 37 billion per second. Frequency of decay is usually expressed in smaller quantities for the sake of radiation protection personnel and standards. A Microcurie is equal to the release of alpha and beta particles at a rate of 37 thousand per second. A picocurie equals a rate of 2.2 releases of alpha and beta particles per minute.

A becquerel is yet another means of measuring the rates of decay. The becquerel measurement was developed in response to a push for a more standard unit of international comparison. One becquerel is equal to a "quantity of radioactive material having a decay rate of one per second" (Moeller, 1994: 4).

Half-life is another means of expressing the decay rates. A half-life refers to the time it takes for one-half of a certain quantity of radionuclides to decay (Moeller, 1994). Some nuclides have relatively short half-lives, such as sodium-24 which needs approximately fifteen hours. (Moeller, 1994). Others such as plutonium have almost incomprehensible half-lives.

The energy of radiation that potentially can damage the human body is commonly referred to as the "dose." **Table 1** depicts the different ways that doses are expressed. The deleterious consequences to life from high doses of radiation are generally well accepted; however at low doses some controversy remains about the actual biological effects.

TABLE 1 - RADIATION DOSE DEFINITIONS

Absorbed Dose: Energy imparted by radiation per gram of tissue.
Dose Equivalent: Absorbed dose weighted for the potential of different radiations to do damage.
Effective Dose Equivalent: Dose equivalent weighted for the susceptibility to harm of different tissues.
Collective Effective Dose Equivalent: Effective dose equivalent to a group of people from a source of radiation.
Collective Effective Dose Equivalent Commitment: Collective effective dose equivalent delivered over time to generations of people.

Source: Lean, Geoffrey, ed. *Radiation: Doses, Effects, Risks*. Nairobi, Kenya: United Nations Scientific Committee on the Effects of Radiation.

Radiation exposure is measured in several ways. A rad is "a unit of absorbed dose or energy absorbed per unit of mass from ionizing radiation" (Yalow, 1988: 240). The effects that radiation emissions cause to biological material is measured in terms of "rems;" thus, a rem is the unit of radiation exposure that takes into account certain biological effects. Typically, the radiation encountered by human beings is measured in terms of millirems which equals 1/1000 rem (Murray, 1989).

Scientists have long been concerned with the potential effects of both low-level and high-level doses of radiation on the human body. The two types of potential dangers are either somatic or genetic (Murray, 1989). Cancer is the most likely somatic danger, while hereditary effects include birth defects or other genetic mutations that are not immediately revealed following exposure.

Different exposure routes can complicate understanding of the deleterious effects of radiation when considering both external and internal pathways of exposure. Several factors are important in the consideration of the potential for adverse health effects resulting from external exposures to radiation. These include:

1. the types of particles released during decay;
2. the energies of those particles;
3. the distance and duration of exposure;
4. any shielding between a person and the source of exposure; and

5. the importance and sensitivity of the organs through which the particles pass (Cox, 1993: 1202).

As Murray (1989) notes, different organs have different tolerance levels for different types of radiation. For example radium is considered bone-seeking. Others such as the radionuclides of iodine can concentrate in the thyroid and provide a diagnostic basis for several medical procedures (Cox, 1993). Moreover, radon gas can affect the lungs and is considered a cancer causing culprit. The Environmental Protection Agency estimates that several thousand cancer deaths per year are attributable to radon (Yalow, 1988). Health risks from internal exposure to radiation are much more complicated than those associated with external exposure. Internal exposure health risks are contingent upon several factors including:

1. the manner in which the body processes the particular nuclides involved, its ability to expel them and the resulting difficulty in determining both the location and duration of exposure;
2. the importance of the particular organ or organs exposed to the radiation and their abilities to withstand ionizing energy; and
3. the types and energies of the particle emissions present (Cox, 1993: 1204).

Scientists have learned much about the effects of radiation on the human body and the environment. Several organizations were developed to study the effects of radiation exposure and to recommend standards and procedures for protection. In 1928, the International Commission on Radiological Protection (ICRP) was formed, followed in 1929 by the National Council on Radiation Protection (NCRP), an organization in the United States (Murray 1989). Other organizations have commissioned studies and

recommended standards for U.S. regulatory authorities, including: the National Academy of Sciences, the National Research Council Committee on the Biological Effects of Ionizing Radiation, publishers of the influential "BEIR" reports, the United Nations Scientific Committee on the Effects of Atomic Radiation, and the International Atomic Energy Agency (Cox, 1993).

Regulatory authorities have developed several assumptions when adopting safety standards for radiation protection. Arguably the most important is the "linear hypothesis." Since World War Two, the idea of a "no threshold dose" has come to dominate radiation protection standards (Yalow, 1988). This hypothesis suggests that the effects of radiation exposure increase in rough proportion to dose; thus there is no threshold below which radiation exposure is said to be "safe." However this hypothesis has been debated within the community of nuclear physics. Some suggest that the linear hypothesis is overly conservative because no directly observable effects can be discerned at very low levels of radiation exposure (Murray, 1988). **Figure 3** illustrates the linear hypothesis.

Since humanity is awash in naturally occurring radiation, regulatory agencies have established a conceptual mechanism for limiting human exposures while balancing the risks of exposure against social gains (Cox, 1993). The ALARA or "as low as reasonably achievable" concept suggests that the risks of radioactive emissions should be weighed against benefits such as electricity from nuclear power plants and the diagnostic capabilities of nuclear medicine.

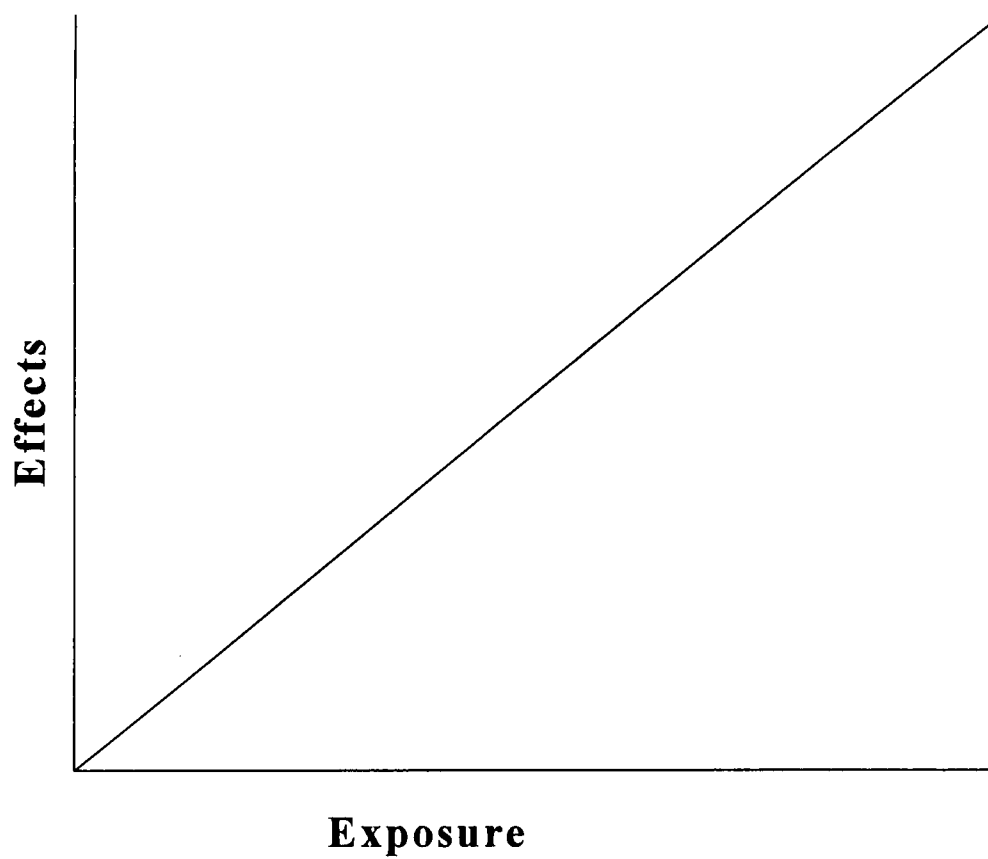


FIGURE 3 - LINEAR THRESHOLD HYPOTHESIS

NUCLEAR SCIENCE: DISCOVERY AND APPLICATIONS

For Daniel Boorstin, "Man the Discoverer" presents an image of the heroic (Boorstin, 1983: xv). For this allusion, he uses one of history's most controversial figures.

The world we now view from the literate West--the vistas of time, the land and the seas, the heavenly bodies and our own bodies, the plants and animals, history and human societies past and present-- had to be opened to us by countless Columbuses (Boorstin, 1983: xv).

Through deductive inquiry and extrapolation, serendipity and imagination, science has brought great good into the world of human existence. Like those in other scientific fields, pioneers studying the atom and radiation were the beneficiaries of their own keen minds, the efforts of others, and a significant allotment of luck. In the history of atomic science, William Roentgen, Antoine Henri Becquerel, and Pierre and Marie Curie are considered the modern "discoverers." Nuclear science has opened new realms of technological applications; however like Columbus, the discoveries of twentieth century physics are a double edged sword. Few would deny that nuclear science has brought much change for the good especially in the field of medicine; but many also would suggest that there has been a severe price.

Roentgen, Becquerel, and the Curies

William Roentgen, a professor at the University of Wurzburg, discovered strange emissions in 1895 while attempting to replicate the experiment of a colleague (Burns and Briner, 1988). After checking his equipment and preparing to conduct the experiment,

Roentgen noticed a peculiar glow in the corner of his makeshift laboratory. These mysterious beams of light he called "X-rays" as "X" stood for the unknown quantity in algebraic equations (Burns and Briner, 1988). Uncertain how his new finding would be received, Roentgen timidly introduced X-rays to the scientific world. Other scientists soon would build upon Roentgen's discovery.

On a January afternoon in 1896, French physicist Antoine Becquerel taped several pieces of uranium bisulfate onto unexposed film cassettes and shoved them in an office drawer. The Frenchman was intrigued by the work of Roentgen. "Becquerel wondered if the fluorescence was induced by ordinary light or by X-rays" (Burns and Briner, 1988: 5). On the day he put away the cassettes the sky was cloudy. Several days later, when he removed them, the cassettes clearly traced the outline of the uranium squares (Burns and Briner, 1988). Becquerel was certain that the images were not caused by exposure to light. His findings intensified the debate: What were these x-rays?

Physics most famous husband and wife tandem, Pierre and Marie Curie, uncovered the truth of the energy emissions. Pierre Curie worked in a Paris laboratory while his wife Marie was a student at the University of Paris (Burns and Briner, 1988). Following the findings of Roentgen and Becquerel, scientists continued to debate whether x-rays were a chemical reaction, or the result of change at the atomic level. Marie Curie's hypothesis for a doctoral dissertation suggested that x-rays were produced by the second (Burns and Briner, 1988).

Her hypothesis was met with skepticism and some hostility. The fact that an element could emit energy challenged the tenets of traditional physics. In 1902, the

Curies now working together were able to determine the atomic weight of radium and place it within the periodic chart (Burns and Briner, 1988).

Radioactivity . . . had at first attracted scant attention. It seemed only a curiosity that a few minerals such as thorium and uranium emitted feeble rays resembling a sort of invisible light. Then Marie Curie discovered the new metal radium, whose rays compared with the whisper from uranium were like a piercing shout (Weart, 1988: 5).

As the twentieth century dawned, radiation experimentation had attracted the eager eye of a new generation of scientists. Neither Roentgen, Becquerel, nor the Curies sought commercial benefit from their discoveries; however, from the forge of scientific discovery, new research, new enthusiasms, and new opportunities quickly arose.

The meager facts known about atomic energy in the early twentieth century were only an ambiguous screen upon which scientists and their admirers could project more urgent ideas. They were building up a tale in which the nuclear physicist was like the legendary alchemist, a man who could work mighty transformations. Atomic energy was coming to stand for things more important than itself. First of all it was coming to stand for all powers of science, powers for the better--or perhaps for the worse (Weart, 1988: 16).

Early Uses of Radiation

Right from the beginning speculation arose in the popular press about the possible applications of these bewildering new discoveries. Unfortunately, radiation often was used before any consideration of possible health affects. Scientific experts and amateurs alike were burned after exposing themselves to many times the radiation dose permitted today. A notorious case is that of the female watch dial painters. Paints laced with radium or thorium were used to create watch dials that could glow in the dark.

The women were not given any safety instructions for working with radioactive materials. The women worked out of small containers of paint which they held in their nondominant hand. They pointed their brushes by drawing them through their lips. Some historians have reported that some of the women found the radium paint so fascinating that they painted their teeth so that they would glow in the dark (Burns and Briner, 1988: 15).

In 1923, several of the watch dial painters were diagnosed with a rare cancer of the jawbone. After a number had died, a study was undertaken by Dr. Harrison Martland that would last for nearly twenty years. This study became one of the first to analyze the potential health effects of radiation exposure (Burns and Briner, 1988).

In the early twentieth century nuclear science was applied in the field of medicine. During World War I, Marie Curie traveled throughout France setting up X-ray machines for the treatment of casualties (Burns and Briner, 1988). Since that time X-rays have been widely used by medical professionals. Other early medical uses included irradiation of skin disorders such as eczema, epidermal cancers, and unflattering hair growth (Ashe, 1993). Radioisotope tracers were first used in 1923 to discover if a boardinghouse manager was serving fresh food (he wasn't). Later in 1926, doctors in Boston used radioisotope tracers to check the flow of blood in the human body (Burns and Briner, 1988).

"During the first decades after the discovery of radiation, there was little government or other control of its uses" (Ashe, 1993: 270). Applications of nuclear science were widely used by traveling vaudevillians and snake oil salesmen. Shoe stores used x-ray machines to measure feet for shoe sizes (Ashe, 1993). Radioactive materials

were found in a number of consumer products. Radiation was fast becoming a commercial enterprise.

An industry arose to meet the demand for radium. The element is rare, a product of the slow transmutation of uranium. So from the jungles of the Congo to the tundra of northern Canada, discoveries of uranium ore raised as much excitement as the discovery of a lode of gold. Indeed, journalists emphasized that radium, gram for gram, cost thousands of times more than other precious metals. Articles about radium often focused on the element's commercial value, strengthening the belief that radioactive matter was valuable beyond compare. How foolish were the alchemists, some writers said, who had sought mere gold! (Weart, 1988: 48)

THE MANHATTAN PROJECT

Advocates of nuclear power are quick to point out that atomic and nuclear weapons are different technologies from that which produces electricity; however both technologies originated with the discovery of fission. Moreover, at the outset of the modern nuclear era, military applications overshadowed the peaceful atom. Atomic energy was a national security issue of vital importance. Science had harnessed the power of the universe and the world had seen pictures of Hiroshima and Nagasaki. Weart suggests that the connection of nuclear energy with images of destruction such as mushroom clouds has not been limited to atomic science:

By the late twentieth century the idea of doomsday would be inseparable from ideas about nuclear energy, but this came only as a late stage in a long process. It was in the early nineteenth century that ideas about the end of the world first began to separate from their original mythical and religious contexts, joining up instead with science (Weart, 1988: 19).

Yet in 1945, the destructive military uses of atomic fission were all too clear. It is a legacy that has survived to haunt the peaceful atom ever since.

Fear and Success

Using the theories of Otto Hahn, Fritz Strassman, Niels Bohr, Otto Frisch, and many others, Enrico Fermi initiated the first chain reaction on December 2, 1942. In a makeshift laboratory underneath Stagg Field on the University of Chicago campus, the newly commenced Manhattan Project had its first real success (Burns and Briner, 1988).

By 1942 the shadow of Fascist Germany lay over most of Europe. Several of the scientists who would contribute to the initial success of the Manhattan Project had fled the Nazi regime. Some such as Rudolf Peierls and Otto Frisch emigrated to Great Britain (Farmelo, 1992). Enrico Fermi "collected his Nobel prize in Stockholm and fled with his family to the U.S." (Farmelo, 1992: 27). In the United States, Fermi was offered a position at Columbia University, and was later joined by Leo Szilard a Hungarian physicist who had left Europe in 1933 following Hitler's ascendance to the German Chancellorship (Farmelo, 1992).

Western physicists continued to refine their theories between 1939 and 1942. At first the U.S. government seemed little interested in their work. In 1939, Albert Einstein was persuaded by a group of fellow physicists to write a letter to President Roosevelt. The letter revealed several important findings.

Some recent work by E. Fermi and L. Szilard, which has been communicated to me in manuscript, leads me to expect that the element uranium may be turned into a new and important source of energy in the immediate future. Certain aspects of the situation which has arisen seem to call for watchfulness and, if necessary, quick action on the part of the administration (Einstein, [1939] 1991: 10).

Einstein revealed that the two best sources of uranium in the world were located in the Belgian Congo and Czechoslovakia. In 1938, the Germans had been ceded the

Sudetenland by the West in an act of appeasement to avert a destructive war with Hitler's Germany. Following the surrender, the Germans quickly took control of the Joachimsthal uranium mines (Cantelon, Hewlett, and Williams, 1984). Western physicists feared that Nazi Germany would develop an atomic weapon, holding the world hostage with its destructive potential. Even Einstein's letter did not elicit much government support (Farmelo, 1992). Soon however, the United States government, on the verge of war in both Europe and Asia, began to take a great interest in atomic science. Frisch and Peierls working in the United Kingdom explained how uranium could be calibrated into weapons grade material. Moreover, the pair suggested that the amount of uranium needed to initiate a chain reaction would fit within a bomb casing, albeit a large one (Brown, 1992).

The possible construction of "super-bombs" based on a nuclear chain reaction in uranium has been discussed a great deal and arguments have been brought forward which seem to exclude this possibility. We wish here to point out and discuss a possibility which seems to have been overlooked in these earlier discussions (Frisch and Peierls, [1940] 1991).

Arthur Compton headed the U.S. research team given the task of producing a sustained nuclear reaction (Weart, 1988). Enrico Fermi became the chief architect of a graphite/uranium pile, "Chicago Pile-1 or CP-1," that was housed on the University of Chicago campus (Farmelo, 1992: 29). In early December, 1942, Fermi's team was ready to run their monumental experiment.

Fermi, the chief builder of the pile, set up strict precautions for its first run. To control the chain reaction was simplicity itself: into the pile Fermi sank a rod containing cadmium, a metal that greedily absorbs neutrons. As the rod was gradually pulled out, the number of neutrons bouncing around within the pile

would increase, and if something began to go wrong the man holding the rod only had to shove it back in (Weart, 1988: 86).

A number of redundant safety precautions had been designed in anticipation of any unforeseen dangers. Several scientists, however, were concerned that the fission research was occurring in downtown Chicago. The uncertainties of their work suggested to many that a more isolated location should have been selected. In the end, Arthur Compton decided that the war and national security necessitated certain risks (Weart, 1992). Fermi began the experiment.

The watchers who crowded into the room saw only a tedious inching out of the control rod while Fermi made calculations, until he announced that the chain reaction was self sustaining. It should have been about as exciting as watching someone tune a radio, yet for those present it was unforgettable. Some like Szilard, left the room troubled by thoughts of weapons, while others thought of the potential of reactors for bringing a shining industrial future. Compton believed the event was a "miracle," the birth of a new era (Weart, 1988: 87).

The Destroyer of Worlds

General Leslie Groves was given overall command of the Manhattan Project.

[I]n terms of capacity and ability to get things done few could surpass Leslie Groves. Forty-eight years old when he assumed command of the Manhattan Project, he was tough, tireless, and relentless. He worked fifteen hours a day and expected similar dedication from those around him. He possessed a vocabulary capable of blistering a construction worker and an ego which constantly assured him that his every decision was the correct one (Johnson and Jackson, 1981: 3-4).

Groves was not widely admired by his subordinates and the scientists who worked with him. Similarly, Groves "did not suffer fools easily . . . and there seemed to be many, especially among the scientists of the Manhattan Engineering District" (Johnson and Jackson, 1981: 4). Groves wanted to move the Manhattan Project in a systematic manner

from the research of nuclear physics to the ultimate manifestation, an atomic weapon.

His standards would continually conflict with those of Project scientists.

Robert Oppenheimer was selected by Groves, as the scientific director of the Manhattan Project. During the early 1950s "Oppie" would fall victim to McCarthyism and the paranoia of the time. Oppie had voiced concerns about the wisdom of developing the hydrogen bomb. This opposition led to a suspension of his security clearance. In the 1960s and 1970s his reputation would be restored to its proper place in history and his contributions to the overall success of the Manhattan Project would be recognized.

The first bombs largely were built in Los Alamos, New Mexico, a recondite government facility in the desert hills outside of Santa Fe. Other "secret cities" were built in Washington state and Tennessee in order to support the project. Oak Ridge, Tennessee, is described by Johnson and Jackson (1981), as "the city behind a fence." The Oak Ridge facility was built for the production of Uranium-235. The Hanford facility, in Washington state developed plutonium.

The Manhattan Project required unprecedented levels of secrecy and unusual chains of command. A memorandum from Oppenheimer to General Groves reveals a plan for concealing the real work ongoing at Los Alamos. He suggests that a false story describing "rocket research" at Los Alamos be leaked to assuage the curiosity of locals (Oppenheimer, [1943] 1991). General Groves reported directly to Cabinet level officials, primarily the Secretary of War and the Chief of Staff, bypassing his military superiors (Burns and Briner, 1988). Many in the upper hierarchy of the military would not know of the Manhattan Project until the city of Hiroshima was destroyed.

By July 1945, project scientists were ready to test a prototype. On July 16, 1945, a bomb was detonated, just before sunrise, at the Trinity site in the New Mexico desert. Project scientists, military personnel, and a reporter, William Laurence, watched the explosion from a protected bunker 10,000 yards from ground zero. Shortly after the explosion, Laurence turned to Oppenheimer asking for his thoughts:

As Oppenheimer watched the cloud boil miles over his head, multicolored and radiant, he had recalled a passage from an ancient Hindu scripture that described a vision of the divine Krishna suddenly growing to reach from earth to heaven, taking on a dazzling multicolored form with numberless arms and eyes, numberless flaming jaws that swallowed whole armies: "I am become Death, the destroyer of worlds" (Weart, 1988: 101).

Science had managed to harness a terrific power; men would now decide how best to use that power. Almost a month later the Japanese cities of Hiroshima and Nagasaki were obliterated by atomic bombs forcing Japan to surrender. The atomic age truly had begun.

THE DEVELOPMENT OF COMMERCIAL NUCLEAR ENERGY

Worldwide there are over 400 nuclear power reactors producing 330,000 megawatts of electricity (MWe) (U.S. Nuclear Regulatory Commission, 1994c). Pressurized light-water reactors and boiling light-water reactors make up over 78% of the total number. **Table 2** lists the total number of worldwide reactors by type and net generation of electricity.

The United States has 109 nuclear power reactors in operation, roughly one-fourth the total number of operational reactors worldwide; however in this country the construction of reactor units has for all practical purposes come to a halt. Other nations,

TABLE 2 - NUCLEAR POWER REACTORS BY TYPE

REACTOR TYPE	NUMBER OF UNITS	NET MWe
Pressurized light-water reactors	239	210,226
Boiling light-water reactors	91	74,885
Gas-cooled reactors, all varieties	36	12,139
Heavy-water reactors, all varieties	34	18,793
Graphite-moderated light-water reactors	15	14,785
Liquid metal fast-breeder reactors	4	1,178
TOTAL	419	332,006

Source: U.S. Nuclear Regulatory Commission. 1994c. *Information Digest*. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

such as France and Japan, continue to surge ahead with ambitious construction programs. According to the U.S. Nuclear Regulatory Commission's (1994c) *Information Digest*, France has six reactors under construction and in Japan eight reactor units are in various stages of development. Sweden, however is committed to shutting down all nuclear power plants by early in the twenty-first century (Jasper, 1990).

Since 1975, in the United States, over 60 planned reactors have been officially canceled through public announcement or written notification with the NRC (Nuclear Regulatory Commission, 1994c). Others have been shut down, due to safety precautions, financial woes, or management problems. Many projects have been halted after construction had already begun. Although few, if any, new facilities will be built anytime soon, nuclear power continues to be an important contributor to the U.S. energy mix.

Boom and Bust

In 1962, the first operating license was issued for a commercial nuclear power reactor. The Big Rock Point facility, northeast of Charlevoix, Michigan commenced operations in 1963 (U.S. Nuclear Regulatory Commission, 1994c). Other facilities would be built during the boom years of nuclear power. The Manhattan Project, powered by the winds of war had ushered in a new era. Scientists were convinced that atomic science could be used for the benefit of mankind. Applications for medicine could be improved and the peaceful atom could be used for the generation of electricity.

In the mid-1940s, new choices about nuclear science had to be made. How should atomic energy be regulated? Controlled? Managed? Which institutions would wield governmental authority over nuclear technologies? Some argued that atomic energy was a national security issue; thus the military should retain authority (Burns and Briner, 1988). The question of authority was answered in 1946 with passage of the **Atomic Energy Act (AEA)**. The AEA of 1946 created the Atomic Energy Commission (AEC), the Joint Committee on Atomic Energy (JCAE), and the General Advisory Committee thereby asserting civilian control over nuclear policies (Sylves, 1987). The second big question was whether or not to develop a commercial nuclear industry. Optimism ran high that a viable nuclear energy industry could be formed if given the proper federal support.

On December 8, 1953, during a speech before the United Nations General Assembly, President Eisenhower introduced the idea of a "peaceful atom" (Jasper, 1990). Eisenhower talked about the dangers of the Atomic Age, specifically the threat of nuclear destruction, and the likelihood that atomic power "eventually will be shared by others, possibly all others" (Eisenhower, [1953] 1991: 98). Late in his talk, Eisenhower discussed an "international atomic energy agency" that would promote peace and in particular promote the peaceful use of fissionable material:

The more important responsibility of this atomic energy agency would be to devise methods whereby this fissionable material would be allocated to serve the peaceful pursuits of mankind . . . A special purpose would be to provide abundant electrical energy in power starved areas of the world. Thus the contributing powers would be dedicating some of their strength to serve the needs rather than the fears of mankind (Eisenhower, [1953] 1991: 102-103).

Eisenhower was a man admired by many. Hero of World War Two, his words carried great weight. His urging for the peaceful use of the atom were heard, especially in his own country. In the following year the **Atomic Energy Act of 1954** was passed amending the earlier 1946 Law. The AEA of 1946 had prescribed a government monopoly on virtually all elements of nuclear energy; further, nuclear energy was shrouded in government secrecy as a measure against the proliferation of nuclear technologies. Even World War Two allies such as Great Britain, France, and Canada were kept in the dark about U.S. research (Clarfield and Wiecek, 1984).

According to Clarfield and Wiecek, the Atomic Energy Act of 1954 altered the earlier Act in several important ways.

1. the federal government would promote nuclear research and development;
2. there would be a less restrictive dissemination of unclassified data;
3. it provided a new scheme for the government's control of the use and production of nuclear energy;
4. it encouraged private industrial participation in the development of nuclear power;
5. it promoted international cooperation in nonmilitary applications (1987: 186).

The critical stages of nuclear technology development are traceable to decisions made during the 1940s. At that time, several reactors were put forth as those best suited for a viable nuclear power industry (Morone and Woodhouse, 1989). According to Morone and Woodhouse, "the perceived scarcity of uranium during the 1940s strongly influenced the scientists working on peaceful applications of atomic energy" (1989: 31). Early on, breeder reactors, ones which could generate fissionable materials received

widespread attention. After several years of research, scientists realized that breeder reactors were only in the very early stages of development. Attention then turned to other technologies (Morone and Woodhouse, 1989). By 1952 the Atomic Energy Commission had established a civilian reactor division and began to study several reactor types in anticipation of commercial applications. This program focused on four reactors including the fast breeder. **Table 3** lists the four types and the main reasons they were selected.

In 1953 however, the Eisenhower administration ordered broad cuts in the federal budget and the Atomic Energy Commission was forced to scale back its research efforts (Morone and Woodhouse, 1989). Many of the atomic energy projects of the AEC were canceled; however one important project remained--the design, construction, and operation of a nuclear power facility. In 1957 the Shippingport Reactor in Pennsylvania came on-line and "provided substantial impetus for the commercial application of light-water technology" (Morone and Woodhouse, 1989: 44).

The early years of civilian nuclear power and decision making by the AEC and other policy actors were dominated by short-term forces. The early emphasis on breeder technology was driven by a perceived lack of fissionable material to fuel nuclear reactions. Light-water reactor (LWR) technology was further along than other technologies. The Shippingport prototype demonstrated the technology's usefulness. Moreover, the LWR program was a "clever response to budgetary constraints" (Morone and Woodhouse, 1989: 45). Not only was a commercial prototype brought on-line in a relatively short period of time, the navy's desire for a reactor suitable for ships and

TABLE 3 - THE REACTOR DEVELOPMENT PROGRAM OF 1952

REACTOR TYPE	MAIN REASONS SELECTED
Fast breeder	Most likely to breed; potential low-cost power producer.
Homogenous	Believed to be technically simpler than fast breeder; most likely to breed among slow types; potential low-cost power producer.
Pressurized water	Could be developed quickly; would fit a submarine; applicable both to aircraft carrier and to commercial use.
Sodium-graphite	Sodium a good coolant; different technology, so AEC would learn from it.

Source: Morone, Joseph G. and Edward J. Woodhouse. 1989 *The Demise of Nuclear Energy*. New Haven: Yale University Press.

submarines also could be met (Morone and Woodhouse, 1989). LWRs were the choice of technology enthusiasts in the United States.

No other reactor type was so fully developed here, so there were no serious alternatives to be vanquished. But the commercialization of the LWR was hardly inevitable even in the United States. Technological enthusiasts at the Atomic Energy Commission had struggled for a decade to force the LWR on utilities before the first commercially competitive LWR was sold in 1963 (Jasper, 1990: 41).

The 1950s and 1960s were a time of heady optimism for nuclear energy enthusiasts; however, according to Jasper (1990), much of the enthusiasm was contained within a small circle of scientists, and the Atomic Energy Commission. "Technological enthusiasm" paved the way for many of the early successes of nuclear power; yet it also resulted in short-sighted planning (Jasper, 1990). Nuclear power proponents overlooked the potential problems of the developing industry including: how to effectively manage the back-end of the nuclear energy cycle, radioactive waste; and what to do when facilities reach the end of their useful lives.

Public utilities had been reluctant to build nuclear power plants for a number of reasons, but primarily the uncertainties of liability. What were the potential consequences of a reactor mishap? Studies were undertaken to determine the hypothetical outcomes of a "maximum credible accident" (Morone and Woodhouse, 1989: 76). Industry spokesmen strongly urged the federal government to come up with a policy indemnifying utilities from the liability of reactor mishaps. Without a safety net, the unknown liability risks were inhibiting industrial ventures. "Utilities and industry were off the hook" when the Price Anderson Act was passed in 1957 (Jasper, 1990: 43).

In the early 1960s, technological enthusiasm began to spread to the private sector. The late 1960s until the mid 1970s were the "great bandwagon market" for nuclear power (Jasper, 1990; Morone and Woodhouse, 1989). Through 1968, utilities had ordered more than 70 plants with a total expected generating capacity of 63,000 MWe (Jasper, 1990).

By 1975, the great bandwagon market was booming. 56 reactors were completed, 69 were in various stages of construction, and over one hundred more were planned (Rosenbaum, 1987). "Never again would the nuclear dream seem so bright" (Rosenbaum, 1987: 137). Soon, revelations of safety problems and mismanagement, coupled with climbing costs, an emerging antinuclear movement, and a series of accidents dimmed the nuclear dream. If nuclear energy, powering pollution free cities, was once the hope of a nation, by the 1980s it had become a disgraced industry with few predicting a revival anytime soon.

NUCLEAR TECHNOLOGIES AND RADIATION PROCESSING

Electricity generation is the most visible application of nuclear technologies; however, several other industries employ radiation. For example, medical diagnosis and treatment techniques have benefitted from radiation technologies. One of the earliest applications were the x-ray machines. Today radiation processing is used to sterilize medical instruments and pharmaceutical ingredients (Machi and Iyer, 1994). Radiation tracers are used to check for disorders in certain organs and the bloodstream. Further, radiation is widely used in the treatment of certain cancers.

Industrial radiography is used to "detect any imperfections, voids, or alien material in the sample being investigated" (Bergman and Petterson, 1994: 36). For example, radiation sources are used in construction to check for flaws in welded joints. The manufacturing sector, especially steel manufacturers, can use radiation gauges to check the quality of their products. Other industries are capable of detecting leaks through the applications of industrial radiography (Bergman and Petterson, 1994). Gauges that measure for density, thickness, and moisture are widely used by a number of industries.

Nucleonic control systems are yet another application. Used in the mining sector, nucleonic control systems can check the quality of boreholes and ores. The coal mining industry applies nucleonic control systems to check for ash content and potential impurities. For reasons of boiler efficiency and pollution prevention, the quality of coal is important to utilities. Nucleonic control systems allow the coal mining industry and coal suppliers to more accurately check the quality of their product (Machi and Iyer, 1994).

Food is sometimes irradiated to kill harmful bacteria (Swinwood, Waite, Kruger, and Rao, 1994). In the United States, a number of facilities are authorized to use radiation on produce and meat products (Loaharanu, 1994). An obvious concern with irradiated food products has been the question of consumer acceptance. Thus far, consumers around the world have been willing to purchase irradiated products (Loaharanu, 1994).

CONCLUSION

The earliest resistance to nuclear power is seen in the unwillingness of the private sector to adopt the technological enthusiasms of the federal government and nuclear scientists. Moreover once it appeared that LWR technologies were a firmly established commercial endeavor, the AEC shifted course. As Jasper suggests, "the AEC abandoned its offspring" in the search for other technologies such as breeder reactors.

Technological optimism also dazzled the AEC with the prospect of further wonders to be uncovered with more advanced technology, while blinding it to the mundane but vital tasks involved in the diffusion and routine operation of the LWR (Jasper 1990: 51).

Within the AEC, a controversy arose. Many felt there was much work to be done before LWR technology could be understood, and before a reasonable degree of confidence in the technologies reliability and safety could be reached.

A number of works offering different explanations have chronicled the downfall of nuclear energy (Jasper, 1990; Morone and Woodhouse, 1989; Weart, 1988; Campbell, 1988; Joppke, 1993). Many of the reasons often cited fall under the rubric of mismanagement and safety concerns. Others note the influence of the antinuclear movement (Joppke, 1993; Price, 1990). Weart offers the most intriguing explanation of nuclear energy's failure. In his book *Nuclear Fear*, he suggests that nuclear energy has become the heir of mystical alchemy and "that the images we cherish have a greater role in history than has commonly been thought" (1988: xiii). And the images of fear have come to dominate.

Twenty years ago the wildest dreams of technological enthusiasts were becoming reality. But the past two decades have seen a blighting of nuclear hopes. Of particular concern to many observers and experts alike is the Achilles heel of nuclear energy-- radioactive waste.

CHAPTER II

RADIOACTIVE WASTE: THE ACHILLES HEEL OF NUCLEAR ENERGY

With Hector dead, Achilles knew as his mother had told him that his own death was near . . . he had driven the Trojans before him up to the wall of Troy. There Paris shot an arrow at him and Apollo guided it so that it struck his foot in the one spot where he was vulnerable, his heel. His mother, Thetis, when he was born had intended to make him invulnerable by dipping him into the River Styx. But she was careless and did not see to it that the water covered the part of the foot by which she was holding him.

Edith Hamilton

INTRODUCTION

Nuclear power continues to face tough opposition to further development. The most difficult social, political, economic, and technological questions involve management of radioactive waste. Ashe effectively sums up the evolution of radioactive waste policies and public perceptions:

During the last century, government regulation of radioactive waste has evolved from simple neglect to a system of detailed regulations enforced by powerful regulatory agencies. Meanwhile public reaction to radioactive waste has grown from naive ignorance to intense fear and skepticism of the effectiveness of both the regulations and the agencies (1993: 268).

CLASSIFYING RADIOACTIVE WASTES

In the United States, radioactive wastes are classified in a number of ways. The different classifications are central to the management of wastes, because different types are regulated according to separate standards and procedures. Moreover, different

agencies control wastes produced by different institutions. The broadest level of classification is the distinction between defense and commercial wastes.

Defense wastes began with the Manhattan Project. The development of nuclear weapons since that time has produced enormous amounts of defense wastes. The second broad category originates in the commercial sector. These wastes are generated mainly through the operation of nuclear plants, fuel processing facilities, research reactors, and through medical uses.

Yet another classificatory schema separates wastes according to radioactivity. High-level wastes (HLW) are generally spent fuel or materials that result from reprocessing (Murray, 1989; Gershey, Klein, Party and Wilkerson, 1990). High-level radioactive wastes, with long-lived and dangerous radionuclides, pose the most serious health hazards. The DOE is currently seeking a long term repository for spent fuel rods and other high level wastes. The **Nuclear Waste Policy Act of 1982** ordered the DOE to select a site and management procedures for final storage of high-level wastes (Gershey, Klein, Party, and Wilkerson, 1990). Yucca Mountain in Nevada is currently being studied as the site for permanent storage. Controversy, scientific and political, continues to confront the Yucca Mountain selection. Even optimistic observers do not predict a long term repository opening until well into the twenty first century.

Transuranic wastes "are the by-products of fuel assembly, weapons fabrication and reprocessing operations" (Murray, 1989: 58). These wastes are composed of isotopes with long half lives, generally materials with atomic numbers greater than uranium. The

primary source of transuranic wastes is plutonium production (Gershey, Klein, Party, and Wilkerson, 1990).

Mining and milling tailings are yet another form of radioactive wastes. Rocks, sludges, and liquids, generated during the mining of uranium and thorium can retain residues of these two elements. Further, daughter products such as radium also are usually present in mining wastes (Gershey, Klein, Party, and Wilkerson, 1990). Mill tailings result from the processing of uranium ore. A nuclear power plant can use upwards of 150 tons per year of natural uranium to generate electricity. The Uranium Mill Tailings Remedial Action Program (UMTRAP) is a federal activity run by DOE, that manages ore processing facilities.

Mixed wastes are materials contaminated with radiation; however these wastes also are tainted with hazardous chemicals (Murray, 1989). Some are very toxic substances such as lead, mercury, PCB's and DDT (Murray, 1989; Gershey, Klein, Party, and Wilkerson, 1990). Mixed wastes present a tricky regulatory conundrum. EPA, NRC, and various state agencies maintain regulatory authority over aspects of mixed waste management.

Some radioactive wastes are unregulated or only partially regulated. For example smoke detectors, emergency exit signs, and many luminescent watches use small quantities of radioactive material. While there are regulations guiding disposal and most products are sold with warning labels, consumers pay little attention and toss these sources into the trash at the end of their useful lives (Gershey, Klein, Party, and Wilkerson, 1990). Naturally occurring radioactive materials (NORM) and accelerator

produced radioactive materials (NARM) are subject to a smattering of state laws but no federal guidance. As mentioned earlier the oil and gas industry has been confronted with a crisis in recent years, after radiation was measured at higher levels than expected on piping and extraction equipment (Clemens, McGalliard, Kerlin, and Miller, 1993). Oil production generates a certain amount of debris known as scale that sometimes contains radium. Like plaque inside human arteries, NORM contaminated scale can gradually accumulate on the inner wall of pipelines producing yet another classification of radioactive waste. A 1993 study by Gross and Barisas found that only a few states have fully promulgated standards for NORM waste management. Most states regulate NORM on a case-by-case basis. A survey revealed that regulators do not feel that NORM is a problem in their state, and that their current regulatory framework is "sufficiently comprehensive" (Gross and Barisas, 1993: 1248).

The final category and the most abundant types of radioactive wastes are categorized as low-level radioactive wastes (LLRW). Commercial LLRW are further delineated into three general classes--A, B, C. A fourth category is listed as "greater than class C waste" (Gershey, Klein, Party, Wilkerson, 1990). Class A waste is the least radioactive but exists in far greater concentrations than either B or C materials. For perspective, **Figure 4** illustrates total amounts of class A, B, and C low-level radioactive wastes received by U.S. commercial disposal facilities in 1992.

Low-level radioactive wastes are generated through a number of nuclear energy practices. Generators fall into four basic categories. Nuclear power plants and fuel cycle facilities generate a significant amount of compacted trash, dry wastes, used

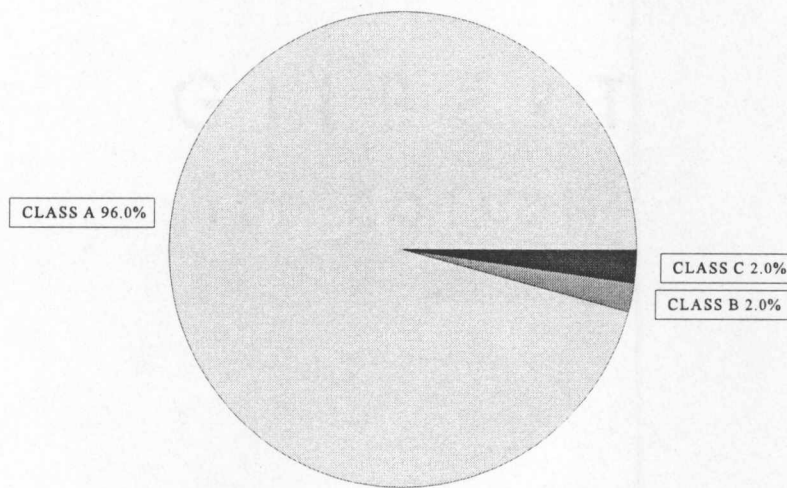


FIGURE 4 - LOW LEVEL RADIOACTIVE WASTE DISPOSAL IN 1992

Source: U.S. Nuclear Regulatory Commission. 1994c. *Information Digest*. Washington, D.C. Nuclear Regulatory Commission Public Documents Room.

filters, and retrofitting materials. Industrial generators include radiochemical companies and producers of consumer products such as smoke detectors, luminous devices, static eliminators, and moisture gauges. Further some corporate research laboratories also contribute to the waste stream. Universities, nonprofit research organizations, hospitals, and medical facilities are institutional generators. Finally, the federal government generates a tremendous amount of low-level radioactive wastes though its wastes generally are managed under different guidelines than commercial wastes (Gershey, Klein, Party, and Wilkerson, 1990).

RADIOACTIVE WASTE DISPOSAL: THE EARLY YEARS

Scientists in the early years of radiation research were not overly concerned with radioactive waste disposal. The amounts were small. Further, there was little in the way of regulation to guide scientists. Burns and Briner suggest that “dilute and disperse” were the guiding principles behind radioactive waste disposal (1988: 29). Wastes were either, “burned, buried in shallow trenches, allowed to evaporate, or poured down the sewer” (1988: 29).

With the onset of the Manhattan Project, the amounts and types of radioactive wastes rapidly increased. Waste management however, remained of secondary concern during the race to develop an atomic weapon. Early disposal methods did not change significantly as shallow land burial, incineration, and pouring liquid wastes down the drain, remained the preferred waste management procedures (Burns and Briner, 1988).

The AEC was given responsibility for managing atomic energy including the disposal of wastes, which occurred primarily at federal sites around the country. These sites included facilities in Hanford, Washington; Oak Ridge, Tennessee; Idaho Falls, Idaho; Los Alamos, New Mexico; and Savannah River, Georgia (Burns and Briner, 1988).

Ocean dumping was another means of disposal. Between 1951 and 1969, some 85,000 containers of LLRW were dumped in both oceans bordering the United States (Oak Ridge National Laboratory, 1993). Over 4,000 drums were sent to the bottom of Massachusetts Bay! (Oak Ridge National Laboratory, 1993). Fortunately, this method was ended by the United States in 1970 (Burns and Briner, 1988).

In 1959, the **Atomic Energy Act of 1954** was amended. The amendments included provisions for allowing states to establish and direct programs for radiation protection (Burns and Briner, 1988). At first, the AEC resisted any decentralization of its authority. For example, in 1961 the State of Kentucky applied for agreement state status. AEC regulations required that agreement state programs should be as stringent as federal standards; further all agreement state applications would have to be reviewed by the AEC. Kentucky received an agreement states blessing from the AEC with clarification, the state would not initially have authority over low-level radioactive waste disposal (Burns and Briner, 1988).

Other states besides Kentucky also clamored for more control of nuclear waste disposal within their own borders and "in 1962 the Southern States Governor's Conference . . . voiced objections over the AEC's absolute control over LLRW disposal"

(Burns and Briner, 1988: 39). By the end of that same year, the first commercial disposal facility for LLRW opened in Beatty, Nevada, soon to be followed by another site in Kentucky. The days of AEC management of disposal sites was coming to an end, at least for commercial wastes. The market would handle things from here on. An AEC official is reported to have remarked: "If states assume jurisdiction in this matter (LLRW) each state would want a burial site within their own borders" (Burns and Briner, 1988: 39). As the coming sections will show, this unnamed official could not have made a poorer prediction.

COMMERCIAL DISPOSAL FACILITIES

The history of commercial disposal sites is not a record of exemplary performance. "Initially the sites were licensed and operated with limited regulation and poorly defined performance criteria" (Gershey, Klein, Party, and Wilkerson, 1990: 47). Since the opening of Beatty, several other commercial facilities have commenced operations, and four have closed. A site in Maxey Flatts, Kentucky was opened in 1963 and operated until 1977 by US Ecology Corporation. In the early 1970s, studies conducted at the site and in surrounding areas discovered the infiltration of water in burial trenches. Radiation also was detected migrating off-site (Gershey, Klein, Party, and Wilkerson, 1990). Kentucky state health officials temporarily closed the facility in 1976 in order to search for a solution to the water problems. After no acceptable solution was discovered the facility was permanently closed the following year and the state of Kentucky assumed responsibility for cleaning up the mess.

Another site operated by Nuclear Fuel Services was opened in 1963 at a location in West Valley, New York (Gershey, Klein, Party, and Wilkerson, 1990). As with Maxey Flatts, water intrusion and contamination became a health and safety concern in the early 1970s. By 1975, the sites waste acceptance program was "voluntarily" shut down and no further disposal has occurred (Gershey, Klein, Party, and Wilkerson, 1990: 52). A third site to close was located in Sheffield, Illinois. Once again water proved an insolvable problem and the facility ceased waste acceptance operations in 1978.

On December 31, 1992, the first commercially licensed site officially stopped accepting LLRW (Oak Ridge National Laboratory, 1993). In operation since 1962, Beatty accounted for over 9% of the total volume of commercial low-level radioactive wastes disposed, as of the end of 1992 (Oak Ridge National Laboratory, 1993). Together the four closed sites received nearly 40% of all low level radioactive wastes buried through the land disposal option (Oak Ridge National Laboratory, 1993).

Three operating facilities continue to accept LLRW. One site is located in Barnwell, South Carolina, adjacent the Savannah River weapons development complex. Another in Hanford, Washington, is housed within the federally owned Hanford Nuclear Facility. A third site, rarely heard of outside of the industry, is owned and operated by Envirocare and is located in Clive, Utah. Envirocare will accept some LLRW such as high-volume, low-activity soils; however the facility primarily came into being to meet the needs of mixed waste disposal (U.S. Nuclear Regulatory Commission, 1994c).

Between the two, Barnwell and Hanford have accounted for nearly 60% of the total volume of commercial LLRW disposed in the United States (Oak Ridge National

Laboratory, 1993). If volume acceptance is an adequate litmus test, then Barnwell has been a highly successful disposal site. Success however has a price. For Barnwell and the residents of South Carolina, this meant that with the closures of other disposal facilities in the 1970s the low-country of southwestern South Carolina could possibly become the primary dumping ground for LLRW. The state of South Carolina made it very clear that this was unacceptable. For example, following the Three Mile Island (TMI) accident in 1979, the governor refused to allow any TMI waste through Barnwell's gates (Gershey, Klein, Party, and Wilkerson, 1990). At one point, Barnwell was the only operating waste disposal facility following the temporary shut down of both Beatty and Hanford (English, 1992). South Carolina Governor Richard Riley quickly acted:

[H]e moved to place volume restrictions on the site. Over the next two years, the amount of waste that would be accepted at Barnwell would be phased down by half, to 1.2 million cubic feet per year. Generators of LLRW could no longer count on unlimited disposal capacity (English, 1992: 7).

Public opposition also was growing. In the state of Washington, voters passed in referendum, an initiative that would have barred most out-of-state waste by mid-1981; however the initiative was overturned in federal court (Peckinpugh, 1988). By 1980, a full-blown waste crisis was emerging and Congress had caught wind of it.

LEGISLATING FOR LOW-LEVEL RADIOACTIVE WASTE

After some initial attention about possible federally managed waste disposal programs, interest gradually turned towards a state oriented approach. "While the states were not altogether enthusiastic about taking on the burden of responsibility for LLRW

disposal, many thought a state approach would be preferable” (English, 1992: 7). In December 1980, Congress passed, as one of its last orders of business, the **Low-Level Radioactive Waste Policy Act** (LLRWPA).

The Act articulated several key provisions. It made each state responsible for disposal of LLRW generated within their borders. To meet this goal, states were encouraged to enter into regional compacts. Authorized states, in congressionally approved compacts, were allowed to refuse out-of-compact waste, beginning January 1, 1986.

As the exclusionary date loomed nearer it soon became painfully clear that the provisions of the LLRWPA were not being fulfilled. While many states had entered into discussions about compact arrangements none however were ratified by Congress before 1986, and obviously none were breaking ground on new disposal facilities. So politicians went back to the drawing board and came up with the **Low-Level Radioactive Waste Policy Act Amendments of 1985** (LLRWPA), which was signed by President Reagan in January, 1986.

In enacting this law, Congress effectively “cut a deal” that gave competing parties what they needed. Those who were relying on the three existing sites for disposal of their LLRW got a seven-year transitional period, during which waste could still be shipped to Hanford, Barnwell, or Beatty. Those who wanted to close existing sites to out-of-region generators as soon as possible, bargained for guarantees that nonsited regions would develop their disposal facilities (Peckinpugh, 1988: 50).

Several key provisions of the act included stipulations of responsibility for the various types of wastes, and importantly established a series of milestones for states to meet on the road to compact operationalization. “Each new milestone represents a discrete step in

the process of developing new disposal sites for each state or compact region to relieve the burden on the three operating disposal sites (Peckinpagh, 1988: 52). The carrots of the Amendments were provisions keeping open the three existing disposal sites. Failure to meet prescribed milestones would result in serious penalties such as denial of access to commercial facilities and fines (Peckinpagh, 1988). Penalties were designed to force states to accomplish the politically difficult task of siting and operationalizing new LLRW disposal sites. The major milestones of the Amendments are illustrated in **Table 4**.

The Amendments have been only partially successful. Compacts have been formed as several states have either entered into regional alliances or indicated they would undertake LLRW disposal alone. As was true of the original Act, the milestones of the Amendments have gone largely unmet.

As of 1994, nine compacts have been formed and nine states and the District of Columbia have decided to remain unaffiliated. Each compact has selected a host state, yet no new facilities have been built. California's disposal facility in Ward Valley was licensed in 1993, but the action is facing a court challenge. Sites in Nebraska and North Carolina are under license review by the NRC (Nuclear Regulatory Commission, 1994b).

DE MINIMIS

"Society is becoming increasingly well informed and anxiety prone about technology-associated risks, which leads to desire for their elimination" (Comar, 1987: xiii). Thus begins Cyril Comar's introductory contribution to *De Minimis Risk*, a text

TABLE 4 - THE LOW-LEVEL RADIOACTIVE WASTE ACT AMENDMENTS

DEADLINE	TASK
July 1, 1986	States join compacts or indicate intent to develop in-state site.
January 1, 1988	Plan for developing new facility completed.
January 1, 1990	NRC license application for a new disposal facility.
January 1, 1992	License application filed for disposal facility
January 1, 1993	Disposal arrangements provided.

Source: Peckinpugh, Timothy L. "The Politics of Low-Level Radioactive Waste Disposal." In *Low-Level Radioactive Waste Regulation: Science, Politics, and Fear*, ed. Michael E. Burns. Chelsea, Michigan: Lewis Publishers.

devoted solely to discussion of this esoteric topic. The sentences immediately following shed further light on the difficulties of establishing any type of de minimis risk policy:

The logical and traditional approach is first to estimate the risk, a scientific risk. Then comes the issue of risk acceptance, a most difficult step--moving from the world of facts to the world of values (Comar, 1987: xiii).

De minimis risk is a concept derived from the legal principle, *de minimis non curat lex*, which translates, "the law does not concern itself with trifles" (Fiskel, 1987: 4). In terms of regulation, de minimis risks are those that are considered to be unworthy of regulatory activity. In short, the "costs of regulation outweigh the importance of risk" (Fiskel, 1987: 4).

Government agencies regulate public health and environmental risks, often with limited resources. To further complicate matters there seems at times to be "an unlimited number of risks" (Menkes and Frey, 1987: 9). As more and more substances and potential carcinogens are considered possible threats to public health and environmental safety, de minimis risk policies seem to offer beneficial alternatives to expensive and time consuming standard setting processes (Whipple, 1987: 15).

De minimis risk management approaches also are "characterized by several unresolved problems" (Menkes and Frey, 1987: 10). These include the viability of existing procedures for setting de minimis levels and the likely cumulative effects of many de minimis risks over time" (Menkes and Frey, 1987: 10). Social acceptance is yet another unresolved problem. In 1986, the NRC began a four year journey where at the end of the road it was hoped, would be one of the holy grails of radioactive waste management, a fully promulgated de minimis standard. However, in order to find the

Grail the NRC would also have to chart a path through the shoals of politics and risk acceptance.

BELOW REGULATORY CONCERN

The search for a de minimis radiation standard is an ongoing debate within nuclear science circles. In January, 1986, the **Low Level Radioactive Waste Amendments Act of 1985** was finally passed by Congress and signed by then President Ronald Reagan. Tucked within the Amendments was a small policy directive that would quickly grow into a major political battle. Section 10 of the Amendments required that the Nuclear Regulatory Commission pursue policy measures that could facilitate the disposal or reuse of radioactively contaminated materials that had been deemed "below regulatory concern" (U.S. Nuclear Regulatory Commission, 1986). In late August of that same year, NRC released a statement of proposed rulemaking. The purpose was "to establish the standards and procedures that will permit the Commission to act upon rulemaking petitions in an expeditious manner as called for in the Act" (U.S. Nuclear Regulatory Commission, 1986: 30839). The notification identified the many topical areas such a rule might eventually include and presented a preliminary staff implementation plan. On July 3, 1990, the NRC once again issued a policy statement, this time with criteria and management protocols that more closely resembled a final rule.

The 1990 policy statement established the framework within which NRC would formulate rules to make licensing decisions to exempt from some or all regulatory controls certain practices involving small quantities of radioactive material (U.S. Nuclear Regulatory Commission, 1990b: 27522).

Four primary exemption practices were discussed in the BRC policy statement. The first would have applied to the release of land and buildings for other uses besides nuclear energy following decontamination of the property. Second, consumer products containing small amounts of radioactive materials could have been addressed; however little more than this was offered. Third, the BRC policy statement would have established rules and regulations for "the disposal of very low-level radioactive waste at other than licensed disposal sites" (U.S. Nuclear Regulatory Commission, 1990b: 27522). Finally, materials and equipment such as metals, concrete, and operations machinery could have been recycled and reused using consistent criteria as opposed to the case-by-case decision making employed by the NRC and Agreement States (U.S. Nuclear Regulatory Commission, 1990b).

An individual dose standard of ten millirem per year was proposed which according to the policy represented a "hypothetical increase of about 0.25% in an individuals lifetime risk of fatal cancer" (U.S. Nuclear Regulatory Commission, 1990b: 27527). A collective dose of one thousand person-rem per year was established as the exemption limit for the most critical population. Since some potentially exempted practices might include recycling and reusing materials another standard for these uses was established:

[A]n interim dose criterion of one millirem per year average dose to all individuals in the critical group will be applied to those practices involving widespread distribution of radioactive material in such items as consumer products or recycled material until the Commission gains more experience with the potential for individual exposures from multiple licensed and exempted practices (U.S. Nuclear Regulatory Commission, 1990b: 27527).

The stage was set for a rulemaking. All that remained was for an organization to petition for a BRC exemption.

The BRC ideas put forth by NRC in 1986 and 1990 were not formal rulemakings, but policy statements. The distinction, all too clear to the NRC, was not so evident to a number of policy actors. In the 1990 *Federal Register* notice, NRC suggested that "the purpose of this policy statement is to establish the risk framework within which the Commission will initiate the development of appropriate regulations" (U.S. Nuclear Regulatory Commission, 1990b: 27525). Further, the Commission intended to define a "practice" broadly such that an exemption decision would have been "evaluated in its entirety" (U.S. Nuclear Regulatory Commission, 1990b: 27525). However, beyond the four general areas discussed in the policy statements little information was provided. The very general nature of the policy statement appeared to partially open a new theater of regulatory decision making, but did not reveal what would occur on stage. As Chip Cameron, an NRC staffer, stated before a Congressional subcommittee investigating BRC, "many groups did not believe that clear and complete information was developed or effectively communicated by the Commission on the implication of the BRC policy" (U.S. Congress, House Committee on Interior and Insular Affairs, 1991: 110).

What are the potential benefits of a below regulatory concern standard? Proponents argue that a BRC policy allows for a greater focus on more significant risks. The monetary and human resources expended to manage BRC wastes could be employed in other areas of radiation risk protection. Second, BRC criteria become especially critical with decommissioning and decontamination of licensed facilities. Currently the

Nuclear Regulatory Commission and authorized Agreement States oversee nearly 24,000 licensees. Facilities that are licensed through this arrangement include nuclear power plants, universities, medical institutions, radioactive source manufacturers, and fuel cycle facilities. Once these facilities are no longer needed, go out of business, or in the case of nuclear power plants, reach the end of their licensed lives, the land and buildings of the site will be decommissioned. A standard BRC exemption could ensure that decommissioned sites across the nation are not cleaned to widely different standards; moreover, "case-by-case decision making is seen as too cumbersome" (Whipple, 1987: 16).

Industry is normally supportive of uniform standards. A de minimis or below regulatory concern guideline "defines a threshold for regulatory involvement" (Whipple, 1987: 16). Over the long-term, defined regulatory standard provides a signpost by which to plan future activities. Further, radioactive materials are found in many different types of consumer products including smoke detectors and luminescent watches. A BRC policy would have resulted in "increased assurance of a consistent level of safety for consumer products containing radioactive material" (U.S. Nuclear Regulatory Commission, 1990b: 27522).

A BRC policy also could permit the recycle and reuse of potentially useful products such as scrap metals, concrete, and equipment. For example, DOE maintains an enormous stockpile of scrap metal. It is estimated that roughly 400,000 tons of various metals are currently segregated at federal sites around the nation. Another 600,000 tons could accumulate through ongoing and future decommissioning, decontamination and

dismantling operations (Quadrex, 1993). Although DOE is not directly regulated by NRC, a promulgated BRC standard would affect DOE decision making on radioactive scrap metals

Despite assurances by NRC officials citing risk analysis evidence and stating that there was absolutely no danger to the public, BRC met with vocal opposition. Interest groups such as the Nuclear Information Research Service (NIRS) and Public Citizen portrayed the policy as “the NRC’s *nonsolution* to the low-level radioactive waste problem” (Becker and Goldman, 1991: 2). Moreover, these groups suggested that the possible adverse health effects resulting from the deregulation of nuclear waste were not seriously pursued by the NRC. The policy also was subject to media scrutiny, a court case initiated by a coalition of public interest organizations, and several congressional hearings. Further, state and local governments voiced their concerns about the policy statements.

In an attempt to manage a political wildfire that was quickly getting out of control, the NRC called for a moratorium on BRC implementation attempted to find some means of shoring up its policy which now teetered on the brink of collapse. A “consensus building” process was announced, but the refusal to participate by several prominent environmental groups quickly dried up enthusiasm for this effort. Concurrently the **Energy Policy Act of 1992** was slowly winding through Congress. In this massive bill was a section revoking the NRC’s BRC policy statements. When the legislation was signed by President Bush in October, 1992, the strange journey of BRC was over. Or was it?

CHAPTER III

THE TRADITIONAL PUBLIC POLICY PROCESS

There are discoverable uniformities in political behavior. These can be expressed in generalizations or theories with explanatory and predictive value.

David Easton

THE PUBLIC POLICY PROCESS: AN INTRODUCTION

Political scientists traditionally have been interested in both the "substance" of issues and the "process" by which issues are addressed in the policy arena (Jones, 1984: 24). One of the difficult areas of inquiry taken up by political scientists is the creation of a semblance of order from the seeming chaos of public policy development. A ninth grade United States Civics text generally describes in neat and orderly fashion how a bill becomes law. Terms such as federalism, checks and balances, division of power, pluralism, and democracy are rarely presented as the complex concepts they truly are in the real political world. As Charles Jones writes: "A government as complex as ours does not lend itself to summation" (1984: 5). With public policy process models, however, political scientists attempt to impose conceptual order on the white noise of politics.

PUBLIC POLICY

It may be easier to say what public policy is *not*, rather than what it is. B. Guy Peters suggests that, "as public policy studies are now popular, everything government does is labeled policy" (1993: 4). In his book, *American Public Policy: Promise and Performance*, he proposes a definition for public policy: "the sum of government activities whether acting directly or through agents as it has influence on the lives of citizens" (Peters, 1993: 4). Moreover, Peters definition encompasses three distinct elements of policy. The first element refers to the "decisions" made by agents of government in accordance with endowments of legal authority and power. The second level is manifested in "policy outputs." By this Peter's refers to "policy choices being put into action" (1993: 4). The final element of his definition of public policy zeroes in on the "policy impacts" of government upon citizens. As government seeks to influence, persuade, or cajole citizen behavior, such activities have both intended and unintended consequences. Moreover, there are few guarantees that policy will be implemented exactly as intended.

THE PUBLIC POLICY PROCESS

Social scientists use formal theories and models as techniques for examining reality and to generalize about a population that is usually too large to directly observe. Policy process models more or less conform to a general pattern of stages including: problem identification and agenda setting, formulation and legitimation, implementation, evaluation, and revision. **Figure 5** illustrates the "traditional" public policy process.

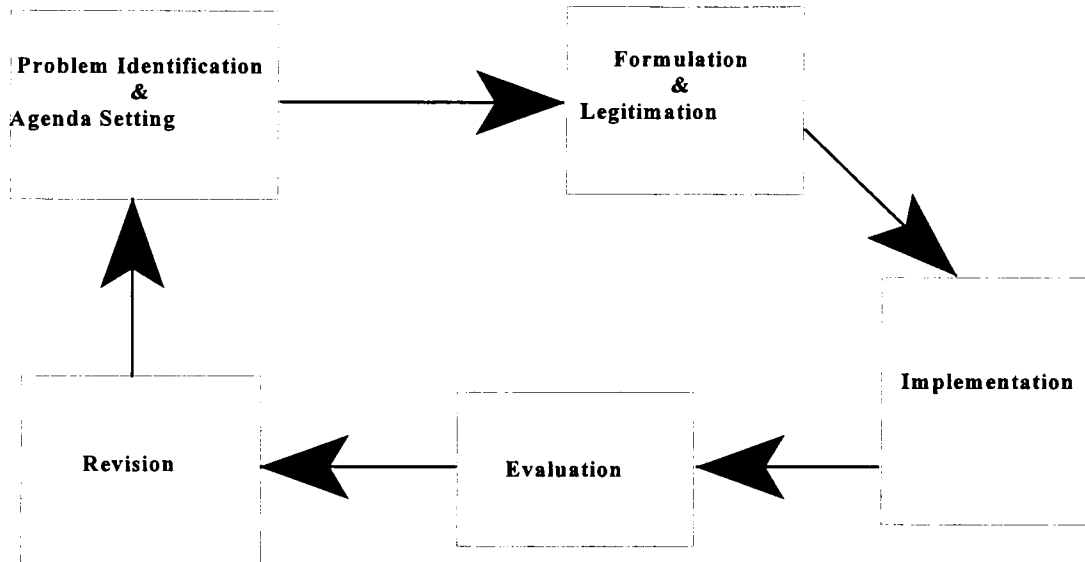


FIGURE 5 - THE TRADITIONAL PUBLIC POLICY PROCESS

Problem Identification and Agenda Setting

The preliminary stages of the public policy process involve getting issues to the table for discussion. According to Jones (1984), the early stages of the public policy process involve both perception of a problem and the definition of its parameters.

Perception is important in the policy process . . . because it conditions the definitions of problems . . . something happens, someone perceives it in a particular way, and defines it as a problem (Jones, 1984: 52).

Policy problems do not miraculously appear on the radar screen of government decision makers, though it may sometimes appear that they do. Interactions among policy actors and the persistence of interested parties in getting the facts of a particular problem to the appropriate governmental figures are some ways that problems reach the agenda of decision makers. Rosenbaum (1987) suggests that crises such as an oil embargo or a perceived LLRW disposal quandary can mobilize government to act upon discernable policy problems. Better knowledge also can propel issues to the active agenda. For example, increased scientific understanding contributed to the growth of the environmental movement in the late 1960's (Dunlap and Mertig, 1992). Further, the mass media also can play a significant role through press coverage of events. Elected politicians also may see an opportunity to make a name for themselves by bringing to light a particular issue. A good example is the gamesmanship displayed by President Richard Nixon and his potential presidential rival Senator Edmund Muskie, each trying to stay one "green" step ahead of the other during the early days of the environmental movement.

How problems are brought to the table of government has spawned a subsystem of social science scholars who have examined the stage of agenda setting. There are many pathways to government action. Likewise government may not act upon a issue even though the general consensus may be that a governmental solution is necessary for a particular policy problem. However, before perceived policy problems can be acted upon, they must through some means or a variety of political interactions, reach the active agenda of government.

Formulation and Legitimation

Once a problem has been identified and brought to the table of politics, it can become the focus of authoritative government power. At this stage the question becomes, does this issue require a government response? Jones (1984) suggests several guidelines in describing policy formulation. First, policy formulation does not correspond to a particular set of policy actors. Congress and the President are the most evident policy actors in the formulation of government answers to problems; however in actuality, other actors including staff members, interest groups, industrial representatives, civil servants, and trusted advisors, often have a hand in proposing solutions to policy problems. Second, policy formulation may "proceed without a clear definition of the problem" (Jones, 1984: 78). Third, formulation often pits potential victims against potential benefactors. In politics there are inevitably winners and losers in both a strict and a symbolic sense.

To legitimate literally means, "to make legal or to justify;" thus once formulations have been proposed, decision makers set about to incorporate potential solutions to policy problems into the law books. It is at this stage that government truly makes a choice for action or inaction. Should officials choose to act "a program is made legitimate when written and declared according to whatever constitutional and statutory procedures are appropriate" (Rosenbaum, 1987: 23).

Legitimation is most often associated with legislation, but this is not always the case. A president issuing an executive order or a bureaucratic institution promulgating a new regulation in accordance with appropriate legislative authority and following designated administrative procedures also legitimates programs.

Once a program has been adopted it must be funded through the appropriations process. As Peters says, "to implement policies, government requires money" (1993: 113). Federal agencies are responsible for submitting estimates of how much money is required to implement public policies. Budgeting and resource allocation, however, involves a number of governmental organizations including the President, the Office of Management and Budget (OMB), Congress, and congressional committees.

Budgeting is a long and complex process. Peters (1993) estimates that the federal budget requires, on average, eighteen months to complete. The federal government spends billions of dollars each year. Although this money is spent, for the most part, on legitimate activities, ask anyone on the street and you are bound to get different responses about the effectiveness and wisdom of federal expenditures.

Policy Implementation

If implementation is the stage of the public policy process where rational, scientific policy making occurs, it is also the point of convergence for powerful political forces. "It is not that economics, political science, and the physical sciences are irrelevant to regulatory policymaking; rather they are not decisive in themselves (Reagan, 1987: 2). Regulatory policymaking "is almost always an exercise in political conflict" (Reagan, 1987: 5).

Regulations are one form of public policy distinguishable from others, such as legislation, by two noteworthy factors: the institutions that promulgate regulations and how these institutions enforce regulatory directives. At first glance the federal government of the United States appears simple and easy to understand; however upon closer inspection it is a hydra-headed behemoth neither uncomplicated nor easily explained. The structure of the federal bureaucracy greatly adds to the size and complexity of the American government.

Since the middle of the twentieth century the federal government has undertaken new responsibilities including but not limited to, protection of the environment, public and occupational safety, drug wars, affirmative action programs, and billions of dollars worth of foreign aid. The growth in a "positivist government has exacerbated another trend--the growth in the major instrument of positive government, bureaucracy" (Meier, 1992: 1).

In 1798, the Federal government maintained three essential Departments: War, State, and the Treasury (Meier, 1992). Since the rudimentary beginnings of the Federal

bureaucracy, other departments, independent commissions, and quasi-private corporations have evolved.

In 1849, opposition to a British-like "Home Department" was overcome and the Department of the Interior was created. By 1862, the first "clientele" department, Agriculture, was created in response to the needs and demands of farmers (Meier, 1992, 20). Throughout the late nineteenth and during the twentieth century, other important bureaucracies have been created including the Departments of Justice, Labor, Commerce, Housing and Urban Development, Health and Human Services, Transportation, Energy, and Education.

The federal bureaucracy also is composed of roughly sixty independent agencies. In terms of organization, size, and influence, independent agencies are similar to the departmental agencies; however for a variety of reasons these agencies were not tied to executive departments. Meier (1992) offers several reasons why this is so. First, some agencies were created in order to develop new ways of operating and new methods of confronting problems. Second, federal bureaucracies normally cater to a particular clientele, which can result in capture of the agency. Therefore some independent agencies were "created to avoid clientele pressures in departments with strong clientele ties" (Meier, 1992: 25). Yet other agencies came into existence in order to avoid direct presidential influence. Still others such as NASA were designed with missions in mind that at the time of creation did not fit within any of the Executive departments.

A third broad category of bureaucratic institutions include the government corporations. Notable examples include the Corporation for Public Broadcasting, the

Postal Service, the Tennessee Valley Authority, and the powerful Federal Reserve System. Other bureaucratic institutions also exist within the federal government including commissions and committees established for very focused and specific purposes.

Both the White House and Congress are much more than elected officials. Burke (1992) describes the "institutional presidency" which has evolved since the time of Franklin Roosevelt. In 1937, the Brownlow Commission issued a report illustrating the growing demands on the President and suggesting reforms.

The President needs help. His immediate staff assistance is entirely inadequate. He should be given a small number of executive assistants who would be his direct aides in dealing with the managerial agencies and administrative departments of government . . . Men for these positions should be carefully chosen by the President from within and without the Government. They should be men in whom the President has personal confidence and whose character and attitude is such that they would not attempt to exercise power on their account. They should be possessed of high competence, great physical vigor, and passion for anonymity (Burke, 1992: xi).

Chapter One in Burke's (1992) work is appropriately titled "From President to Presidency." Since the first utterance of "the President needs help" to the modern era, the Executive Office of the President (EOP) and the White House Staff has grown in terms of size and major responsibilities. The Office of Management and Budget (OMB) plays a significant role in the promulgation of new regulations. Executive Order 12291 issued by the Reagan administration in 1981 directs all federal regulatory agencies to submit to the OMB a cost-benefit analysis on proposed "major" additions to the *Code of Federal Regulations* (Reagan, 1987: 129). The main point of this decree suggests that society should benefit from any expansion of the nations regulatory framework.

Not to be outdone, the Congressional bureaucracy rapidly grew during the 1970s (Meier, 1992). Through the Library of Congress, members can request up to the minute information on issues by using the Congressional Research Service (CRS). Other powerful institutions include the Congressional Budget Office (CBO) and the General Accounting Office (GAO). As a watchdog of agency behavior for Congress, the GAO annually issues hundreds of reports that offer evaluation of government operations.

Bureaucracies are the bridge between government power and the American citizenry. Through rulemakings, and regulations bureaucratic agencies interpret legislation into more specific elements of government activity. And these activities directly and indirectly impact the lives of American citizens.

Policy Evaluation

The evaluation of public policies is increasingly realized as a critical step in the public policy process.

Today virtually every federal agency in every executive department has an evaluation branch responsible for using scientific methodology to determine whether agency programs have their intended impact. Congress has also incorporated program evaluation into its oversight activities. Both the General Accounting Office and the Congressional Budget Office have evaluation responsibilities (Langbeim, 1980: 3).

Further, a cottage industry of evaluation contractors lurk as beltway bandits inside the Washington area, or in academic and nonprofit research centers all across the country.

Evaluation can mobilize significant political activity. For example, in 1966 the controversial Coleman Report suggested that America's public schools were not fulfilling

the mandates of equal preparedness. The report suggested that factors outside the school system proper were limiting the advancement of certain ethnic populations (Langbeim, 1980). The worth of policy evaluations is that they can "produce findings contrary to the prevailing myths" and hopefully produce better public policies (Langbeim, 1980: 3).

Policy Revision

Policy termination is another means of identifying the final stage of the public policy process; however, few policies are rarely completely dismantled. As Peters suggests:

Once begun, programs have a life of their own. They develop organizations, and those organizations hire personnel. Programs also develop a clientele, who come to depend on the program for certain services (1993: 161).

The longer a policy is in existence the more friends there are that support it, and thus it becomes a more difficult task to make meaningful change. This is the fearsome spectacle of Jonathan Rauch's book *Demosclerosis*, "government's progressive loss of the ability to adapt" (1994: 123).

The goal of policy evaluation is to determine what works and what needs changing. However straightforward this statement may seem, the road from policy evaluation to policy change is rarely straight and narrow because "producing a valid evaluation of government programs is a difficult and highly political process in itself" (Peters, 1993: 149). Because of this, program advocates and government institutions can always debate the merits of any evaluation.

Forming public policies was never meant to be easy. Changing them has proven even more difficult. Incrementalism is the most often cited culprit prohibiting policy change (Hayes, 1992). Factors that produce Incrementalism according to Hayes (1992) include the "multiple veto points" through which a policy must pass:

[T]he Constitution is designed to subject all proposed policy changes to a process of protracted deliberation and all too often precludes a timely and coherent response to pressing problems, promoting instead obstructionism, localism, and delay (1992: 40).

PROCESS MODELS

In their book *Agendas and Instability in American Politics*, Baumgartner and Jones argue for a "punctuated model of policy change" (1993: 3). These authors suggest that over the long run of policy development and maturation, public policies often will be revisited. Over time "the generation of new ideas, makes policy monopolies unstable in the long run" (Baumgartner and Jones, 1993: 4). Kelman describes the policymaking process as a "set of stages that starts with proposals and ends with government actions that affect peoples lives" (1987: 6). Bryson and Crosby (1992) conceptualize a "policy change cycle" that bears many similarities to other public policy models. They define the policy change cycle as the "general process whereby leaders and followers tackle public problems in a shared power and no-one-in-charge world" (Bryson and Crosby, 1992: 57). Their model is depicted in **Figure 6**.

Some authors argue that to separate the public policy process into a compact and sequential model is to commit a logical fallacy:

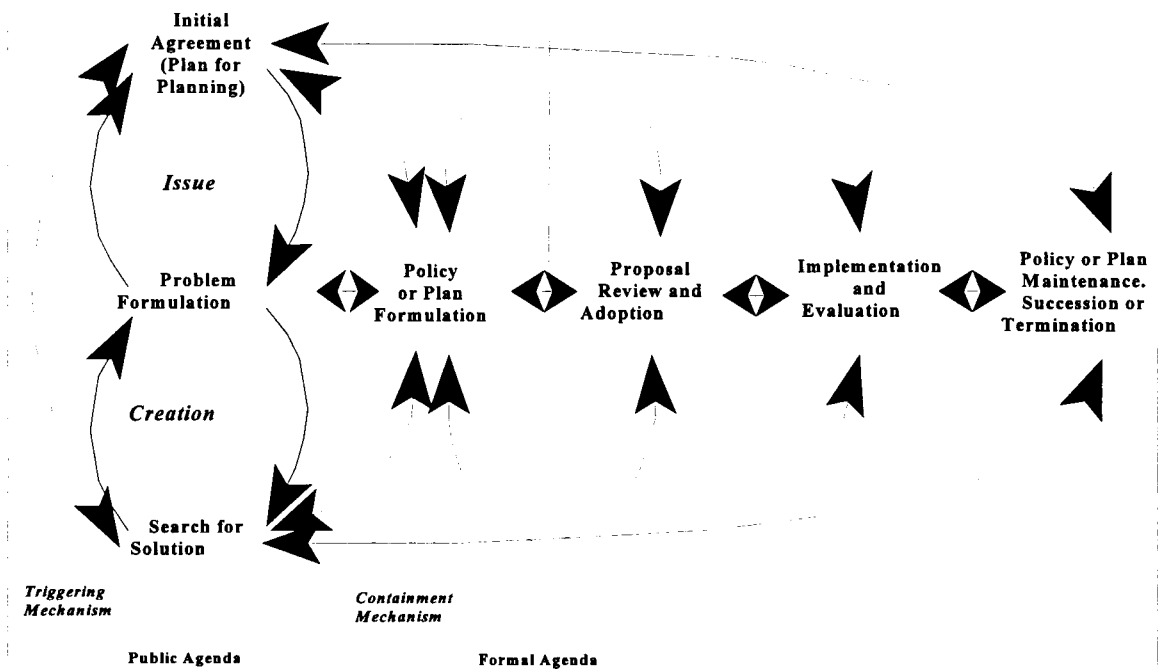


FIGURE 6 - A PUBLIC POLICY PROCESS IN A SHARED POWER WORLD

[B]reaking the policy making process into hypothetical units is artificial, and also can entail great intellectual cost if searching for elements unique to each step obscures universal issues and phenomena such as systematic inequalities that bias the entire process (Lindblom and Woodhouse, 1993: 10).

This reaction in part can be attributed to the authors' underlying assumptions that the important elements of the public policy process are the "deeper forces structuring and often distorting governmental behavior: business influence, inequality, and impaired capacities for probing social problems" (Lindblom and Woodhouse, 1993: 12). Lindblom and Woodhouse are partially correct in suggesting that a public policy process model denotes "artificiality;" however then the same can be said about nearly all social scientific models as a means of research examination.

A public policy process model can be a useful tool for examining the reality of policy-making provided that certain caveats are heeded. Bryson and Crosby describe the policy change cycle as "messy in practice" and argue that their model is an "orienting framework" (1992: 64). Jones writes that the model he offers is "primarily heuristic and not prescriptive" (1984: 28). He is careful to note that students of public policy should understand several qualifying points when attempting to use a conceptual framework to examine the dynamic interactions of policy making.

1. The sequence of the model may not reflect reality. Policy discussions may initiate at a later stage than "perception and definition" (Jones, 1992: 29).
2. Activities in the public policy process may and in fact often do overlap. For example agencies already may be working on solutions to potential public problems (implementation) prior to specific legislative mandates.
3. The stages in the public policy process may never be truly completed. Jones argues that criteria to determine closure of a particular stage of the model would be hard to define or quantify.

4. Government along with society at large are sources of agenda setting. Public policy problems not only emerge from perceived social dilemmas originating in society but many times through the increased understanding of issues in specific institutional areas of specialization.

5. Policy actors are not singularly classified with a particular stage in the public policy process model. As Jones states "implementation need not be engaged solely by bureaucrats, nor legitimation only by legislators" (Jones, 1992: 29).

What is the benefit of establishing a public policy process model? Many times social scientists expend a tremendous amount of intellectual effort creating elaborate diagrams in the attempt to make the real world easier to understand, only to have readers become frustrated by the uncooperative dynamics of reality. But, in political science and other fields of inquiry the benefits of conceptual mapping become clear when "accurate" models help us to understand the phenomena occurring around us.

A second question might be, why not focus on institutions, organizations, or political power? Centering on public policy necessitates an understanding of process. As Michael Hayes argues "a focus on policy-making forces us to look not only at a multiplicity of actors and institutions but also at how issues flow over time through a more or less predictable series of stages or phases" (1992: 2).

CONCLUSION

This chapter has examined the traditional public policy process. In general, conceptual models tend to flow through a series of stages from agenda setting to policy revision.

Conceptual models can only illustrate so much.

[I]t goes without saying that [policy] cycles are illustrative only. The variations are virtually limitless. The point is not to identify all combinations...but to discover the patterns appropriate to public policies being studied (Jones, 1984: 216).

It is the contention of this thesis that traditional models of the public policy process are inadequate illustrations for complex and controversial issues such as nuclear energy, radioactive waste, and radiation protection. Chapter 4 presents a revised model of the public policy process, one that is a more appropriate model for the failure of the Nuclear Regulatory Commission's below regulatory concern standards.

CHAPTER IV

THE CHANGING POLICY PROCESS

Whether or not theory formation is the most important and distinctive scientific activity, in one sense of the term "theory" this activity might well be regarded as the most important and distinctive for human beings. In this sense it stands for the symbolic dimension of experience, as opposed to the apprehension of brute fact.

Abraham Kaplan

INTRODUCTION

Anthony Nownes sheds some light on the realities of governance in America:

The proliferation of interest groups in the United States is a well documented phenomenon. This recent proliferation has been attended by massive government growth and a fragmentation of political power. Given these three developments it is no wonder some scholars see the American political system as somewhat pathological and incapable of decisive action on broad policy questions (Nownes, 1991: 1).

This chapter, examines the variables that Nownes alludes to and other factors that are affecting the public policy process. As suggested in the previous chapter, traditional public policy models are inadequate illustrations of the policy dynamics associated with complex and controversial policy issues such as radiation protection and radioactive waste. Recent history has shown that the technical uncertainties of radioactive waste are overshadowed by the political uncertainties. As a result, the politics of radiation often result in gridlock.

GROWTH OF GOVERNMENT

Government in the United States has grown from a simple night watchman state providing defense, police protection, tax collection, and some education into an immense network of organizations and institutions affecting the daily lives of citizens (Peters, 1993: 3).

To many the size of the public sector is a sign of governmental power run amok; to others the growth in government has resulted in many collective benefits such as racial equality, environmental protection, housing for the poor, and educational opportunities. As Peters points out "drawing any clear distinctions between public and private sectors in the mixed-economy welfare state is difficult" (1993: 31). In the post World War Two era however, the size of government has grown in terms of personnel, expenditures, and the number of programs and regulations.

In 1950, the total number of employees at the federal, state, and local levels of government numbered roughly 6.5 million. By 1990, these figures had increased to over 18 million on the taxpayers' payroll. This represents an increase in governmental employees from 10.9% of total employment in the United States to over 15% (Peters, 1993).

Growth in government expenditures as a percentage of gross national product (GNP) also has dramatically increased. In 1950, total governmental expenditures accounted for roughly 24.6% of the GNP. By 1990 this figure had increased to 41.5% (Peters, 1993).

The growth in governmental employment and expenditures is tied to the increasing number of programs for which government has assumed responsibility. Many

programs to protect the environment and public health have been implemented since the mid 1960s. Further, "New Deal" and "Great Society" programs such as social security, school lunches, Affirmative Action, and urban housing have expanded the scope of governmental power.

With the increase in size has come an increase in complexity and confusion:

[L]aws, regulations and the process by which they are made have become unproductively complex. There are so many centers of power, overlapping jurisdictions and complicated procedures that it is hard for both participants and onlookers to figure out who is in charge and whom to blame for what (Rivlin, 1992: 3).

Almost everyday the *Federal Register* announces some new initiative of the national government. According to Rauch (1994), the number of pages printed annually in the *Federal Register* has grown significantly since the time of President Harry Truman. Moreover, the *Code of Federal Regulations* has increased so much in size and scope no one can know everything the volumes contain.

An important development of the past few decades has been the increase in programs and regulations designed to protect the environment, worker safety, and public health. Standards, rules, and regulations are issued by agencies such as the Environmental Protection Agency, the Nuclear Regulatory Commission, the Occupational Safety and Health Administration, the Department of Transportation, the Consumer Products Safety Commission, and the Office of Surface Mining. Reagan (1987) describes these as "social regulation."

Social regulation came under serious partisan attack during Ronald Reagan's presidency. The telegenic President promised to get government off the backs of

business and let the economy roll. At the top of Reagan's list of onerous burdens were the intricate networks of policies governing environmental protection and energy productivity. In order to accomplish these goals President Reagan "drastically altered" energy and environmental policies (Rosenbaum, 1987: 9). Budgets for the Environmental Protection Agency were reduced, curbing research for new regulations and forcing reductions in the Agency's work force (Rosenbaum, 1987). Reaganites such as James Watt and Anne Burford were appointed to key positions as heads of the Department of the Interior and the Environmental Protection Agency and worked to implement the Reagan Revolution.

From "deregulation" to "Reinventing Government" cries to reform the American regulatory system have been voiced by elected officials. These rhetorical statements have not completely lacked in substance as Presidents from Richard Nixon to Bill Clinton have sought to devolve, decentralize, and dismantle governmental programs and institutions that have been deemed ineffective or unnecessary. How successful have these attempts at reform been and what are the effects upon social regulations? Until the present, reform has been only marginally successful as social regulations have become an established part of everyday life.

[W]hile these areas of regulation may pause and be set back a step, the long-term thrust over two decades has been to institutionalize them as parts of the accepted pattern of life in the United States, beyond effective partisan attack (Reagan, 1987: 111).

It remains to be seen if this assumption will remain valid during the current era of budget cutbacks.

Risky Business

Alvin Weinberg, retired former director of Oak Ridge National Laboratory describes the "regulators dilemma:"

When the concerns were patent and obvious--like smog in Los Angeles--science could and did give unequivocal answers . . . The regulators course was rather straight forward because the science upon which the regulator based his judgement was operating well within its power. But when the concern was subtle, how much cancer is caused by 10% of background radiation, science was being asked a question that lay beyond its power; the question was "trans-scientific." Yet by law the regulator was expected to regulate even though science could hardly help him (1987: 27).

Weinberg may only be partially correct in his assertion of a "regulators dilemma."

Regulation is a political event. Likewise risk can be an equally political phenomena, especially when policy actors can not agree on the "true" facts of a risky activity.

Bradbury defines the "traditional, technical approach" to risk as "the probability and consequences of an adverse effect" (1989: 382). According to this interpretation, risk is to be identified and controlled by an objective and value-free examination of facts. In short risk can be explained, predicted and controlled by science" (Bradbury, 1989: 381). In reality, the management and analysis of risk is very much a political activity.

Radioactive waste management has historically been subject to the two sides of risk, with the politics of risk acceptance currently holding the upper hand. Simply put, radioactive waste and radiation protection risks cannot be described only by turning to the numbers.

Regulating risk with all of its political and legal booby-traps has become a primary function of regulatory agencies. This development has required a "synthesis of scientific research and administration within highly professionalized agencies" (Eisner,

1993: 134). The call for public health standards, occupational safety guidelines, and environmental protection, propelled risk assessment and risk management into the national spotlight. Governmental institutions such as the Environmental Protection Agency, the Occupational Safety and Health Administration, the Consumer Product Safety Commission, and other offices within executive departments now regulate all kinds of potential risks. Hardly a day goes by when the news media does not report some new finding that saccharin, coconut oil on popcorn, or electromagnetic fields from overhead transmission wires, presents a potential human health risk. Increasingly government has assumed responsibility for checking the validity of these claims.

DIFFUSION AND DECENTRALIZATION

The fundamental characteristic of government in the United States "is the absence of effective coordination and control" (Peters, 1993: 17). King George and the abuses of power employed by the monarchy were fresh in the minds of the Founders, as the constitutional convention of 1787 progressed. Since that time checks and balances, separation of powers, and federalism have become familiar concepts in the lexicon of American political thought.

As government has grown and expanded into the far corners of American society the lack of an effective center to guide decision makers has made the development of public policies exceedingly difficult. As Peters writes, "the capacity of government to run roughshod over the rights of citizens is diminished in our federal system;" however, "Americans have paid a price for this lack of coordination" (1993: 17). Federalism has

diffused power into multiple layers of government, resulting in numerous points through which public policies must pass. Reforms during the 1970s expanded the congressional committee system, which has since, for good or ill, been partially rolled back by Republicans following the 1994 congressional elections.

Federalism and the Growth of Subnational Institutions

The patterns of governmental authority in a diffused power federal system are not clearly discernible. Different governmental layers maintain certain responsibilities with different policies. Thus many observers refer to the American regulatory system as a "marble cake" with regulatory responsibilities interspersed amongst federal, state, and local agencies. As Rosenbaum suggests, energy policies are affected by this decentralization.

Federalism forces national energy policy makers to respond to state and regional interests, ensures the states a large measure of independence in dealing with their own energy problems, and constrains federal power. But it also erects numerous veto points in the policy-making process that can protract negotiation and cause enormous delay in formulating and implementing energy policies (Rosenbaum. 1987: 40).

In fact, it may not be appropriate to refer to "federalism" in the strict sense of the word. Federalism implies, first a division of constitutional responsibilities between state governments and the federal government. Second, each level of government is autonomous in its decision making (Reagan, 1987). A better concept frequently utilized by federalism scholars, "intergovernmental relations" refers to the complex interactions

that occur everyday between different levels of government (federal-state, state-local, federal-local).

During the 1960s and 1970s a number of laws were passed by the federal government that require a significant amount of intergovernmental enforcement. Reagan offers several examples which are summarized in **Table 5**. The defining characteristic of these programs is that while most are implemented by state governments through specialized arrangements, and fall most heavily on the private sector, the federal government maintains a strong supervisory role.

Although amendments to the **Atomic Energy Act** in 1959, created Agreement State arrangements, federal management of nuclear energy including radioactive waste predominated until the late 1970s. Today, state radiation protection agencies are authorized to act in the place of the NRC, provided that the state programs meet criteria set forth by the Commission. In recent years, state governments have assumed greater responsibilities in the management of radioactive waste. The 1980 **Low-Level Radioactive Waste Policy Act** urged states to form regional compacts to facilitate the siting of disposal facilities. Amendments to the bill in 1986 maintained a prominent role for states. Similarly, the 1982 **Nuclear Waste Policy Act** established specific roles for states to play in the management of high-level radioactive wastes, especially in regards to the siting of a repository for long term storage of spent fuel (Zimmerman, 1988).

The relationship between state governments and the federal government in regards to radioactive waste has at times been contentious. As Kearney writes:

TABLE 5 - FEDERAL PROGRAMS REQUIRING INTERGOVERNMENTAL
IMPLEMENTATION

Year of Enactment	Statute
1965	Water Quality Act Highway Beautification Act
1967	Wholesome Meat Act
1968	Wholesome Poultry Products Act
1969	National Environmental Policy Act
1970	Occupational Safety and Health Act Clean Air Act Amendments
1972	Federal Water Pollution Control Act Amendments Coastal Zone Management Act Federal Insecticide Fungicide, and Rodenticide Act
1973	Endangered Species Act
1974	Safe Drinking Water Act
1976	Resource Conservation and Recovery Act Toxic Substances Control Act
1977	Surface Mining Control and Reclamation Act
1978	Public Utility Regulatory Act
1980	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)

Source: Reagan, Michael D. *Regulation: The Politics of Policy*. Boston: Little Brown and Company.

"Perhaps in no other policy field has American Federalism been so conflictual as in radioactive waste management" (1993: 57). Other authors suggest that the collaborative arrangements have significantly contributed to the poor management of this important waste issue. According to Joppke (1992/1993), even as prominent national environmental groups turned their attention in the early 1980s from nuclear energy to the specter of nuclear weapons and war the decentralized arrangements provided an opportunity to state and local policy actors. Regionally situated antinuclear groups found willing allies in local and state governments that also did not want radioactive waste in their backyard (Joppke, 1992/1993).

Congress is Watching

During the 1970s, a "profusion of committees" resulted from reforms enacted in both the Senate and the House (Rosenbaum, 1987: 50). One of the important consequences of the increase in committees and subcommittees has been an escalation in congressional oversight activities. Congressional oversight was not given much consideration by observers of the American system until the middle of the twentieth century (Aberbach, 1990). Following the McCarthy era of unfounded witch hunts, and 1960s congressional questioning of President Johnson's Vietnam policies, oversight became the focus of study and inquiry (Aberbach, 1990).

According to McCubbins and Schwartz, "Congressional oversight policy concerns whether, to what extent, and in what way Congress attempts to detect and remedy executive-branch violations of legislative goals" (1984: 166). The reforms of the 1970s

boosted Congress's oversight capabilities by adding more staff to support the new committees, creating institutional structures such as the Congressional Research Service and the Office of Technology Assessment, and empowering evaluation agencies such as the GAO to conduct frequent program audits (Aberbach, 1990).

In his work, *Keeping a Watchful Eye*, Aberbach relates information from a survey sent to congressional staff members. Why has congressional oversight of bureaucratic activities increased? Aberbach divides the responses into external forces and internal stimuli.

External Factors

1. Increasing size and complexity of government.
2. Negative reactions to the executive's accrual or abuse of power.
3. Increased publicity value of oversight.
4. Influx of new members interested in oversight.

Internal Factors

1. More or better staff, support agency personnel.
2. Impact of internal congressional reforms.

McCubbins and Schwartz (1984) identify two types of congressional oversight. "Police-Patrol Oversight" is the result of Congress, "at its own initiative," examining "a sample of executive agency activities, with the aim of detecting and remedying any legislative goals and, by its surveillance, discouraging such violations" (McCubbins and Schwartz, 1984: 166). "Fire-Alarm Oversight" is less systematic: "Congress places fire-

alarm boxes on street corners" in order to hear the complaints of citizens, groups, and government officials (McCubbins and Schwartz, 1984: 166). Because of the decentralized political system, the number of watchdog and information gathering groups affecting the political system, and the enormous workload of the legislature, fire-alarm oversight is the more often employed means of congressional scrutiny.

Crises, injustices, and mismanagement are just a few of the many reasons why Congress might call for a congressional hearing on a particular issue. LLRW is an extremely volatile issue that has aroused the wrath of citizens, groups, industry, and governing officials. As a result Congress has not been shy about investigating the many facets and applications of nuclear waste policy.

During the early days of nuclear energy oversight, the Joint Committee on Atomic Energy (JCAE) was the principal Congressional participant in the now familiar iron triangle that also included the Atomic Energy Commission and the nuclear industry. Decision making was tightly controlled in this small subsystem. However, this cozy arrangement has been replaced by a more decentralized and open system in which many more political actors are influential and more committees have jurisdiction over aspects of nuclear science.

The essence of American politics is bargaining and compromise that results from the fragmentation of the political system. The expansion of congressional committees and subcommittees, in both houses, has complicated the public policy process. Legislation including that which involves, nuclear energy, radioactive waste, and radiation protection often must pass muster with several subcommittees and committees.

Moreover, both houses of Congress are not necessarily going to agree on the proper path to follow. As Rosenbaum (1987: 51) suggests: "So many congressional actors and interest may claim a voice in policy making that no legislative reconciliation of divergent viewpoints may be possible."

INTEREST GROUPS

Since the founding of the United States, observers of the American political system have discussed, analyzed and debated the role, function, and place of organized interests. In 1787, James Madison alerted Americans to the "mischiefs of faction" (Madison, Hamilton, and Jay, 1982: 43). In 1994, congressional candidates railed against the damaging influences of special interests and promised to curb the excesses of well-heeled lobbyists.

Other commentators on the American political system have been less hostile to organized group activity. Alexis de Tocqueville wrote that: "Wherever at the head of some new undertaking you see the government in France, or a man of rank in England, in the United States you will be sure to find an association" (De Tocqueville, 1945: 114). Jeffrey Berry notes that interest group politics contributed to the decline of subgovernments. As he writes, "if there are to be lobbying organizations it is best that they be as representative as possible of all segments of society" (Berry, 1989: 230).

Various theories describing interests groups, pluralism, and politics have been put forth by political scientists and other scholars. In fact, it is one of the most popular

subfields of American political science. It seems likely that the debates over interest groups will continue into the foreseeable future:

Perhaps the only conclusion that observers of groups in the America might agree upon is that there are a lot of groups attempting to influence the political process and policy outcomes (Ornstein and Elder, 1978: 3).

Madison and De Tocqueville

Madison defined "factions" as "a number of citizens whether amounting to a majority or minority of the whole who are united and actuated by some common impulse of passion, or of interest, adverse to the rights of other citizens, or to the permanent and aggregate interests of the community" (Madison, Hamilton, and Jay, 1982: 43). Madison goes on to offer two means by which to limit the "mischiefs of faction:" one, by "removing its causes," and two, "by controlling its effects" (Madison, Hamilton, and Jay, 1982: 43). Madison rejected the former and embraced the latter citing republican democratic principles as the cure. De Tocqueville, arguably the most insightful of the French travelers who wrote of early America, described the propensity to associate: "In no country in the world has the principle of association been more successfully used or applied to a greater multitude of objects than in America" (De Tocqueville, 1945: 199). Thus from the earliest days of the Republic, organized interests have been considered an important element in the American system.

Bentley, Truman and Schattschneider

Arthur F. Bentley is generally credited with being one of the first political scientists to systematically examine the influence of group behavior on the political system. For Bentley, groups were a proper unit of analysis for the study of government. He suggests that society is "nothing other than the complex of groups that compose it," and "all phenomena of government are phenomena of groups pressing one another," (Bentley, 1935: 205). David Truman is credited with taking the study of groups and the "governmental process" to a new level of notoriety. Like Bentley, Truman suggested that the group struggle was the determining factor of the governmental process, and political leaders umpired the game.

Other political scientists took another view of pluralism and did not see either the state or groups as predominate in the American political system (McFarland, 1993). Scholars such as Aaron Wildavsky and Robert A. Dahl suggested that the assumptions of Truman pluralists could not be corroborated with reality (McFarland, 1993).

E.E. Schattschneider, yet another member of the long line of political science scholars, examined pluralism and the American system of politics. In his work *The Semisovereign People*, he describes the "contagiousness of conflict:"

[T]he outcome of every conflict is determined by the extent to which the audience becomes involved in it. That is, the outcome of all conflict is determined by the scope of its contagion. The number of people involved in any conflict determines what happens, every increase or reduction in the number of participants, affects the results (Schattschneider, 1975: 2).

He suggests that "control of the scope of conflict" is the essence of politics (Schattschneider, 1975: 10).

Interest Groups and Public Policy

Almond and Powell define interest articulation as "the process by which individuals and groups make demands upon political decision makers" (Almond and Powell, 1966: 73). Moreover, interest groups will gravitate towards "those channels which are most available and which seem most likely to bring the demands to the attention of the relevant decision makers" (Almond and Powell, 1966: 75). Almond and Powell do not suggest that interest articulation is the singular function of organized groups nor is it only the domain of organized interests. As they write: "Political structures, in short, tend to be *multifunctional*, although the degrees of multifunctionality depend upon many factors" (Almond and Powell, 1966: 31). However, according to this view articulation is the primary function of organized interests in the public policy process.

Various authors have attempted to classify organized interests in different ways. In an early chapter of their book, *Interest Groups, Lobbying, and Policy Making*, Ornstein and Elder (1978) identify groups by the types of functions they perform. **Symbolic functions** include those that allow members an outlet for expressing interests through an organized body. **Economic functions** are the primary demarcation between public interest groups and private interest groups. Economic functions are performed to provide a beneficial return to members (individual and organizational) through group activity. **Ideological functions** include a wide range of activities that reflect the ideological tendencies of members. The dissemination of facts, details, and news between members is one element of Ornstein's and Elder's **information function**. Other elements include

input into the legislative process and regulatory decision making. Still another is the general concept of public education. The **instrumental function** is best exemplified by those group activities taken in pursuit of a particular goal. Examples include, antiwar groups that formed to protest American troops in Vietnam, and pro-life organizations opposed to abortion. Ornstein and Elder are careful to note that the functions they identify are not mutually exclusive. In reality, most groups perform a number of functions.

Mahood (1990) describes the benefits that members hope to derive from joining interest groups. **Economic benefits** are tangible benefits. Groups such as unions, trade associations, and business interests are often concerned with promoting the economic well-being of their members.

Solidary benefits include those that reflect "the establishment of emotional ties across the membership" (Mahood, 1990: 12). Examples he gives include the work of the National Association for the Advancement of Colored People (NAACP), and the National Organization for Women (NOW).

A third category of benefits are those that are "derived from the satisfaction of having contributed to a worthy cause" (Mahood, 1990: 12). According to his description these types of **purposive benefits** are associated with the belief that membership is leading to some greater good such as a clean environment, a reduction in nuclear weapons, or better educational opportunities for all (Mahood, 1990: 12).

Many groups have arisen in recent years that are specifically focused on one aspect of public policy, such as the right to bear arms, have an abortion, or drink clean

water. These single issue groups have become more prevalent in recent years and provide what Mahood (1990) describes as **policy benefits**.

Interest Group Explosion

Mark Petracca writes: "The politics of interests has shaped American politics, how we view ourselves, and how others view us as well" (1992: 3). In recent years political observers have noted the increasing number of interest groups operating inside the beltway, and influencing state governments all across the country. However, despite the continued study and interest in organized group behavior, several unknowns continue to hamper assessments.

The most basic unknown is the size of the interest group universe. How many interests are acted upon through formal representation? No clear numbers are available but some statistical evidence can does shed a little light. According to Jonathan Rauch, (1994) during the mid-1950s, roughly 5,000 organizations were listed in the *Encyclopedia of Associations*; in the mid-1990s, this number is approaching 25,000. Between 1950 and 1975 a steady stream of interest groups added to the total number before spiking around the time of Ronald Reagan's election to the presidency (Rauch, 1994). During this period of organizational growth, millions of Americans joined one group or another.

Have we entered an era of hyper-pluralism? Rauch seems to think so.

I have come to suspect that the conventional wisdom is backward; the most worrisome thing is not so much that American society is in the grip of its

gridlocked government, but that American government . . . is in the grip of powerful and broad changes in American society (Rauch, 1994: 16).

One of these powerful changes has been what Jeffrey Berry and many others have termed the "advocacy explosion" (1989: 16). A significant element of this explosion has been the arrival of citizens groups. Many of these groups evolved out of the social upheaval of the 1960s. The civil rights movement came to life in the 1950's, before gathering a full head of steam in the 1960s. Antiwar protests against Johnson's and Nixon's Vietnam policies mobilized millions, of mostly young, Americans. Yet other powerful social forces have included the women's movement, which focused on an Equal Rights Amendment in the 1970s and the environmental movement. Many of the new organizations that evolved out these movements have been lumped into the category of public interest organizations. Other changes in the interest group system are also noteworthy. For instance, researchers are noting the expansion and diversification of interest groups operating at the regional, and local levels. Moreover, interest groups are employing different strategies and tactics to accomplish their organizational goals.

Interest Groups and Subnational Politics

Research on pluralism has tended to focus on national organizations operating at the Federal level. In fact however, interest groups are nationwide and are active participants in policy making at the regional, state, and local levels of government.

Whereas the large number of interests operating at the national level has produced a pluralism that has prevented any one interest from dominating national politics, this has not been historically true in the states. One or a handful of interests-- mining and railroads in the West, agriculture in the South and Midwest, for

example--have been able to dominate state policy making for long periods. Consequently, a very good case can be made that over the years interest groups have had a more visible and much greater impact on public policy in the states than in Washington D.C. (Thomas and Hrebenar, 1992: 151).

Thomas and Hrebenar also suggest that there are several reasons for studying "subnational" interests including the complexity of governmental programs that often involve more than one layer of government (Thomas and Hrebenar, 1992: 152). In essence, pluralism and group activity has expanded and diversified at the subnational level as programs have become more complex and multigovernmental, filtering through the layers of the U.S. federal system.

Resources, Strategies, and Tactics

According to Hayes interest groups have several valuable intangible resources. First, groups can serve as a data bank of "information" and possibly "expertise" (Hayes, 1992: 49). Interest groups provide information to constituents, but also assist policy makers with information and suggestions. A second resource is a group's "legitimacy" (Hayes, 1992: 49). Some groups are pictured as benevolent do-gooders acting for the well being of society or a particularly needy constituency; while others are criticized as annoying meddlers. Hayes (1992) cites the nearly indomitable power of senior citizen's groups and their seemingly untouchable programs such as Social Security and Medicare.

A final intangible is a group's "strategic position in society" (Hayes, 1992: 49). For example, business groups claim to represent what almost every American wants, a

healthy economy. As such, business groups are given a special "listen-to" by elected politicians.

Intangibles make for good conversation and endless speculation, but certain tangible resources and new operational techniques have increased the influence and power of modern day interest groups.

If an organization operates in a competitive environment and offers benefits similar to those of other groups, how aggressively it markets itself may make the critical difference in its ultimate success (Berry, 1989: 57).

In this increasingly competitive environment, groups have taken this cue and implemented several strategies in order to add to their membership rolls and boost their financial status. Direct mail is one means of accomplishing these live or die objectives.

Direct mail campaigns can involve thousands of letters and phone calls, soliciting money, seeking new members, or informing constituents about governmental activities and the work being performed on their behalf by a dedicated staff. Mailing lists can be purchased from companies, and consultants can help groups formulate effective targeting strategies.

Direct mail tactics are used to "demand action" on the part of sympathizers, and constituents. Much larger direct mailings may target large segments of the population or particular geographic regions alerting them to a proposed government action and the possible ramifications. In recent election years, direct mail has become an increasingly prevalent means of reaching voters. According to R. Kenneth Godwin, "more than 200 million pieces of political direct mail reach millions of American citizens" (1992: 308).

Groups also can reach citizens using the telephone. Membership lists are computerized as are targeted populations. A specialized industry of survey researchers can instruct groups in the most effective ways of reaching citizens, which explains that call from the Association of Snipe Surveyors during dinner or just prior to the first commercial break of "Roseanne" reruns.

New technologies are rapidly transforming the way in which Americans receive information. Television has become a powerful source of dubious political communication. Religious figures such as Jerry Falwell and Pat Robertson have employed television to increase membership rolls in their organizations and amass "funds for political purposes" (Godwin, 1992: 312). Politicians such as Lamar Alexander have exploited cable television to discuss ideas and issues with friendly audiences and to raise funds. The Internet offers yet another communication medium for organized interests and its effects have not been widely explored by political scientists.

Advertising in widely read journals, newspapers, on television and radio are another means through which organized interests reach out to a larger public or conversely a specific target. Loomis and Sexton suggest that advertising is but "one component of the broad public relations campaigns of those interests that can afford them" (1995: 211).

Yet another development in recent decades is judicial acceptance of interest groups standing to sue.

The federal courts are yet another channel of broadening groups access. Recent years have witnessed an easing of restrictions on one's legal standing to sue (Mahood, 1990: 183).

Political observers are quick to point out that changes in the interest group system have occurred over the past thirty years and have significantly affected the policy process.

The mobilization of these new groups has profoundly affected the policy process in recent years. On issue after issue, previously autonomous policy subsystems have been penetrated by new interests, giving rise to more complex issue networks in which a multiplicity of actors contend over policy. Similarly, regulatory agencies are now much more likely to operate in a highly pluralistic environment. Agencies once co-opted by their industrial clientele now find themselves confronted with lobbying, and litigation by a variety of public interest groups (Hayes, 1992: 58).

Salisbury seems to agree suggesting that formerly "external" groups have penetrated policy subcircles and have "destabilized the policy making process" (1990: 210-211).

The proliferation or fractionation of interests in particular policy domains has undermined the hegemony of peak associations in those domains, pushing some groups into small policy niches and forcing others into much more complicated coalitional efforts to secure their policy desires (Salisbury, 1990: 211).

Arguably, no other subset of citizen groups have been as successful at penetrating policy subsystems as environmental organizations.

American Environmentalism and Antinuclear Activism

The history of the American environmental movement can be traced at least as far back as the Progressive era. Debates over whether to preserve or use wisely America's enormous amount of natural resources were led by John Muir and Gifford Pinchot (Humphrey and Buttel, 1986; Dunlap and Mertig, 1992). Throughout the twentieth century, several stages of environmentalism can be traced, but the most important was ushered in during the 1960s. Rachel Carson's book *Silent Spring* brought to light questions about the potential effects of widespread use of DDT and other agri-chemicals

(Carson, 1962; Dunlap and Mertig, 1992). Protests against the Vietnam War and the civil rights movement provided a fertile breeding ground for environmental activism. The activist culture of the sixties "encouraged people especially youths to take direct action to solve society's ills" (Dunlap and Mertig, 1992: 2).

By 1970, scientific knowledge about ecosystems, pollution, and hazardous wastes had grown tremendously. Moreover the media began to notice environmentalist concerns following the Santa Barbara oil spill in 1969 and the first Earth Day celebration in 1970 (Dunlap and Mertig, 1992).

One of the big questions continuing to confront the American environmental movement involves its staying power. There is fairly strong evidence indicating that environmental values have penetrated the collective social conscience of the United States. Riley E. Dunlap summarizes a number of public opinion polls which suggest that the general public has maintained a high level of environmental concern.

[T]he foregoing evidence in public opinion toward environmental issues strongly indicates that the environmental movement has been extremely successful in attracting and maintaining--for two decades--the public's attention to and endorsement of it's cause (Dunlap, 1992: 113).

Even during the Reagan years, there is evidence suggesting that "the Gipper" unintentionally helped to invigorate a stalled environmental movement.

The environmental movement not only avoided demise but it experienced a major revitalization, gaining increased membership, new organizations, especially at the local level, and renewed support from the public and policymakers (Dunlap and Mertig, 1992: 4).

Environmental groups have greatly profited from the application of direct mail. This drive has been especially sophisticated and effective. Employing computers and communicating "the message" has increased membership rolls, operating budgets, and brought concerns about the environment directly into the homes of millions of Americans (Mitchell, Mertig, and Dunlap, 1992).

Environmental organizations have increasingly turned to lobbying professionals in order to affect the development of public policy.

In 1969, before Earth Day, only two full-time environmental lobbyists served the movement . . . a decade later the number of environmentalist lobbyists had swelled to 88 (Mitchell, Mertig, and Dunlap, 1992: 20).

More importantly, environmental groups often have become key witnesses during administrative proceedings. Despite periods when environmentalists were granted fewer opportunities before policy makers, such as the Reagan era, environmental organizations generally have been given more opportunities to testify. As a result, they have become important and influential policy actors in the administrative process.

They have done this by critiquing the environmental impact statements that are mandatory for major government projects, commenting on proposed regulations, petitioning for regulatory action . . . participating in scientific advisory committees, providing information to the agencies, and testifying at administrative hearings (Mitchell, Mertig, and Dunlap, 1992: 20).

Environmental organizations also have become litigants against government agencies and private sector corporations. For example, in 1983, DOE was sued by several environmental organizations led by the Legal Environmental Assistance Foundation and the Natural Resources Defense Council over allegations that the Department was violating a number of laws. The suit alleged that the Department's

facility in Oak Ridge was discharging toxic chemicals and radioactive materials into the Clinch River of East Tennessee in violation of the Resource Conservation and Recovery Act (RCRA) and the Clean Water Act (O'Leary, 1993). A U.S. district judge ruled a year later that the facilities in East Tennessee must come into compliance with federal law as quickly as possible (O'Leary, 1993).

Professionalism and specialization also characterize modern environmental organizations:

[O]rganizations of amateurs . . . were fully capable of dealing with first generation issues . . . second generation issues were far more numerous, diverse and complex, and their resolution often took years of sustained effort. Dealing with them required a high level of legal and scientific expertise. It was no accident, therefore, that the earlier amateurism was rapidly transformed into professionalism by the early 1970s (Mitchell, Mertig, and Dunlap, 1992: 21).

Advocacy science or counter science is commonly employed by environmental organizations to answer the claims of government agencies. For example, James Werner, a Clinton political appointee at the Department of Energy, was a scientist and a spokesman for the National Resources Defense Council on decommissioning and environmental restoration of contaminated sites. The Union of Concerned Scientists is another group of advocacy expertise that attempts to shed light on the perceived dangers of nuclear energy and very real threats posed by nuclear weapons.

"The national environmental organizations frequently practice the politics of ad hoc coalitions" (Mitchell, Mertig, and Dunlap, 1992: 23). As environmental issues and problems have become more complex, groups have tended to develop areas of expertise, "and an informal division of labor results" (Mitchell, Mertig, and Dunlap, 1992: 23). For

example, the Tennessee Valley Energy Resource Coalition (TVERC) is a coalition of organizations in the Tennessee Valley Authority (TVA) region that acts as a watchdog over TVA activities.

Characterizing all environmental organizations under one conceptual heading oversimplifies the diversity that exists between and among the many groups. Jerome Price argues, "subtle ideological differences among environmental groups reflect the fact that all have unique ways of interpreting their ecological values and each chooses a different tactical style to bring about preferred changes" (1989: 38). There are many issues to which organized environmental groups have turned their resources and attention. Though many groups do not actively oppose nuclear energy and some in fact have supported its development in years past, nuclear science has become the focus of many important policy organizations.

POLITICAL COMMUNICATION: IMAGERY AND EFFECTS

Sig Mickelson eloquently describes the scene at a CBS studio, in the pre-dawn hours of November 7, 1952:

The euphoria that dominated studio 41 stemmed from elation that the job had been well done, that a new and infinitely complicated communications medium had been harnessed effectively to deliver an unprecedented communications service. Joyful news personnel were confident that a new era in the American political process had begun (Mickelson, 1989: 12).

And indeed a new era had begun, one in which the mass media would play an increasing role in the public policy process. Would the era be one for the better, or one for the worse? At the time of Eisenhower's election the query was answered almost

overwhelmingly with positive responses. However, in the introduction to his work, Mickelson suggests "that it is time to survey the damage" to the electoral process brought on by over forty years of television (Mickelson, 1989: 3). Many others have heeded this call and broadened the examination of the mass media and politics to include attention on the policy making process.

Eric Severeid, a news correspondent with CBS spoke before a joint session of the Massachusetts State Legislature. On a winter day in 1967, he suggested that the relationship between the press and government is one of mutual distrust and mutual necessity.

People like you work on the cutting edge of history; people like me along with you live at the growing points of society. And we live together, in a frequently miserable marriage of necessity, as restlessly close as any two elements society knows . . . together we compose the invisible environment of the American mind, make the community weather, sound the tones of the day. And frequently we detest each other, because as in any marriage, we happen to have certain conflicts of interest (Severeid, 1967: 6).

Distrust and strained accommodation characterize press relations throughout much of American political history. Early in the deliberations at the Constitutional Convention, the Founders devised a secrecy rule in order to limit outside knowledge about what was occurring inside the State House. Even the gregarious Benjamin Franklin agreed to abide by the rule, though it appeared to many that he would at some point, unintentionally violate the clause:

As for old Dr. Franklin, it seemed impossible to keep him quiet; it is said a discreet member attended the Doctor's convivial dinner, heading off the conversation when Franklin, in one of his anecdotes, threatened to reveal the secrets of the convention (Bowen, 1966: 22).

George Washington was criticized by certain newspapers, both as a field commander during the revolutionary war, and as President. Thomas Jefferson did not like the secrecy rule when the news was presented to him in France; however later in his life he seemed to show a certain disdain for the press. A letter to John Norvel gives more than a hint of his feelings.

Perhaps an editor might begin a reformation in some such way as this. Divide his paper into four chapters, heading the 1st, Truth. 2nd, Probabilities. 3rd, Possibilities. 4th, Lies. The first chapter would be very short, as it would contain little more than authentic papers, and information from sources as the editor would be willing to risk his own reputation for their truth (Jefferson, [1807] 1944: 582).

Some of the most controversial figures of the nineteenth century include the founding fathers of yellow journalism, William Randolph Hearst and Joseph Pulitzer. Many have cited their papers' roles in exciting war fever over Cuba (Press and Verburg, 1988). Other progressive journalists and writers brought to light some of the problems of America's industrial growth. Upton Sinclair's, *The Jungle*, exposed the horrendous working conditions of the meatpacking industry and is credited with stimulating government regulations (Spitzer, 1993). During the 1960's, television pictures of black Americans being fire-hosed, beaten with billy clubs, and attacked by police dogs, helped turn American public opinion more favorably towards the civil rights movement. Moreover, pictures from Vietnam gradually soured public opinion towards the Vietnam War.

The mass media has evolved into a number of powerful communication mediums. Television has become the primary source of most Americans' news information (Nimmo

and Combs, 1981). Recent years have seen the development of new technologies. The Internet and other on-line computerized communication systems host listservers and discussion groups on any number of topics.

In their book, *The Rational Public*, Page and Shapiro suggest that the mass media is an important contributor to the vicissitudes of public opinion.

It makes a good deal of difference which events are reported, which are emphasized and which are ignored. It also matters what sorts of "facts" are conveyed and how they are interpreted. The facts and their policy implications are seldom unambiguous or uncontested. (Page and Shapiro, 1992: 340).

The effects of intensive media coverage tends to correlate with sharp changes in public opinion (Page and Shapiro, 1992). Over the long term distinct effects are more difficult to judge.

Gamson and Modigliani (1989) using an analysis derived from national media outlets including network news programs, newsmagazine articles, and newspapers, focused on changing public attitudes towards nuclear power. The authors trace an evolution of cultural attitudes that moved from an "age of dualism" when both fear of atomic destruction and hope that nuclear power would provide an abundant source of energy evolved to one of "runaway" technology and a widespread belief that nuclear power is terribly unsafe. During this time media information gradually became less optimistic and more critical of nuclear technologies (Gamson and Modigliani, 1989).

THE CURIOUS CASE OF CITIZEN PARTICIPATION

James Peterson begins his introductory chapter to *Citizen Participation in Science Policy* with an interesting observation.

One of the ironies of the 1970s was that while social commentators were decrying the rise of self absorption and the abandonment of social responsibility, the citizen participation movement in the United States was flourishing (Peterson, 1984: 1).

The American Constitution created a benign climate in which interested citizens could participate both formally and informally in the workings of government. Traditional democratic thought suggests that citizens "are interested in and participate in politics, are knowledgeable about the process of government . . . and vote in accord with a set of values or principles" (Conway, 1991: 2). Republican-democracy theory assumes that the wishes of the masses will be channeled through political institutions, with good government being the ultimate result. For good or bad, neither of these ideals have been met in the American political system; however, as Peterson and others have noted, demands for more public participation have increased across the spectrum of policy making.

Citizens enter the public policy process in a number of ways including elections, hearings, focus groups, and direct action (Peterson, 1984). Because the public is not and cannot for the most part be up to speed on all political undertakings all the time, citizens act on issues that are salient to them. And, the many aspects of nuclear energy including radioactive waste management and radiation protection have become important issues for many Americans.

The battle lines have been drawn between those who value citizen participation in science and technology policy, and those who scorn the idea.

Proponents of scientific autonomy and professional self-regulation often equate democratic governance with some kind of populist anti-intellectualism or bureaucratic Lysenkoism. Proponents of greater political accountability or of increased citizen participation in the policy-making process often assume that formal or procedural mechanisms alone are sufficient democratic ideas (Jennings, 1986: 223).

According to Abrams and Primrack, public participation in the policy making process "adds to the legitimacy and public acceptance of a government decision" and can lead to a "better decision" (1986: 75). Jennings suggests that public participation adds to the civic-mindedness of citizens, and enhances the "political reasonableness, judgement, and civic sensibilities" of participants (1986: 235).

Technical experts are quick to point out that the management of radioactive waste is a relatively straightforward task. The more complex issues are those of a social and political variety. It is these variables that often propel citizens into the arena of radioactive waste politics. The intensity of public participatory desires in radioactive waste decision making has attracted the attention of researchers from many disciplines. As such, various reasons have been put forth in order to explain this development including fears about possible policy ramifications, equity in decision making, religious and cultural issues, safety concerns, and future generations being saddled with cleaning up the mistakes of earlier generations.

A final reason for increased cries of more citizen participation is the atmosphere of skepticism and distrust that people feel towards the nuclear power industry and the agencies responsible for overseeing it. As Freudenburg and Baxter suggest:

It may have proved expedient in the early years of the industry for the AEC to limit public influence over the regulatory process and to discourage public disclosures of industry problems, but it may also be that these early actions contributed to a long-term legacy of skepticism and distrust (1985: 106).

Nuclear science, specifically nuclear power and those who manage it suffer from a crisis of legitimacy. This crisis is an affliction that continues to hamper further expansion of nuclear power and the development of effective and acceptable nuclear waste policies. As a recent report by the DOE argues, 'trust and confidence make a central contribution to the sustaining legitimacy of public organizations within the American system of governance'(U.S. Department of Energy, Secretary of Energy Advisory Board, 1993: 3).

THE CRISIS OF LEGITIMACY

Observers of the American system have long noted the influence of public opinion on the public policy process. Politicians now employ pollsters and statisticians to check the direction of the public wind. Similarly, interest groups can point to surveys that claim to show what the American people think about a particular issue. Polling and statistical analysis is a complicated, expensive, time consuming, and often times, fruitless endeavor. Bias, double-barreled questions, "is it random error or isn't it," these are just a few of the difficult problems that must be overcome when conducting survey research. Statistical interpretation is the most critical point in survey research and this stage is where

viewpoints among competing ideas tend to diverge. Public opinion however, is important to the policy process in two broad ways. First, public opinion puts a fence around the field in which governing officials can operate. Second, public opinion can add legitimacy to the arguments of policy actors (Freudenburg and Baxter, 1985). Still the connection between governing decisions and public opinion is tenuous at best.

Charles Piller suggests that American public's optimism for technology and its overseeing decision makers has eroded:

[T]he relationship between the general public and those who create, manage, and profit from science and technology has gradually soured. A litany of ecological disasters and technical failures--from Love Canal and the space shuttle Challenger explosion to the Chernobyl nuclear meltdown--has turned many Americans away from technological optimism. More important, Americans have lost their faith that those who control technology will do so competently and in the public interest (Piller, 1991: x).

Polls have shown, and observers have lamented, the seeming crisis of legitimacy affecting government. Nuclear waste and the institutions responsible for its management have been no exception. Polls over the past two decades have shown that nuclear energy, radioactive waste, and those institutions responsible for its management have been the source of much public concern.

Prior to the mid 1970s, public support for nuclear power was a no-brainer. Nuclear power was an expression of the nation's technological prowess. Few people were scared to have a power plant in their backyard. The concern over radiation fallout from atmospheric testing eroded once the U.S. switched to underground experiments. The situation began to evolve in the 1970s. A 1975 fire at the Browns Ferry facility raised concerns about the safety and management of nuclear power plants. Browns Ferry,

however, was nothing compared to the concerns that Three Mile Island would generate. Public opinion was changing and not in the direction that nuclear power proponents wanted to see.

According to recent survey interpretation by Rosa and Dunlap, “trends in the longest running time-series items have become increasingly unfavorable to nuclear power” (1994: 295). Harris and Cambridge polls showed majority support for nuclear power until the accident at Three Mile Island. Following several months during which the image of TMI was fresh in the minds of many people, polls revealed that the public was very wary of nuclear power. However, the decline in support soon leveled off and began to rise in later polls until a majority once again supported nuclear power development. The return to normalcy was short-lived. By the early 1980s, majority support was wavering before more people finally began to indicate that they did not support further expansion of nuclear power (Rosa and Dunlap, 1994). What is interesting about the evolution of public opinion is that support for expansion of nuclear power seems to have been eroding several years before the tragic accident at Chernobyl.

During the late 1970s and early 1980s several crucial decisions were made in regards to nuclear weaponry. In 1979, NATO announced a plan to deploy nuclear tipped cruise missiles in Europe. Following his election in 1981, President Ronald Reagan supported further development of the neutron bomb and MX missiles (Rosa and Dunlap, 1994). Concern over nuclear weapons mobilized peace activists and revealed that many Americans considered nuclear war a very real danger. As public fear over nuclear weaponry was surging in 1982, support for the expansion of nuclear power facilities

slipped into the minority (Rosa and Dunlap, 1994). 1979 and 1980 also were the days of a LLRW crisis that still has not been fully resolved. How much this contributed to the decline in public support for nuclear power is open to debate and could be the source of more careful examination.

Proponents of nuclear power continue to suggest that public support still exists. Citing polling data which reveal that many Americans, sometimes a majority, think that nuclear energy will be an important source of electricity in the future, proponents claim that a rebound in public support remains a real possibility. Opponents suggest that this line of reasoning is mere nonsense or faulty reasoning. Without a concerted attempt to revive the nuclear power option speculation will remain just that. Rosa and Dunlap summarize the uncertainty and offer one interpretation of the seeming contradiction: "the public is apparently unwilling to rule out the nuclear option, but it is opposed to the implementation in the near future" (1994: 306).

Radioactive waste was one of the "last public concerns associated with fission technology" (Freudenburg and Rosa, 1993: 45). This concern has proven to be a serious handicap. Radioactive waste did not prove to be a public opinion problem until the early 1980s (Freudenburg and Rosa, 1993). Opposition during the 1970s was centered around safety and the barriers to public information erected by governing bodies (Freudenburg and Rosa, 1993). However, during the last fifteen years polls have consistently shown that radioactive waste is a serious concern for American citizens.

Just as public support for nuclear power has declined and public concerns about radioactive waste have increased, there has been a shift in attitudes towards industrial and

governmental decision makers responsible for the management of nuclear science and technology. For example, in April 1991, Admiral James Watkins, the former Secretary of Energy, commissioned a study to investigate DOE's lack of public trust. The report suggested that despite progress, distrust of the Agency's civilian waste management program exists and is likely to be around into the foreseeable future (U.S. Department of Energy, Secretary of Energy Advisory Board, 1993).

In truth, an image problem had been hovering over governing agencies prior to DOE. In 1975, the Atomic Energy Commission was split into two separate agencies; the Energy Research and Development Administration (ERDA) and the Nuclear Regulatory Commission (NRC). Since its inception, the AEC had been responsible for both promotional and regulatory oversight of nuclear energy. With the breakup, ERDA and then DOE became responsible for research and promotion, while the NRC assumed the AEC's regulatory duties. The new arrangements were due in large part because of the perception that the AEC was overly cozy with the commercial nuclear power industry. Today, opponents of nuclear power continue to suggest that the NRC is in an unholy alliance with the nuclear energy industry and the dismantlement of the AEC did little to rectify the coziness problem. Proponents argue however, that the NRC is overly susceptible to the swings of public opinion, lacks a certain sense of leadership fortitude in the face of vocal opposition, and is prone to ignore scientific reasoning, giving way to political forces far too often.

The institutions associated with nuclear energy, radioactive waste, and radiation protection suffer from a crisis of legitimacy. Chauncey Starr argues, that "the acceptance

of risk is more dependent on risk management than on the quantitative estimates of risk” (1985: 98). The lack of trust in the risk managers of nuclear science has exacerbated the difficulties of establishing policies that are both effective and acceptable to the American public.

A REVISED PUBLIC POLICY PROCESS MODEL

There are numerous forces affecting the public policy process that are not illustrated in traditional models of the American policy process. What does this imply for decision makers who are responsible for regulations, such as radiation protection standards? It suggests that the likely endpoint of the policy process for complex and controversial issues is either long delays in implementation or never-ending revisions of previous "solutions." In short, policy gridlock.

In the United States, public policy development was never meant to be easy. The Constitution established a fragmented framework of institutions designed to channel the wishes of the masses. The hoped for result would be good governance. However, few if any of America's great political thinkers from that era could have foreseen the difficulties faced by political institutions responsible for dealing with complex technical issues such as radioactive waste and radiation protection standards.

Feldman, Peretz, and Jendrucko (1994) suggest that the gridlock which continues to hamper radioactive waste decision making had its genesis in the LLRW crisis of the late 1970s and early 1980s. In their view, "LLRW policy gridlock is the result of federal-state conflict, MIMBYism, and ineffective planning" (Feldman, Peretz, and Jendrucko,

1994: 590). Moreover, as effective solutions to radioactive waste disposal continue to elude regulatory and legislative institutions, the judicial system becomes the playing field upon which the policy combatants ultimately must test their skill. **Figure 7** illustrates their model of "gridlock in radioactive waste."

Other authors have conceptualized the public policy process for technical issues with similar models. McCabe, Colglazier, and Fitzgerald (1993) suggest that the public policy process has changed in several fundamental ways. As a result the "implementation of public policy has become increasingly problematic" (McCabe, Colglazier, and Fitzgerald, 1993: 5). First, public trust in institutions has declined over the past thirty years. Second, many more groups than ever before are operating in the political system. Further these groups are capable and willing to exploit the mass media, utilize the judicial arena, and effectively use direct protest to accomplish their goals. These changes have resulted in a new public policy process, which all too often results in gridlock. McCabe's, Colglaziers, and Fitzgerald's model of the changing policy process as seen in **Figure 8** is a better means of illustrating policy making for issues such as nuclear energy, radioactive waste, and radiation protection.

Once a regulatory institution has formulated an option for meeting the spirit of legislative directives, that decision is placed in the public domain for review and commentary. At this point, the changes in the public policy process often lead to gridlock. Implementing agencies attempt to weather the criticism of their decisions (the classic "decide, announce, and defend" reaction). The new forces affecting the American policy process, however, have made this an increasingly difficult endeavor.

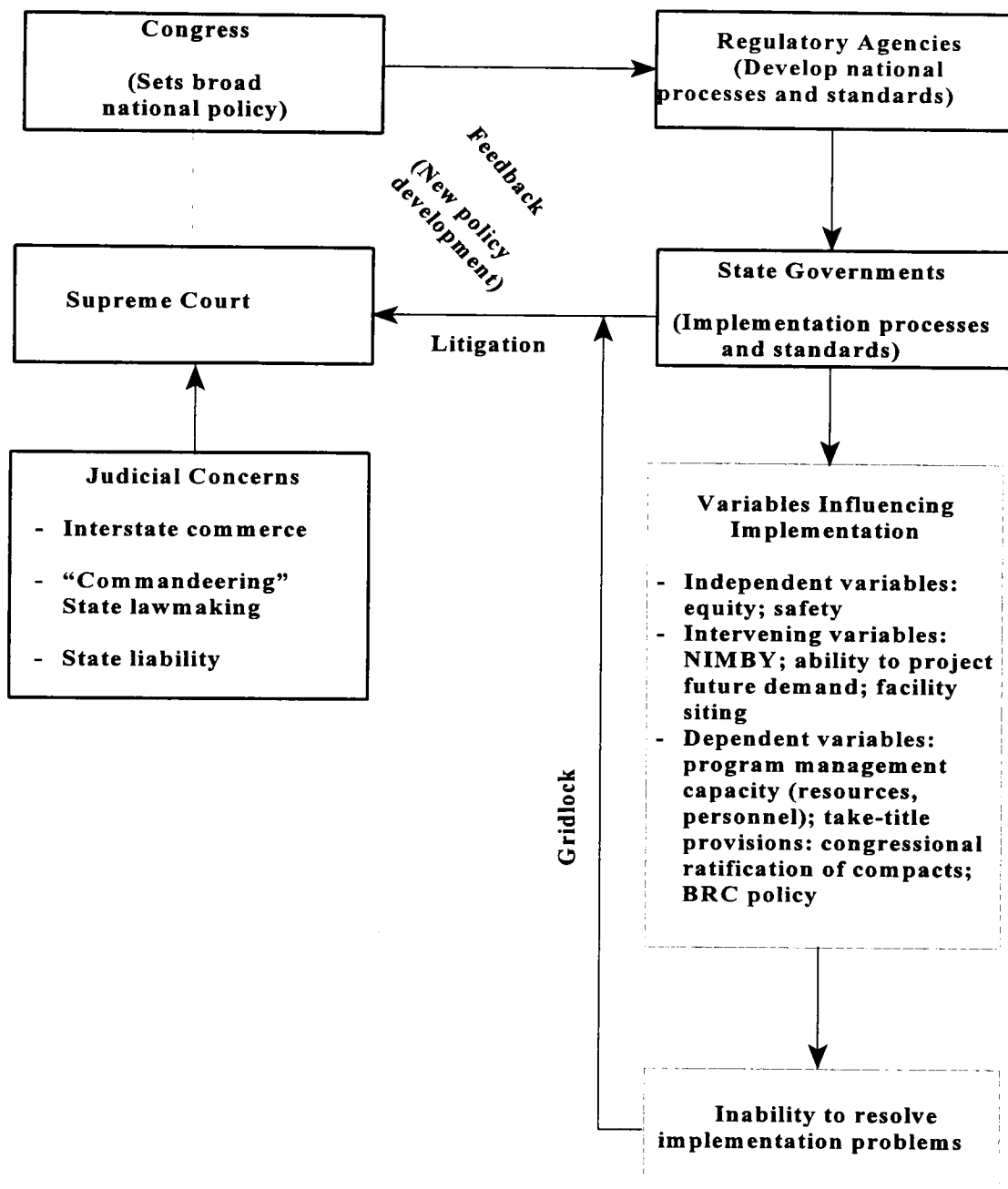


FIGURE 7- CONCEPTUAL FRAMEWORK OF GRIDLOCK IN RADIOACTIVE WASTE

Source: Feldman, David F., Jean H. Peretz, and Barabara Jendrucko. 1994. "Policy Gridlock in Waste Management: Balancing Federal and State Concerns." *Policy Studies Journal* 22: 589-603

CONCLUSION

During the second half of the twentieth century, American governmental institutions have assumed management responsibilities for all sorts of highly complex issues. Since the late 1960s, environmental issues have expanded in scope to include water, air, land, and nonhuman species. None may be as controversial and complex as nuclear science. As the American policy process has evolved, the likelihood of establishing effective and acceptable nuclear energy, radioactive waste, and radiation protection standards for the long term has diminished. The next chapter will explore how changes in the policy process led to the failure of the Nuclear Regulatory Commission's BRC initiative.

CHAPTER V

THE FAILURE OF BELOW REGULATORY CONCERN

Facts alone are wanted in life. Plant nothing else, and root out everything else. You can only form the minds of reasoning animals upon Facts; nothing else will ever be of any service to them . . . In this life, we want nothing but facts.

Thomas Gradgrind, the schoolmaster in Charles Dickens, *Hard Times*.

INTRODUCTION

Definitive proof of a below regulatory concern (BRC) level has long been sought by radiation researchers (Meyers, 1987). Before World War Two, scientists operated under the assumption of a "tolerance dose" (Yalow, 1988: 239). It was assumed that there was a level of radiation exposure, below which no harmful effects occurred. As the Manhattan Project progressed, knowledge about the possible ramifications of radiation exposure began to accumulate. Further, as the diffusion of nuclear science into more numerous uses became likely,

the possible exposure of large groups of people to ionizing radiation because of the development of nuclear weaponry, the introduction of nuclear medicine, the increased use of diagnostic and therapeutic radiation, and the anticipated progress in the use of nuclear power provided the incentive to establish tighter guidelines than had earlier been used (Yalow, 1988: 240).

Other countries have established BRC levels, mainly based on guidelines put forth by the International Atomic Energy Agency (IAEA). Nonetheless, BRC radiation levels continue to elude U.S. regulatory agencies responsible for radiation protection.

In 1986, the Nuclear Regulatory Commission announced that it would soon be looking into the feasibility of BRC standards. Another policy statement was put forth in 1990. Opposition which had been limited and virtually unnoticed suddenly intensified. Opponents perceiving that the time was ripe began their offensive and continued until 1992 when the policy statements were revoked by the **Energy Policy Act**. This chapter illustrates that the failure of the BRC initiative was the result of changes in the American policy process.

BRC AND GOVERNING INSTITUTIONS

NRC is the primary federal agency responsible for regulating commercial applications of nuclear science. Its authority is derived from several pieces of legislation as shown in **Table 6**.

The NRC is authorized to license the construction and operation of nuclear power plants, fuel cycle facilities, and nonpower research reactors. The NRC also licenses possession of nuclear material used for medical and industrial purposes. Over 22,000 licenses are currently held by medical, industrial, and academic users of nuclear material (U.S. Nuclear Regulatory Commission, 1994c). Of this total, approximately 6,700 are the direct responsibility of NRC while the other 15,000 are regulated by state radiation agencies, through the NRC's Agreement State program.

NRC also is responsible for licensing low-level radioactive waste disposal facilities and practices (U.S. Nuclear Regulatory Commission, 1994c: 4).

TABLE 6- LEGISLATIVE AUTHORITY FOR THE NUCLEAR
REGULATORY COMMISSION

Atomic Energy Act of 1954, as amended
Energy Reorganization Act of 1974, as amended
Uranium Mill Tailings Radiation Control Act of 1978, as amended
Nuclear Non-Proliferation Act of 1978
Low-Level Radioactive Waste Policy Act of 1980
West Valley Demonstration Project Act of 1980
Nuclear Waste Policy Act of 1982
Low-Level Radioactive Waste Policy Act Amendments of 1985
Diplomatic Security and Anti-Terrorism Act of 1986
Nuclear Waste Policy Amendments Act of 1987
Solar, Wind, Waste, and Geothermal Power Production Incentives Act of 1990
Energy Policy Act of 1992

Source: U.S. Nuclear Regulatory Commission 1994c. *Information Digest*. Washington, D.C. Nuclear Regulatory Commission Public Documents Room.

accordance with its regulatory authority, NRC has in the past permitted wastes and materials to be released. A number of consumer products such as smoke detectors and watches with luminescent dial faces are simply too numerous and the risks too low for much concern with stringent regulatory oversight. Some alternative waste disposal is permitted by NRC regulations 10 CFR 20.302 and 10 CFR 20.2002. Since the exemptions were promulgated by NRC in 1983, very few exemptions have been approved or even requested by waste generators (Bangart, 1992; Minns, 1992).

In June, 1974, the AEC released a directive, still used by the NRC, "Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors." Waste generators and more specifically a growing industry of decontamination and waste processing firms are using "Regulatory Guide 1.86" to release materials. In particular, metals contaminated with a very low levels of radiation have been the subject of much research and policy discussion.

Alternative disposal and the release of minimally contaminated materials is done on a case-by-case basis. With the BRC initiative, the NRC hoped to promulgate consistent and generally applicable standards to replace the smattering of initiatives and case-by-case decision making that had characterized previous releases.

Several federal agencies have important roles in radioactive waste management. These include the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), the Department of Transportation (DOT), the Department of Energy (DOE), the Department of Defense (DoD) and state agencies. EPA is primarily responsible for off-site releases of radiation including air and drinking

water standards. EPA also has radiation guidelines for the Superfund program. Rules and regulations for the shipment of radioactive materials are set by the DOT. When the AEC was disbanded, ERDA and later DOE assumed developmental responsibilities. DOE does not directly regulate any commercial nuclear enterprise; however, DOE's Office of Civilian Radioactive Waste Management (OCRWM), performs research on LLRW problems. Moreover, the Department will operate the high-level radioactive waste repository, should one ever open.

DOE also has assumed responsibility for the vast network of federal production plants, research laboratories, and fuel cycle facilities developed during the Cold War. In 1989, the Office of Environmental Management was created, signaling a sea change within DOE. As the Cold War ended, the ugly forty year legacy of nuclear weapons production came under the spotlight. What revealed itself was an environmental nightmare. Land, water, and buildings are contaminated with mercury, PCBs, radiation and other dangerous carcinogens. DOE is only now in the early stages of cleaning up the mess.

The proliferation of federal government agencies responsible for managing radioactive wastes has complicated the process of establishing effective and acceptable regulations. Interagency conflict can occur. NRC, EPA, and state governments have complimentary regulatory responsibilities in radiation protection and the lines of demarcation are not always clear. Moreover, there is no guarantee that all agencies will agree on regulatory requirements. Agencies have different agendas, different clients, and different bureaucratic cultures. A 1994 GAO report suggests that the U.S. regulatory

framework for radiation standards is overly complex and not the best means of protecting public health.

Taken together, the radiation standards that have been developed reflect a lack of overall interagency consensus on how much radiation risk to the public is acceptable. Because the standards have different regulatory applications and are based on different technical methodologies, the estimated risks to the public that are associated with these standards and guidelines vary considerably (U.S. General Accounting Office, 1994: 1).

As this section illustrates, the proliferation of agencies responsible for radioactive waste management has complicated the regulatory policy process. The following sections describe how the complex governmental arrangements for managing radioactive waste helped to bring about the failure of the Nuclear Regulatory Commission's BRC initiative.

When Experts Disagree

Comments submitted to NRC by DOE, reveal that the Department was not entirely satisfied with the proposed BRC policy.

DOE believes the proposed limit of 10 mrem/yr may be too high considering other existing standards and the fact that many of our facilities or sites have multiple routes of exposure rather than a single pathway of exposure (U.S. Department of Energy, 1989: 1).

DOE also was not satisfied with the "go-it-alone" approach of NRC. EPA has certain complimentary responsibilities and DOE comments on the BRC policy statement suggested that NRC should work in "close coordination" with EPA (U.S. Department of Energy, 1989: 2). DOE argued that failing to present a unified front would result in a public outcry against yet another bureaucratic blunder. Moreover, the Department felt that BRC standards should be consistent with international criteria in order to permit

trade between nations of exempted materials and the NRC's policy statements did not meet this stipulation (U.S. Department of Energy, 1989).

DOE is waiting on the magic BRC number in order to more effectively contain the costs of cleaning up the weapons production complex. According to Leo Duffy, BRC standards are critical.

We are trying to get down to the \$12 billion number rather than the \$25 billion, and the \$25 billion rather than the \$50 billion . . . One of the major areas that would have a significant difference on the cost is if the Environmental Protection Agency and the [Nuclear Regulatory Commission] defined a below regulatory concern number of how clean is clean (U.S. Congress. House. Committee on Interior and Insular Affairs, 1990: 241).

Despite the expressed need for a BRC standard, the NRC policy statements were not what DOE was looking for.

DOE's comments however, were mild when compared with EPA's public reactions. First, EPA's comments indicate that any BRC initiative was not solely the domain of NRC--the EPA had jurisdiction as well.

In accordance with our responsibilities . . . the Environmental Protection Agency has reviewed the Nuclear Regulatory Commission's Advanced Notice of a Proposed Policy Statement on Exemptions from Regulatory Control (53 FR 49886). EPA has serious concerns with the notice. The proposed action could have a profound effect on regulation of radiation released to the environment outside the boundaries of licensed facilities, and it deals with areas in which EPA has complimentary statutory responsibilities (U.S. Environmental Protection Agency, 1989: 1).

By broadly interpreting Section 10 of the Low-Level Radioactive Waste Policy Amendments Act, NRC established a policy statement that would reach beyond its regulatory parameters. And this concerned the EPA:

Almost any conceivable application of the proposed policy would directly affect exposure of the public in the general environment, an area of primary concern to EPA (U.S. Environmental Protection Agency, 1989: 3).

EPA felt that the BRC policy did not clearly delineate which exemption activities were within the bounds of NRC authority and which were not.

EPA also was concerned about the NRC's assumptions and definitions. EPA felt that the BRC proposal short-changed the ALARA concept, by "reinterpreting" this long standing radioactive waste management concept (U.S. Environmental Protection Agency, 1989: 4). Moreover, EPA felt that the proposed exposure limits for BRC exemptions were not acceptable: "10 mrem/yr is too high [and] consideration of the possibility of exposures as high as 100 mrem/yr is totally inappropriate" (U.S. Environmental Protection Agency, 1989: 4). As the NRC was fighting for its BRC policy, EPA was in the process of developing its own BRC initiative. A staff draft of the EPA version suggested that individual exposures should be limited to no more than 4 mrem/yr (Quinn, 1990).

EPA also expressed serious reservations about BRC's compatibility with other domestic and international radiation standards. EPA claimed that the BRC policy was not consistent with guidelines promulgated by international agencies such as the IAEA, nor even consistent with "the Commission's own policy on BRC for low level waste issued in August, 1986" (U.S. Environmental Protection Agency, 1989: 6).

It seems clear that the intent of the 1986 Policy is to keep individual doses well below 10 mrem/yr, and if possible, below 1 mrem/yr. This is quite in contrast to the present proposal that would assure exemption to any activity with an estimated exposure below 10 mrem/yr, and permit exemptions up to 100 mrem/yr (Environmental Protection Agency, 1989: 7).

EPA officials later testified before a House subcommittee hearing on BRC (U.S. Congress, House, Committee On Interior and Insular Affairs, 1990). Richard Guimond, who was at the time both Director of the Office of Radiation Programs and Assistant Surgeon General echoed the conceptual and numerical reservations expressed by his agency. Guimond indicated that he was unsure how conflict with the regulatory responsibilities of other agencies would be managed. Guimond also suggested that the BRC policy criteria of ten millirem could compromise EPA's radiation standards for drinking water. NRC promised to work out the kinks as petitions were submitted for BRC exemptions. However, few were comfortable with this notion, including the EPA.

BRC and the Problems of Federalism

Amendments to the **Atomic Energy Act** in 1959 authorized states to partially manage their radiation protection programs provided they could show that their protocols would be as effective as the AEC's (Ashe, 1993). The **Low-level Radioactive Waste Policy Act of 1980** and its Amendments furthered the decentralization of radioactive waste management by requiring each state to be responsible for disposing LLRW generated within their borders.

The decentralization of control has led to several political disputes over radioactive waste. For example, another controversial element of the **Low-Level Radioactive Waste Policy Amendments Act** was the "take title" provision. As part of the carrot and stick approach adopted by the 99th Congress, the most severe provision of the Amendments required that state governments "take title" to radioactive waste if

disposal capacity had not been arranged for by January 1, 1986 (Ashe, 1993). This provision was a last minute amendment urged by Senator Strom Thurmond of South Carolina who was aware of his home state's desire to close the Barnwell facility. States viewed the take title provision as a violation of the tenth amendment. Eventually, the Supreme Court ruled in favor of the states (Ashe, 1993).

BRC evoked images of a heavy-handed federal government. States argued that BRC was not consistent with the decentralization of control for radioactive waste management. State governments argued that BRC policy would result in federal preemption of their authority. For example, James T. Kilbraith, Chief Deputy Attorney General of Maine argued that it makes no sense to establish an elaborate compact arrangement for LLRW disposal and then "take out of the regulated universe, 30% of the waste stream" (U.S. Congress, House, Committee on Interior and Insular Affairs, 1990: 55). Kilbraith also urged Congress to "reassess the entire question of federal preemption" in regards to radioactive hazards (U.S. Congress, House, Committee on Interior and Insular Affairs, 1990: 56).

State officials lined up to voice their opposition to BRC. The Conference of Radiation Control Program Directors (CRCPD), an organization of radiation protection officials supported the spirit of a BRC policy but opposed the Nuclear Regulatory Commission's proposed individual and collective dose limits (U.S. Congress, House, Committee on Interior and Insular Affairs, 1990). In December 1990, the National Association of Attorney's General adopted a resolution opposing the federal preemption of state authority to regulate low-level radioactive waste. Commenting during hearings

on the Radiation Protection Act of 1991, California governor Pete Wilson feared that "states may lose their right to adopt more stringent standards on the disposal of low-level radioactive waste" if Congress did not do something about the Nuclear Regulatory Commission's BRC policy statements (U.S. Congress, House, Committee on Interior and Insular Affairs, 1991).

Opponents pointed to a number of state and municipal ordinances forbidding BRC waste disposal. Minnesota, Vermont, Maine, Iowa, Pennsylvania, and other states passed statutes against BRC (U.S. Congress, House, Committee on Interior and Insular Affairs, 1990). Further, following a court case initiated by a coalition of environmental organizations and the state of Maine, sixteen states filed a "friend-of-the-court" brief urging that the Washington D.C., circuit court restrict the Nuclear Regulatory Commission's ability to preempt state control with imposed BRC standards (U.S. Congress, House, Committee on Interior and Insular Affairs, 1991). Eventually, the case was deemed "not ripe for review;" however, this did not set back opponents who continued to hammer away at the BRC policy. Congress was becoming very interested in the Nuclear Regulatory Commission's below regulatory concern initiative and wanted to uncover first-hand what all the fuss was about.

BRC and Congress

After much debate and a near defeat over mixed waste provisions, the **Low-Level Radioactive Waste Policy Amendments Act of 1985** was signed into law. BRC requirements are set forth in Section 10.

Not later than 6 months after the date of enactment of the Low-Level Radioactive Waste Policy Amendments Act of 1985, the Commission shall establish standards and procedures, pursuant to existing authority, and develop the technical capability for considering and acting upon petitions to exempt specific radioactive waste streams from regulation by the Commission due to the presence of radionuclides in such waste streams in sufficiently low concentrations or quantities as to be below regulatory concern.

A two volume report issued by two House Committees indicate that BRC was a part of early bills submitted for markups (U.S. Congress, House, Committee on Energy and the Environment, 1985). Little attention however, was given to the BRC provisions as the Amendments were debated. Although, John Dingle, Chairman of the House Committee on Energy and the Environment did express some concern:

The NRC should exercise such authority with particular care and diligence to ensure that waste that may be a possible threat to public health and safety does not escape careful regulation (U.S. Congress, House, Committee on Energy and the Environment, 1985: 37).

Senate markup of the Low-Level Radioactive Waste Policy Amendments Act was entrusted to the Committee on Energy and Natural Resources, chaired by James McClure. Appearing before the committee, Sheldon Meyers, Acting Director of the EPA's Office of Radiation Programs alerted the Committee's attention to possible conflicts between EPA and NRC over the development of a BRC regulation. In accordance with earlier statutes, EPA was preparing to issue a BRC standard for low-level radioactive wastes (U.S. Senate, Committee on Energy and Natural Resources, 1985). Meyers suggested that in order to avoid possible confusion and regulatory overlap, the Environmental Protection Agency should set the numerical guidelines for BRC and the Nuclear

Regulatory Commission should establish the proper procedures for ensuring prompt and effective application of the criteria.

Within five years, Congress was once again revisiting the BRC issue this time as opponents of the policy. The Congressional charge against BRC was led by Representative George Miller. In 1990, Miller organized a subcommittee hearing on BRC. Calling the hearing to order, Miller suggested that BRC was an "unprecedented reversal of current policy . . . that has raised considerable concern among our colleagues in both the House of Representatives and the Senate" (U.S. Congress, House, Committee on Interior and Insular Affairs, 1990: 1). Representative Chester Atkins feared a "Sword of Damocles" hanging over the head of his constituents in Massachusetts. Moreover, Atkins stated that "the NRC's BRC policy would move this country's waste disposal situation from the crisis stage to the stage of catastrophe" (U.S. Congress, House, Committee on Interior and Insular Affairs, 1990: 16). Phil Sharp representative from Indiana, argued that "our colleagues are dealing in a very personal way with this issue and that is the way this has to be dealt with" (U.S. Congress, House, Committee on Interior and Insular Affairs, 1990: 24).

Much of the discourse during the 1990 hearing was centered around the testimony of Kenneth Carr, Chairman of the NRC. Chairman Carr argued that the BRC policy statements established general guidelines for consistent cleanup criteria and would allow the Commission to focus on more serious radiation risks. During the discussions, Chairman Carr and his fellow NRC witnesses were asked to explain the Commission's BRC statement, react to the testimony of other witnesses, and turn the other cheek to the

criticism of subcommittee members. In one exchange, Carr suggested that the EPA and NRC were only minimally in disagreement as to the dose limits of BRC. Firing back, Miller suggested that while the actual dose limit differences may indeed be technically small, "politically they are very large" (U.S. Congress, House, Committee on Interior and Insular Affairs, 1990: 122).

At times the exchange between subcommittee members and witnesses such as Chairman Carr reflected the technical complexity of the BRC issue. The following excerpt reflects the communication problems of technical experts called before a body of laypersons.

Mr. Carr: I would like to make a point.

Mr. Kostamayer: Yes sir.

Mr. Carr: The 1000 number is 10 times lower than the U.N. Committee says can be used for any meaningful discussion of this dose limit for a population. They say if you are looking at a cumulative dose of less than 10,000 man-rem, then you are liable to be making conclusions that you can't substantiate. So we are a factor of 10 below that. Commissioner Curtiss would like to go a factor of 10 down, but he was not persuasive to the other members.

Mr. Kostamayer: Well that is true. But I gather I am correct in saying that 1000 is still 10 times higher than the original staff recommendations.

Mr. Carr: And 10 times lower than the U.N recommendation.

Mr. Miller: Three times pi r-squared, but where the hell are we?

Mr. Carr: We are in a numbers game. (U.S. Congress, House, Committee on Interior and Insular Affairs, 1990: 120)

Late in the 101st session, the House Interior and Insular Affairs Committee "moved to block" implementation of the BRC policy statements (Pytte, 1990: 2907).

Representative Miller introduced a bill (HR 5505) to revoke the policy statements and give states authority to regulate wastes that the NRC might designate as below regulatory concern (Pytte, 1990). An amendment to require that state governors be informed if BRC wastes were disposed of in their states, presented by West Virginia Representative Nick Rahall was adopted. Miller's 1990 bill however, never made it to the floor of Congress, dying in committee.

BRC debates did not end with the close of the Congressional session, as Miller maneuvered in 1991 to reopen the issue. Hearings were held by the House Subcommittee on Energy and the Environment in September 1991. Similar legislation, HR 645, "The Radiation Protection Act" was introduced. Once again, a bill would prevent the NRC from fully implementing its BRC policy statements. The bill was unanimously reported out of the subcommittee on September 26 (Idelson, 1991). Subcommittee Chairman Peter Kostmayer was successful in amending the bill to give states more authority to oversee not only BRC wastes but also the recycle of radioactive materials, nuclear facility decommissioning, and any distribution of consumer goods that could contain slightly radioactive materials (Idelson, 1991). Even tougher restrictions were proposed by Jim Jontz, a Democrat from Indiana, but were deferred until the full committee could meet (Idelson, 1991). A similar bill was put forth in the Senate by Alphonse D'Amato and George Mitchell (S 1111).

The House Committee on Interior and Insular Affairs moved quickly to pass the bill. On October 2, HR 645 was approved before it went to the House Committee on Energy and Commerce which has joint jurisdiction on matters of radioactive waste

(Congressional Quarterly, 1991; Idelson, 1991). At the same time, the crisis in the Persian Gulf was increasing the pressure for new energy legislation as called for by President Bush in his National Energy Strategy.

Following the successful conclusion of the Gulf War, a National Energy Strategy was a long way from Congressional approval. Energy issues fell under the jurisdiction of nine committees and a number of energy proposals had been put forth by several members of Congress (A. Taylor, 1992). After much negotiation among committee chairman, lobbying efforts by environmentalists and by industry representatives, an energy bill was passed in the House of Representatives in May 1992 (Idelson, 1992). Within the bill were provisions for revoking the BRC policy statements.

Congress which at one time had given its legislative blessing to BRC, now was on the verge of rescinding it. In a classic example of fire-alarm oversight, Congress was brought into the debate and provided an expanded forum for opponents of the policy to voice their concerns. Environmental organizations which never would have been called before the Joint Committee on Atomic Energy, were given an opportunity to submit their opinions before Congress.

The basic premise behind congressional oversight is political accountability and many representatives wanted to know what the NRC was up to with its BRC policies. The willingness of Congress to hold hearings on BRC was instrumental in bringing about the demise of the initiative.

BRC AND INTEREST GROUP PLURALISM

Environmental organizations led by Public Citizen, the Nuclear Information and Resources Service (NIRS), and the Natural Resources Defense Council (NRDC) headed up the interest group opposition to BRC. Public Citizen has long been a critic of nuclear power and radioactive waste management in the United States. Following the 1973-1974 energy crisis, Ralph Nader, organized a series of meetings that were a "crucial step in politicizing nuclear power and building a national movement" (Joppke, 1993: 63). A 1989 Public Citizen report, *Nuclear Legacy*, gives an overview of the disposal problems that have resulted from manufacturing nuclear weapons and generating electricity from nuclear power.

Today, almost 50 years after the first sustained nuclear fission reaction, and over 30 years after the first commercial reactor began operating, there is still no proven or safe technology to isolate nuclear waste from the environment for the millions of years it will remain radioactive . . . If ever there were problems which could be allowed to continue to grow in the absence of a solution, the issue of nuclear waste is not among them (Saleska, 1989: 1).

In short, according to Public citizen, nuclear waste management has been a failure.

The early 1970s signaled a sea change for antinuclear activism (Joppke, 1993). Formerly one of the myriad issues enclosed within the general rubric of environmentalism, the antinuclear movement began to establish a separate identity. By 1975, the nuclear industry could sense the difficult days ahead.

While the nuclear critics were visibly gaining momentum, the negative impact of the energy crisis on the nuclear industry was being felt. Climbing fuel prices, higher interest rates, and stagnating electricity demand resulted in cash-flow shortages and difficulties in raising money on the stock and bond markets. By late 1974, electric utilities had canceled almost half of the nuclear projects scheduled to be completed by 1983 (Joppke, 1993: 63).

Into this breach stepped individuals and organizations critical of nuclear power, and they have been around ever since.

In April 1991, Public Citizen's Critical Mass Energy Project released a report entitled *Deregulating Radioactive Waste: A Status Report*. The report made several recommendations for Congress to consider:

1. invalidate the 1986 and 1990 BRC policies;
2. limit the NRC's authority under the Atomic Energy Act to exempt radioactive materials from regulation only when: there is a demonstrable benefit to the public health and safety; and, in the case of consumer products using radioactive materials, there is no available non-radioactive alternative;
3. remove the NRC's authority to pre-empt state laws governing radioactive waste deregulation that are more protective of public health and safety than are NRC rules or policies;
4. require that any exemptions, even those that apply to just one generator, be preceded by: advance notice of the proposed regulatory action in the *Federal Register*; opportunity for public comment or the right to participate in an adjudiciary hearing; and, an environmental impact statement in accordance with the National Environmental Policy Act;
5. stop the production of radioactive waste by discontinuing the use of nuclear power (Becker and Goldman, 1991: 2).

Public Citizen suggested that NRC was "throwing in the towel" following a decade of frustrating attempts to establish radioactive waste policies (Becker and Goldman, 1991: 2).

Public Citizen took issue with the NRC's risk analysis assumptions suggesting that the BRC exemptions would result in an unacceptable number of cancer deaths. Moreover, the group suggested that the policy failed to take into account other deleterious effects, such as genetic mutations, retardation, and cancers that do not result in death

(Becker and Goldman, 1991). Questions were raised about the wisdom of allowing even minimally contaminated radioactive materials into municipal landfills, garbage incinerators, or sewage systems because it placed the burden of public safety upon the disposing organization.

Since it seems that the NRC plans to leave the monitoring of radiation levels to the dumper, there may be no way of measuring actual exposure levels (Becker and Goldman, 1991: 11).

In August 1990, Public Citizen entered the judicial arena, alleging that the NRC violated several laws and well-established precedents with BRC. Backed by a coalition of environmental organizations and the state of Maine, Public Citizen filed a lawsuit in federal court (Ashe 1993). According to the petition, the NRC failed to comply with public notification and public commentary requirements stipulated in the **Administrative Procedures Act**. Further, the BRC policy statements did not meet the public health and safety provisions of the **Atomic Energy Act** and the **Low-Level Radioactive Waste Policy Act Amendments**. Moreover, by failing to prepare an environmental assessment, the NRC was in violation of **National Environmental Policy Act** (Becker and Goldman, 1991). Finally, the brief suggested that the NRC completely disregarded its longstanding policy of prohibiting frivolous uses of radiation (Becker and Goldman, 1991).

Interest groups were especially active inside the beltway, testifying before Congress and submitting information for Congressional review. Arguing against the policy, Thomas Cochran, a staff scientist of the Natural Resources Defense Council took issue with the NRC's risk assessments. Moreover, Cochran argued that both the NRC's

individual and collective dose limits were too high and a threat to public safety and the environment (U.S. Congress, House, Committee on Interior and Insular Affairs, 1990).

Citizens Against Radioactive Dumping adamantly opposed the policy statement, suggested a conspiracy was involved, and put forth the idea of a "radiation establishment" (U.S. Congress, House, Committee on Interior and Insular Affairs, 1990: 126). The Maryland Safe Energy Coalition argued that "radioactive waste disposal is a problem for the GENERATORS to deal with . . . not the public to inherit" (U.S. Congress, House, Committee on Interior and Insular Affairs, 1990).

Some organizations came out as champions for the BRC initiative. For example, The Electric Power Research Institute (EPRI) commissioned a series of studies designed to add quantitative backbone to the policy. This research effort was initiated by EPRI "to develop the necessary technical information" to support a rulemaking petition by the nuclear power industry (Science Applications International Corporation, 1989: iii).

Other traditional nuclear energy advocates, fearing the repercussions of widescale adverse public reactions, offered only lukewarm support of BRC. A prominent nuclear industry trade association, the Nuclear Management and Resources Council (NUMARC), felt that "alternative disposal of mildly radioactive waste would not affect public health" (Quinn, 1990: 45). Despite this belief the nuclear industry wanted "to avoid raising fears, no matter how unfounded" (Quinn, 1990: 45). Other groups such as the U.S. Council on Energy Awareness (USCEA) agreed with EPA assessments that the dose limits established by NRC were too high (Quinn, 1990). Moreover, the USCEA was concerned about the possible recycling of materials into consumer products. The American Nuclear

Energy Council expressed its support; however, the group also agreed with the assessment of NUMARC, USCEA, and other industry organizations that the possibility of negative public opinion was something the nuclear power industry did not need and which was likely to result if the BRC policy was implemented.

The American College of Nuclear Physicians and the Society of Nuclear Medicine both supported the conceptual development of a BRC standard but suggested that the criteria put forth by the NRC "were overestimated and incomplete" (U.S. Congress, House, Committee on Interior and Insular Affairs, 1990: 162). Likewise the Conference of Radiation Control Program Directors (CRCPD), decried the inconsistencies of the Nuclear Regulatory Commission's BRC levels when compared with other domestic and international standards (U.S. Congress, House, Committee on Interior and Insular Affairs, 1990).

Interest groups were very active in the discourse on BRC. More importantly, both traditional opponents and supporters of nuclear energy contributed to the demise of the BRC initiative. With few friends of BRC in sight, the Nuclear Regulatory Commission's policy wavered on the brink of collapse.

RADIOACTIVE TRASH: BRC AND POLITICAL COMMUNICATION

Radioactive waste, the back-end of the nuclear fuel cycle, has received increasing amounts of media attention. Articles on radioactive waste "climbed steadily in numbers" from the 1950s through the 1970s (Weart, 1988: 317). Weart uses a "history of images" in his book *Nuclear Fear*, to describe the development of nuclear energy. He writes:

[W]hen I began studying the history of nuclear energy I did not think that images were important in themselves. I was wrong. Radioactive monsters, utopian atom-powered cities, exploding planets, weird ray devices, and many other images have crept into the way everyone thinks about nuclear energy, whether that energy is used in weapons or in civilian reactors. The images, by connecting up with major social forces, have exerted a strange and powerful pressure within history (Weart, 1988: xi).

The sources of imagery include the outlets of popular culture, such as television, cinematic productions, and literature. Moreover, both the print and the electronic news media contribute to the development of images that are transmitted as food for thought to society (Weart, 1988). Weart suggests that the legacy of nuclear science and its various applications offer a symmetry of nuclear hope, ("power too cheap to meter" and atom-powered homes) and nuclear fear (nuclear holocaust, radioactive contamination). As the 1960s, came and went, the symmetry between "nuclear hope" and "nuclear fear" shattered; "for most people nuclear hope could no longer balance nuclear fear" (Weart, 1988: 422).

BRC was discussed in the popular press in terms of "nuclear garbage" in municipal landfills and radiation in commonly used consumer products. An article in the June 26, 1990 edition of the *New York Times* begins:

[M]ildly radioactive waste could be disposed of in municipal dumps or ordinary incinerators or even recycled into consumer products under a new policy that the Nuclear Regulatory Commission plans to announce (Wald, 1990: A12).

Other major newspapers including the *Chicago Tribune*, the *Washington Post*, and *The Christian Science Monitor* also ran stories on the BRC policy statements (Bukro, 1990; Lippman, 1990; Foster, 1990). Smaller publications posted articles on BRC and maintained the imagery of "nuclear garbage." For example, an article in *The Nation*,

entitled "Dumping On Us" describes how the NRC is going to "fill neighborhood landfills with low-level atomic waste" (Wasserman, 1990: 76). "Gamma Rays in the Garbage" an article in the April 1990, *Bulletin of the Atomic Scientists*, brings to mind images of dangerous radiation in municipal waste management facilities. As the mass media began to take notice of the BRC debates the eye of Congressional actors turned towards the policy statements.

Observers of the American system have taken note of the potential influence of the mass media. As Allen Mazur writes: "Today few people would claim that the mass media can give extended coverage to an event or issue without shaping it in some degree" (1988: 140). In the case of BRC it is difficult to assess the impact of the mass media on the final outcome of the BRC debates. Media discourse was brief, but the images invoked by BRC, raised the specter of deregulated radiation insidiously contaminating the countryside. It seems far more likely that the mass media was only one source that served to widen the scope of conflict.

BRC AND PUBLIC PARTICIPATION

In a statement before the House Subcommittee on Energy and the Environment Richard Guimond suggested that ignoring public opinion on issues such as BRC was entering dangerous territory:

[A]ny attempts to deregulate radioactive materials must be handled with extreme sensitivity to the concerns of the public . . . EPA believes that a prudently implemented BRC concept is feasible and can be protective of the public health and the environment. Such a policy, however, must be developed and implemented in a way that fosters better public understanding and confidence in

the Federal Government's handling of radioactive materials (U.S. Congress, House, Committee on Interior and Insular Affairs, 1990: 27-28).

More importantly, BRC could potentially affect citizens from Maine to California. Thus, according to Thomas W. Orteiger, Director of the Department of Nuclear Safety for the state of Illinois "the most reprehensible aspect of the BRC policy statement is that the NRC did not make any real effort to seek public comment" (U.S. Congress, House, Committee on Interior and Insular Affairs, 1990: 60). Representative Miller scolded Kenneth Carr, for his Commission's attention to a "notion of below regulatory concern" but inattention to "the notion of below public concern" (U.S. Congress, House, Committee on Interior and Insular Affairs, 1990: 126).

As Representative Miller suggested the "notion of public concern" was an argument of many BRC critics. It seemed as if the Nuclear Regulatory Commission was trying to slip BRC past the vigilant eyes of nuclear power opponents. The NRC did hold several public hearings around the country on BRC, but only after opposition to the policy had erupted. Moreover, by suggesting that its BRC ideas were only "policy statements," the NRC claimed that it was not required to meet the provisions of NEPA, which include among other things an environmental impact statement (EIS) and a scoping process that requires public workshops.

Concluding his subcommittee's oversight hearing on BRC, Representative Miller addressed Chairman Carr of the NRC.

You have made a determination, and that policy is going to have to withstand public scrutiny. And if it doesn't and if it is changed or if it is repealed or what have you, that will certainly be a disappointment for this Commission. But that is not necessarily a failure. It may just show you how even more complex these

problems have become . . . over the last decade as public concern has been heightened (U.S. Congress, House, Committee on Interior and Insular Affairs, 1990: 126).

The NRC was scolded for its poor performance in involving the public during the development of its BRC initiatives. However, involving the public is easily espoused, but hard to actually accomplish. Most citizens did not take the time to become actively involved in the debates over BRC. Nonetheless, the rhetoric of public participation has become a powerful tool in many environmental disputes, and regulatory agencies have attempted to expand their public involvement efforts.

After issuing a moratorium on BRC, the Nuclear Regulatory Commission tried to involve representatives from industrial groups, state agencies, environmental organizations, federal institutions, and tribal associations in a consensus building process. As planning for the process progressed, environmental groups decided not to participate. Without them, the process lacked legitimacy. The NRC's final attempt to salvage BRC in the court of public opinion failed.

CRISIS OF LEGITIMACY

During the past three decades the American public has grown increasingly more cynical about the actions of its government. The dramatic shift in public attitudes from a time when people used to believe in positive aspects of government action to now when many believe that "government cannot be trusted to do what is right" signals a warning bell that something has changed in the public policy process (Kelman, 1987: 5).

The credibility of Federal agencies responsible for radiation protection standards and radioactive waste management likewise has been strained. Since the beginnings of the Atomic Age, secrecy has stymied outside scrutiny of nuclear weapons facilities and nuclear power plants. Unfortunately, it has also resulted in concern with agency activities. The biggest concerns of national security experts were staying ahead in the Cold War arms race with the Soviet Union and keeping atomic weapons out of the hands of rogue states. The best way to do so was to keep the vaults of nuclear secrets under lock and key effectively shutting out the public.

As Harvey Wasserman notes: "Fortunately for the opponents of BRC, the Nuclear Regulatory Commission's credibility is at an exceptionally low ebb" (1990: 76). Researchers are most likely to characterize the crisis of legitimacy as a problem of trust. Critics of the BRC policy lambasted the Nuclear Regulatory Commission for the way it put forth the BRC policy statements and for the ideas it contained.

First, BRC opponents felt that the only benefactors of the policy would be the nuclear power industry and the Department of Energy.

The actual justification for BRC may be the savings it will bring to the nuclear power industry, particularly in the course of the decontamination and decommissioning of retired nuclear reactors . . . DOE is also waiting for BRC standards to use (Becker, 1991: 4).

Most would agree that the significant benefits of a BRC policy would accrue to the nuclear power industry and DOE. Even the Electric Power Research Institute suggested as much. Other benefactors such as hospitals, universities, and industries employing nuclear energy technologies were as anxious to have a BRC standard. Thus critics of the

policy argued that the NRC was setting aside health and safety protection for the public in order to save the nuclear power industry millions of dollars.

Opponents also suggested that the NRC Commissioners "overrode staff proposals" (Becker, 1991: 12). Staff recommendations for BRC exemption standards, a one millirem per year individual dose, were not acceptable to NRC Commissioners who wanted a higher individual dose, presumably the ten millirem individual dose exemption that was put forth in the 1990 policy statement.

It seems likely that distrust of the Nuclear Regulatory Commission was a significant factor in the demise of BRC. The Commission was unable to convince key opponents and importantly Congress, that BRC was necessary and good. And the lack of credibility did not help the Nuclear Regulatory Commission in its efforts.

AFTERMATH

Opposition to BRC was highly effective. On March 19, 1991, plans for implementing a BRC rule were formally approved by the NRC's governing commission (J. Taylor, 1992). Petitions for BRC exemptions had been submitted by the University of Utah and Rockefeller University (Parler, 1993). However, on June 28, 1991, an NRC memorandum placed a moratorium on any BRC implementation (J. Taylor, 1992). For all practical purposes the policy was listing heavily in rough seas, though the NRC held out hope for a break in the storm.

A hint of the intensity surging against BRC was revealed by James M. Taylor in a memo sent to the NRC's governing commission following a series of public meetings on

the policy: "The prevailing sentiment expressed at all of the meetings was opposition to the BRC policy and to its implementation" (1990: 2). In late February 1991, NRC announced that it "will work towards consensus on BRC policy issues" (U.S. Nuclear Regulatory Commission, 1991: 1). Chip Cameron, the Deputy Director of the NRC Office of the Licensing Support System Administrator took the lead in sorting out the various viewpoints on BRC (U.S. Nuclear Regulatory Commission, 1991). Letters from the Nuclear Regulatory Commission were sent to members of Congress, state radiation protection directors, and state governors. Several states indicated their support of a consensus building process on BRC. Former Arkansas Governor Bill Clinton returned a note to the Commission, backing the consensus building process.

I strongly support open and constructive communication between governmental entities and their constituents and appreciate the NRC's willingness to revisit the BRC policy (U.S. Congress, House Committee on Interior and Insular Affairs, 1991: 120).

After several attempts to organize meetings, representatives from environmental organizations indicated that they would not participate in the consensus building process (J. Taylor, 1992). The viability of reaching consensus became a house of sand once the main opponents to BRC refused to take part in discussions. According to Chip Cameron, several of the groups indicated a "certain amount of suspicion that this consensus building initiative was motivated primarily by the need to forestall unfavorable federal legislation" being pushed by George Miller (Cameron, 1991: 8). In the end the consensus building process was abandoned.

The NRC formulated a last ditch effort to forestall legislative action against BRC.

The Commission would go back to square one:

Now that the BRC consensus building process has been terminated, the staff proposes to proceed with an enhanced participatory rulemaking on a high priority regulation, namely the establishment of radiological criteria for decommissioning of licensed sites. The staff proposes that other formal actions on issues related to the BRC policy statement continue to be deferred until insights gained in conducting the enhanced rulemaking have been taken into account (Taylor, 1992: 1).

Initial plans suggest that NRC was slowly realizing that residual radioactivity standards were an extremely sensitive issue that required new ways of thinking about developing appropriate policies. A series of workshops were originally scheduled to begin in June 1992; however the dates were pushed back until September and later, January 1993 (Taylor and Parler, 1992). The workshops would be open to the public, but actual roundtable discussions would include a more selective group. As with the consensus building process, balance and representativeness would be needed to ensure the viability and legitimacy of the rulemaking process; thus environmental groups and citizens organizations were considered vital. Further, as opposition to BRC was found all across the nation, NRC sought to ensure "geographical diversity" (Taylor and Parler, 1992a: 1). Congress was informed of the enhanced participatory rulemaking initiative in mid-July, 1992, even as repeal of the BRC policy statements was approaching in the form of new energy legislation.

The politics of BRC seem minor in comparison to the titanic clashes over the Arctic National Wildlife Refuge (ANWR) or better fuel performance (CAFE standards) in automobiles; however, the final nail in the coffin that would hold BRC was driven

home with the scribbled stroke of President Bush's signature. The end of residual radioactivity regulations was forestalled, however, in the very piece of legislation that revoked the 1986 and 1990 BRC policy statements.

Although Section 2901 of the Energy Policy Act effectively revoked the 1986 and 1990 BRC policy statements by providing that they should have no further effect, it did not explicitly remove the Commission's obligation under Section 10 of the Low-Level Radioactive Waste Policy Amendments Act of 1985 to develop criteria and procedures for evaluating exemption requests for specific radioactive waste streams. Nor did the Act revoke the Commission's authority under the Atomic Energy Act to exempt classes of materials from licensing (Parler and Taylor, 1993: 3).

Even as the door closed on the disastrous failure of BRC, the Nuclear Regulatory Commission was surging forward with a radically new means of decision making--the enhanced participatory rulemaking process.

CONCLUSION

The BRC initiative failed because of changes in the American policy process. These changes have made it increasingly problematic for agencies such as the Nuclear Regulatory Commission to manage complex and controversial risk management issues. Establishing nuclear science policies has become especially difficult. The next chapter explores the NRC's reaction to the difficulties of decision making.

CHAPTER SIX

THE ENHANCED PARTICIPATORY RULEMAKING PROCESS

Often, when a process or machine is not working as intended, it is because we have not yet learned how to operate it. But in this case we resist that conclusion. After all, we Americans are the architects and pioneers of self-government. How could our system fail us. What could be wrong?

Vice President Al Gore

INTRODUCTION

In 1957, a reactor in Shippingport, Pennsylvania, came on line to overwhelming acclaim (Weart, 1988). By comparison with reactors built during the great bandwagon years, the Shippingport station with a 72 MW(e) capacity was small. The first nuclear power plant to begin operations, Shippingport also would be the first of its kind to undergo permanent closure. After 25 years, the facility was shut down in 1982. The method of decommissioning selected for the site was DECON. Physical decommissioning and decontamination activities began in 1985. In 1989, the reactor vessel was sent to the Hanford commercial burial site for final disposition. And in 1990, the Shippingport site was formally released for unrestricted use.

Decommissioning of commercial and federal facilities is yet another unknown in the legacy of nuclear science. Largely ignored by policy researchers, decommissioning will soon become an important issue for social science scholars. As Martin Pasqualetti

writes about decommissioning: "We are about to discover that this huge, complex, and endless activity is the next focus of nuclear power" (1991: 128).

Following the failure of the BRC policy initiative, the Nuclear Regulatory Commission commenced an enhanced participatory rulemaking process designed to solicit input from interested parties prior to the development of its decommissioning standards. This action represented a significant changeover from past methods of acquiring input. If widescale decommissioning of commercial facilities occurs as seems likely during the first few decades of the twenty first century, the NRC will need residual radioactivity criteria to guide cleanup operations.

The failure of BRC has been examined through a policy process framework. Similarly, the decision to go with the enhanced participatory rulemaking process was a gauging of the political winds by the Nuclear Regulatory Commission. This chapter first describes some of the regulatory concepts and details of decommissioning and then examines the enhanced participatory rulemaking process. In conclusion, this chapter proposes a revised policy process model based on the idea of "stakeholder" involvement as a potential solution to the gridlock of nuclear science politics.

DECOMMISSIONING

By the year 2030, nearly 40 reactors are scheduled for decommissioning (U.S. Nuclear Regulatory Commission, 1994a). Licenses for commercial facilities could be extended beyond the 40 year limits imposed by the **Atomic Energy Act of 1954**; however it seems likely that many facilities will be permanently closed, decommissioned,

decontaminated, and dismantled. DOE also is actively engaged in decommissioning federal facilities as is the DoD. Increasingly, effective standards and procedures for decommissioning have become the focus of governing bodies. Until recently, however, decommissioning has remained largely a side issue in the debates over nuclear science.

Facility Closure

The NRC defines decommissioning as "the process of safely removing a facility from service followed by reducing residual radioactivity to a level that permits the release of the property for unrestricted use" (U.S. Nuclear Regulatory Commission, 1994b: 108). 28 licensed facilities have ceased operations and are in various stages of decommissioning; however, only three have been completely dismantled. These include the Shippingport reactor, the Elk River Power Station in Elk River, Minnesota, and the Sodium Reactor Experiment in Santa Susana, California (Oak Ridge National Laboratory, 1993).

The NRC has officially sanctioned three methodologies for decommissioning activities:

1. **DECON**: is the immediate removal of all radioactive materials in order to permit unrestricted release of a formerly licensed site.
2. **SAFSTOR**: is an "interim" condition in which a facility is maintained in a nonoperational status. Surveillance of the facility ensures that the site is safe to the environment and not a danger to the public health (Fisher, Partain, and Sype, 1995)
3. **ENTOMB**: is a method in which nuclear facilities are made secure and structurally sound in order to prevent the migration of radioactive materials until

levels of radioactivity reach a point where unrestricted release of the property can be permitted.

The three decommissioning alternatives assume that sites will one day be returned to a "greenfield" state, permitting unrestricted use. The biggest hurdle for decommissioning policies, an answer to the question, "how clean is clean" has not been determined.

Finding an effective and acceptable answer to this question was the primary goal of the enhanced participatory rulemaking process.

Decommissioning Policy

Regulatory agencies are not unfamiliar with decommissioning. However, facilities that have been decommissioned are relatively small when compared to the power production stations that came on line during the great bandwagon years. Several policy questions will inevitably arise as the age of decommissioning approaches. Moreover, the long complex process of establishing effective and acceptable regulatory protocols will require that NRC and other responsible agencies begin planning, post-haste.

Meeting the requirements of decommissioning will require early planning. The 1990s will be the decade of during which the decommissioning agenda will be set. This will include funding mechanisms, investment strategies, regulations, legal requirements, siting decisions, and the feasibility of life extension (Pasqualetti, 1991a: 129).

One of the most controversial elements of decommissioning will be deciding whether or not to extend the operational lifetime of nuclear power plants. Further, cost uncertainty remains, including the indeterminability of future disposal rates. Estimates

suggest that burial costs at the Ward Valley site in California will approach \$ 440 cu³, provided the facility opens in 1996 as planned (Fisher, Partain, and Sype, 1995). It is estimated that disposal costs of wastes arising from the decommissioning of the Rancho Seco facility could exceed one hundred million dollars (Fisher, Partain, and Sype, 1995).

Decommissioning and Public Involvement

The public has little knowledge about decommissioning. People living near a facility likely are better informed than American society as a whole; however a general lack of awareness and the paucity of accessible information has limited public knowledge of decommissioning (Pasqualetti, 1991). Most of the information on decommissioning is found in specialized conference proceedings, trade journals, and government documents which are not widely read by many Americans. Until recently, national interest groups have not focused on decommissioning, turning their attention instead to issues such as radioactive waste, nuclear power plants, and nuclear weapons (Pasqualetti, 1991).

ENHANCING PARTICIPATION: STRUCTURING THE PROCESS

Following the demise of BRC, the Nuclear Regulatory Commission initiated a short lived "consensus building" process and issued a moratorium on any implementation of a generic BRC policy. It soon became clear that consensus on BRC would be impossible, as a number of key environmental groups refused to be drawn into the discourse. Then in 1992, the enhanced participatory rulemaking process was proposed. NRC was forced to backtrack from its broad ranging and widely applicable BRC ideas

and narrow its focus. The enhanced participatory rulemaking process concentrated on "Radiological Criteria for Decommissioning NRC-Licensed Facilities" (U.S. Nuclear Regulatory Commission, 1994b: XIII-4).

[T]he intent of this rulemaking is to provide a clear and consistent regulatory basis for determining the extent to which lands and structures must be remediated before a site can be considered decommissioned (U.S. Nuclear Regulatory Commission, 1994b: XIII-4).

Once again, the question of residual radioactivity would be the focus of a potential rulemaking. .

The normal method by which the Nuclear Regulatory Commission promulgates regulations is first for a draft rule to be developed by the appropriate NRC staff. Following review and approval by the NRC's governing commission, a proposed rule is published in the *Federal Register* for public commentary. After a designated period of public review, a draft final rule is issued for a second round of public commentary, before the rule becomes a part of the *Code of Federal Regulations*.

Following passage of the **Energy Policy Act of 1992** and the revocation of the BRC policy statements, NRC was forced by statute to meet the will of Congress. Congress however, did not explicitly forbid NRC from pursuing residual radioactivity standards. Thus the NRC was legally allowed to proceed with the enhanced participatory rulemaking.

The Commission intended to solicit public commentary on the decommissioning criteria, prior to the development of a staff rule. Moreover, the Commission also hoped to rectify some of the political mistakes made during the BRC fiasco, including:

1. a NEPA assessment and an environmental impact statement;
2. working more closely with the Environmental Protection Agency and Agreement State radiation protection bureaus;
3. issuing a staff rule prior to formal review by the upper hierarchy of the NRC; and
4. improving the opportunities for public review of the policy.

Letting the People Know

From January through May, 1993, the Nuclear Regulatory Commission held seven workshops in cities across the United States as illustrated in **Table 7**.

With the workshops, NRC hoped to lure back BRC opponents that had been unwilling to participate in the consensus building process.

While these workshops were not designed to seek "consensus" in the sense that there is agreement on how each issue should be resolved, the workshops were conducted at a very early stage of rulemaking to enhance the participation of interested parties and the public with the following objectives: (a) to ensure that the relevant issues have been identified; (b) to exchange information on these issues; and © to identify underlying concerns and areas of disagreement, and where possible, approaches for resolution (U.S. Nuclear Regulatory Commission, 1994b: XIII-7).

A number of organizations participated in the round-table discussions. Because the workshops were held on a regional basis subnational environmental organizations, individual state regulatory authorities, locally elected officials, and industry representatives that otherwise might not have attended, did so. The meetings were open to the public as space would allow. The Keystone Center, a facilitation organization, mediated the workshop discussions which were centered around an issues paper put

TABLE 7 - ENHANCED PARTICIPATORY RULEMAKING WORKSHOPS

LOCATION	DATE
Chicago	January 27-28
San Francisco	February 23-24
Boston	March 12-13
Dallas	March 23-24
Philadelphia	April 13-14
Atlanta	April 29-30
Washington	May 6-7

together by the NRC staff (Parler, 1993). Other information for workshop participants included case studies on "real world decommissioning experiences" that made "tangible the abstract concepts . . . that lie at the root" of the workshop discussions (U.S. Nuclear Regulatory Commission, 1993b: I). Midway through the schedule of workshops, adjustments were made to improve the process of notifying the public about upcoming workshops. One early complaint was that notification in the *Federal Register*, through press releases, and by relying on the networking initiative of groups and individuals was not reaching everyone that might be interested. In response, the NRC expanded the notification process to include more print and electronic media advertisements, advance mailings to potentially interested interest groups, and postings in regional libraries (Parler, 1993).

NEPA and Environmental Assessment

Arguing that BRC was simply a policy statement, and not a rulemaking effort, the Nuclear Regulatory Commission did not conduct an environmental assessment as required of all federal activities that could have an ecological impact. As part of the enhanced participatory rulemaking process, the Nuclear Regulatory Commission admitted that it was in fact engaged in a formal rulemaking and thus would perform an environmental impact statement.

A Memorandum of Understanding

Some of the most damaging evidence used against the Nuclear Regulatory Commission in its battle for BRC, were the public disagreements with the Environmental Protection Agency. Both agencies have complimentary responsibilities in many areas of radiation protection. By trying to develop BRC proposals alone, the Environmental Protection Agency suggested that the Nuclear Regulatory Commission had overstepped its authority and the Agency was concerned that the Commission's criteria for BRC practices might conflict with other radiation protection standards.

In response to the earlier conflict, NRC and EPA, signed a Memorandum of Understanding (MOU) to facilitate cooperation between the two agencies during the development of radiation protection standards (U.S. Nuclear Regulatory Commission, 1992). The MOU committed the agencies to:

1. keeping the other abreast of plans for rulemakings;
2. responding to requests for assistance and information; and
3. recognizing at the earliest stage possible, implementation problems, such as duplication of regulatory criteria or inconsistency with the other agencies regulations (U.S. Nuclear Regulatory Commission, 1992).

During the enhanced participatory rulemaking process, EPA was a partner in workshop planning and implementation, much to the relief of state governmental representatives (Parler, 1993). The complimentary radiation protection responsibilities of NRC, EPA, and the states often leads to contradictory regulatory requirements for implementing agencies. The radiological site criteria would be evaluated by EPA to ensure that they adequately protect public health and safety. Concurrently, NRC was

participating with the Department of Energy (DOE), the Department of Defense (DoD) as well as EPA in a "high-level Steering Committee to ensure coordination of agency activities, timely progress, and appropriate resources for the establishment of standards for cleanup" (Parler, 1993: 4).

Staff Rule Prior to Commissioners' Review

During the congressional hearings on BRC, a conspiracy was suggested by opponents of the policy statements. In particular, evidence suggesting that NRC directors overruled staff recommendations alarmed BRC critics. Were the directors attempting to end run around public health and environmental protection concerns by not revealing the disagreements between staff and higher management?

In order to avoid a repeat of this scenario, the NRC announced that it would put forth a staff draft of the proposed rule for public review prior to its evaluation by the NRC's governing commission. The draft rule also would incorporate answers to concerns submitted as public commentary.

Improving Access to Information

In response to demands for earlier, better, and easier access to information, the Nuclear Regulatory Commission initiated several programs of information dissemination. The draft staff rule and summaries of comments received on the rule were sent to Agreement State radiation offices, participants in the workshops, and others interested in the policy.

The NRC also published an availability notice in the *Federal Register* announcing the draft staff rule and set up an electronic bulletin board to promote easier access to information relevant to the rulemaking (U.S. Nuclear Regulatory Commission, 1994a). Moreover, a period of public comment on the draft staff rule, allowed interested parties to comment on the staff recommendations.

STAKEHOLDER INVOLVEMENT AND THE PUBLIC POLICY PROCESS

In 1978, Hugh Heclo became a familiar name in political science. His article "Issue Networks and the Executive Establishment" published as a chapter in *The New American Political System* debunked the notion of iron triangles.

Based largely on early studies of agricultural, water, and public works policies, the iron triangle concept is not so much wrong as it is disastrously incomplete. And the conventional view is especially inappropriate for understanding changes in politics (Heclo, 1978: 88).

In his view, "issue-networks," are a more accurate guide for understanding the policy-making process.

The notion of iron triangles and subgovernments presumes small circles of participants who have succeeded in becoming largely autonomous. Issue-networks on the other hand, comprise a large number of participants with quite variable degrees of mutual commitment or dependence on others in the environment (Heclo, 1978: 102).

Issue networks are difficult to define because different policies are populated by different sets of policy actors and policy communities can change over time. More importantly, formerly closed iron triangles are now subject to the influence of many more influential political actors. How can effective and acceptable policies be established?

Environmental and energy issues offer a unique forum for discussions of new ways of developing public policy solutions to diffuse and complex problems. First, public attitudes towards environmental issues have changed in the past thirty years. The American public has consistently shown a strong desire for environmental protection, quality public health management, and effective occupational safety measures. Second, environmental issues attract a diverse array of citizens, organized interests, and industrial representatives that to different degrees will be affected by the actions of government. Finally, environmental and energy issues such as global warming, clean water, ambient air quality, and radiation protection standards have increased in complexity. As science and technology have propelled human understanding and detection capabilities, this ever increasing knowledge has led to uncertainty. How much human harm can result from previously unknown risks? To what issues should we direct resources? Taking the idea of issue networks one step further, researchers in the disciplines of management, sociology, planning, and to a certain extent political science have created another means of conceptualizing actors in a policy community--stakeholders.

According to R. Edward Freeman, a strategic management scholar, a stakeholder is "any group or individual who can affect or is affected by the achievement of a corporations purpose" (1984: vi). The underlying philosophy behind Freeman's notion of stakeholders suggests:

[T]hat while one must communicate with his or her critics, communication alone will not guarantee success. An effective player must take his or her critics into account systematically (1984: 49).

Researchers in other disciplines such as planning, sociology, and political science have explored the feasibility of stakeholder based decision making. Moreover, several federal agencies have tested these preliminary ideas in the real world of regulatory decision making. For example, DOE has applied stakeholder based decision making in regards to future land use decisions at sites around the nation. Another example is the Department's Recycle 2000 Initiative. In this case, DOE has systematically involved stakeholders in the earliest stages of conceptual development for a project that proposes the use of radioactively contaminated scrap metals as feed material in the production of low-level radioactive waste disposal containers.

Researchers emphasize that stakeholders for any public policy issue are case specific. Thus, stakeholders are not merely another name for "the Public" or organized interest groups. Stakeholder involvement is a means of systematically formulating, implementing, and maintaining public policy initiatives. In short, stakeholder based decision making may be a means of avoiding gridlock and establishing "good" public policies. **Figure 9** illustrates a stakeholder based public policy process.

ENHANCING STAKEHOLDER INVOLVEMENT

With enhanced participatory rulemaking, the NRC employed a version of stakeholder theory in its attempt to establish radiological criteria for decommissioning. Several general points about the process are noteworthy. First, after realizing that residual radioactivity was an extremely controversial issue and had activated many influential policy actors, the NRC sought a way to more effectively control the scope of

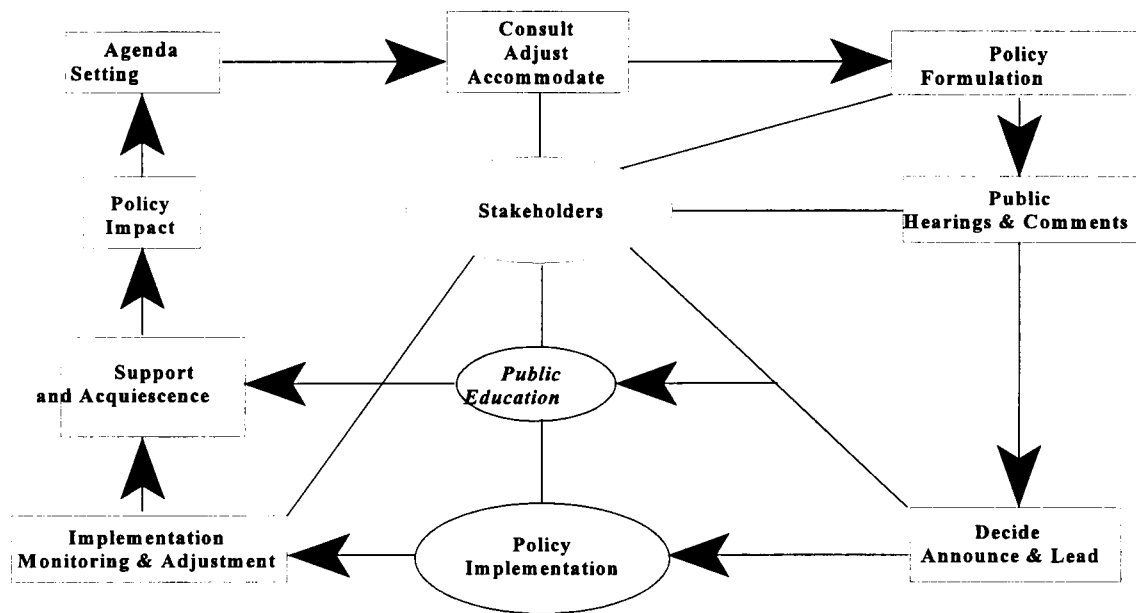


FIGURE 9- A STAKEHOLDER BASED PUBLIC POLICY PROCESS MODEL

Source: McCabe, Amy S., E. William Colglazier, and Michael Fitzgerald. 1993. "Public Acceptance and Nuclear Waste: Do New Technologies Matter?" Presented at the annual Waste Management Symposium, Tucson.

conflict. Participants in the process were given a stake in the establishment of standards. Rather than trying to weather the storm following the announcement of a controversial policy, NRC hoped to channel discourse into a systematic discussion of key issues. Government institutions such as EPA, DOE, and state agencies would directly offer input into the process. External interests such as environmental groups, industrial associations, and citizens could take their opinions and expertise straight to responsible agencies. Moreover elected officials in state governments and Congress were kept informed about the process.

Second, by using a stakeholder involvement process, NRC sought to overcome the disturbing "crisis of legitimacy" that many major institutions face in the late twentieth century. The new spirit of openness and cooperation was specifically undertaken to boost stakeholder trust and confidence in the decision making abilities of the NRC. As public comments revealed, many people supported enhanced participatory rulemaking, though they were not necessarily happy with the product.

Finally, establishing public policies for many technical issues has become increasingly problematic. Risk calculations and health concerns magnified by scientific uncertainty are not easily translated into effective public policies, especially in the changing American political system. The ultimate goal of enhanced participatory rulemaking was to break down the barriers of stalemate, overcome the gridlock of nuclear science politics, and proceed with the increasingly important issue of decommissioning standards.

CONCLUSION

As of 1995, enhanced participatory rulemaking is an ongoing process. A final rule on radiological criteria for the release of land and buildings is expected later this year. Currently the NRC is exploring the feasibility of commencing a second enhanced participatory rulemaking to guide the development of standards for managing the enormous amount of waste that will result from decommissioning, and decontaminating licensed sites. The next and final chapter explores some of the early reactions to enhanced participatory rulemaking, the staff rule, and thoughts on what the future holds for stakeholder based decision making.

CHAPTER SEVEN

LOOKING TO THE FUTURE

I think when we looked at the subject [BRC] whose name we cannot mention in these hallowed halls, we found that we had absolutely no bridges with the opponents...We couldn't get them to even come and talk to us at all . . . My impression is that it [the enhanced participatory rulemaking process] has, if not built bridges, at least thrown some ropes across the canyon that you can cross with hand-over-hand.

NRC Commissioner Kenneth Rogers

INTRODUCTION

Establishing regulatory policies for nuclear energy, radioactive waste, and radiation protection that are both effective and acceptable guidelines has become increasingly difficult. This thesis has reviewed the Nuclear Regulatory Commission's attempt to implement BRC regulations and suggested that the policy's failure resulted from changes in the policy process. Moreover, this research has reviewed the Commission's reaction to the new public policy process as manifested the enhanced participatory rulemaking effort. The final order of business is forecasting the future. Will the enhanced participatory rulemaking process lead to residual radioactivity standards that are both effective and acceptable?

TAKING A CAREFUL LOOK

On March 29, 1995, the NRC met in open session to be briefed by staff members on lessons learned from the enhanced participatory rulemaking (U.S. Nuclear Regulatory

Commission, 1995). Participants included Ivan Selin Chairman of the NRC, and Kenneth Rogers and E. Gail de Planque both members of the NRC's governing commission. Presentations were given by Jim Taylor and Chip Cameron, the primary architects of enhanced participatory rulemaking.

Researchers have suggested that enhancing stakeholder involvement in the development of regulatory policies likely results in higher resource expenditures in work-hours and monetary expenses. Initial estimates by the NRC corroborate this assumption. The cost of the entire rulemaking, including the enhanced participatory workshops, an environmental impact statement, and staff work-hours totalled roughly seven million dollars (U.S. Nuclear Regulatory Commission, 1995). According to preliminary estimates, this is roughly 15% more than what an equivalent rulemaking would have cost without the enhanced participatory elements (U.S. Nuclear Regulatory Commission, 1995). It is difficult to delineate the particular costs because there is no baseline with which to compare the enhanced participatory rulemaking effort. Further there may be no systematic means, worth the effort, to judge the exact cost increases of enhanced participatory rulemaking. In order to develop the rule, nearly five million dollars worth of technical work was required much of which can be applied to future residual radioactivity rulemakings (U.S. Nuclear Regulatory Commission, 1995).

The NRC staff suggested several benefits of enhanced participatory rulemaking after reviewing comments submitted on the process, contacting participants, and observing reactions at the workshops (U.S. Nuclear Regulatory Commission, 1995). First, Cameron noted that there seemed to be "more of a willingness to engage in talking

about the issues, even though there is disagreement" (U.S. Nuclear Regulatory Commission, 1995: 13). Second, the NRC was saluted for soliciting comments and opinions on a proposed policy early in the decision making process. Many commentators were pleased to see that their concerns would be taken into account prior to the development of a draft rule. Finally, the willingness by the NRC to consider the wisdom of outside interests resulted in discussion on issues that would not have come up in a traditional rulemaking effort.

[W]e do think that the workshop discussions did result in a more enlightened approach to the rulemaking issues. There are things in the rule, and who knows whether they'll survive or not, but at least at this point the workshop process led us to consider the restricted release of sites, [and] the use of such mechanisms as site-specific advisory boards in the process. We explored the feasibility at least of a return to a background standard of some type, and I think it is the consensus of the rulemaking team that was involved that if we would have just done this the ordinary way that we would not have given much consideration to concepts like that (U.S. Nuclear Regulatory Commission, 1995: 16).

And as Commissioner de Planque suggests, that really was "the beauty and the purpose of the process, to get input and ideas that you wouldn't otherwise have come up with" (U.S. Nuclear Regulatory Commission, 1995: 17).

The workshops for enhanced participatory rulemaking also illustrated just how complex and controversial radiation protection policies can be in lieu of the fact that most people do not have working knowledge of the technical issues, much less the legal, political, and economic matters. For example, Cameron noted that there was some confusion regarding NRC's relationship to DOE, particularly "deciding the economic feasibility of using nuclear power rather than just ensuring that it was safe" (U.S. Nuclear Regulatory Commission, 1995: 35). Other participants did not understand why health

and safety regulations for DOE sites were self-imposed rather than decided by the Nuclear Regulatory Commission.

Technical questions were the most problematic concern during the workshop process. Cameron suggested educational components built into future attempts at enhanced participatory rulemakings. But he warned that the NRC should be wary of anything that could be considered promotional (U.S. Nuclear Regulatory Commission, 1995).

For the most part, the NRC's governing commission was pleased with the first ever enhanced participatory rulemaking. As Commissioner Kenneth Carr suggests:

Well, I think a number of questions have been raised today that I think are very good questions. I think we have to keep in mind this was the first of its kind. We hadn't tried anything like this before and obviously the first time you do something it is not going to be the best way to do it. It does look to me as if in this particular case it worked reasonably well (U.S. Nuclear Regulatory Commission, 1995: 46).

FROM THE OUTSIDE LOOKING IN

NRC Commissioners repeatedly pointed out during the March 29 meeting that it would be difficult to separate the meaning of comments on enhanced participatory rulemaking from those on the actual rule. Cameron felt that the "process influenced the results" making the policy more palatable to traditional opponents, such as environmental organizations (U.S. Nuclear Regulatory Commission, 1995: 47). Others however were unsure how to evaluate the demarcation between product and process.

I think it was a great rulemaking process. I think it really fit the situation. I think it's a different rule from what we had. But if it had 100 millirem in it instead of 15

millirem, through exactly the same process, we would not be getting these results. So I think you've got to really be quite careful about what you attribute to the process versus what you attribute to the rule that came from the process . . . in other words, the results have a big impact (U.S. Nuclear Regulatory Commission, 1995: 17-18).

However, the question remains, is enhanced participatory rulemaking enough to ensure a full-scale implementation of site radiological criteria for decommissioning? Or will policy gridlock once again be the result?

The NRC posted a notice in the *Federal Register*, early in February 1994 announcing the availability of the staff's draft of the proposed rule. Early reactions to the announcement were mixed. Many of the comments were supportive of the enhanced participatory rulemaking process; however, many also perceived shortcomings in the rule. For example, the Nuclear Energy Institute commended the NRC for employing a process, "that solicited input from all interested parties at the earliest stages of gathering information;" however, they also made it very clear that the nuclear power industry had "significant concerns" with the policy (1994: 1). The Institute for Energy and Environmental Research (1994), a public interest research organization, also applauded the NRC for embarking on a participatory decision making program but also had some significant concerns with the policy. Greenpeace saluted the NRC for its attempt to take into account a broad range of interests. Their comments, however, indicate that "this rule cannot be considered to adequately protect the public welfare" (1994: 1). Likewise, Public Citizen reemphasized the point that "there is no safe level of radiation" and "nuclear licenses have no right to inflict health hazards on communities" (1994: 1). As noted in an earlier chapter, Public Citizen is one of the leading critics of the NRC and the

nuclear power industry. In recent years, this experience has led the group to take the environmentalist lead on decommissioning issues. An April 1993 report, *The Dark at the End of the Tunnel: Federal Cleanup Standards for Nuclear Power Plants*, offers suggestions and recommendations for the NRC in developing what they perceive as effective elements of decommissioning standards.

1. Return sites and buildings to the level of naturally occurring background radiation for that location.
2. Set an absolute risk limit from all sources of radiation, natural or man made, on the site. That risk should not exceed the risk from exposures within the common scope of naturally occurring background radiation, excluding radon.
3. Do not release land or buildings for unrestricted use that do not meet both these requirements.
4. Create an advisory board--composed of federal and state environmental officials, environmental scientists, public-health experts, representatives of environmental and citizen organizations, labor unions, and others from society affected by the issue--to make impartial, location-specific assessments of background radiation. Announce the formation of the advisory board with a public notice and invite nominations for participants. Make the NRC's final decisions a regulation subject to notice and comment.
5. Continue monitoring and remediation of contaminated land and buildings.
6. Do not abandon the "justification of practice" principal.
7. The NRC should verify, in all cases, that licensees have fulfilled the conditions of the decommissioning plan.
8. Make the Environmental Impact Statement as specific as possible.
9. The EPA should issue its own standards. The EPA standards would serve as a general guide and baseline to ensure that the NRC standards are adequate.
10. The NRC should not license additional nuclear facilities (Becker, 1993: 20-22).

Interestingly enough, many of Public Citizen's recommendations were discussed in the workshops and the influence of these discussions are manifested in the actual rule. For example, the designation of site specific advisory boards as a communication medium between local communities and decommissioning entities.

POINTS OF DEPARTURE

Two of the most contentious issues of the staff's rule were: first, the radiological limits incorporated in the policy, especially how the three millirem "goal" and the fifteen millirem "limit" would be implemented; and second, the utilization of the Site Specific Advisory Boards (SSAB).

The Numbers Game: Effective? Acceptable? Both?

The staff's draft put forth the idea of a "goal" and a "limit" for radiological criteria. A three millirem per year *goal* was determined to be "barely distinguishable from variations in local and national radiation background levels, and is consistent with the 10^{-4} level of lifetime risk used by EPA for Superfund" (U.S. Nuclear Regulatory Commission, 1994b: 20). Similarly, as fifteen millirem per year *limit* was suggested to be within acceptable risk based parameters.

Following disclosure of the staff's draft, the NRC was immediately critiqued by both environmental and industrial organizations about the actual meaning of its cleanup standards. Carol S. Marcus, a medical doctor with UCLA suggested that the cleanup values were "absurdly low, and appear to represent abandonment of hard scientific

reasoning" replaced instead by "political groveling to irrational antinuclear terrorists" (University of California, Los Angeles, 1994: 1). The Environmental Protection Agency was unhappy with the three millirem goal because it could be "misconstrued" as a de facto BRC level, rather than a "default level" below which ALARA is satisfied (1994: 2). Other groups such as the Health Physics Society, the Nuclear Energy Institute, the U.S. Council on Energy Awareness, the Fuel Cycles Facilities Forum, the Conference of Radiation Control Program Directors, and the State of Washington's Department of Health were concerned that the three millirem individual dose exposure goal would become a de facto limit for unrestricted release of a site and would be the source of future conflict in the decommissioning process. Comments submitted by the State of Nebraska's, Department of Health argued that the goals and limits were inconsistent with other established guidelines and would be "technologically difficult to obtain" (1994: 1).

Taking an opposing view, the Sierra Club suggested that three millirem should be the "maximum hazard" as opposed to the fifteen millirem limit established by the policy (1994: 1). Other organizations such as the Institute for Energy and Environmental Research (1994) suggested that the cleanup limits proposed by the NRC did not adequately take into account the potential harm to future generations, especially the lingering effects of residual radioactivity that is the result of long-lived radioactive elements. Public Citizen argued that the radiation goal is "something of a facade" because the actual limit is fifteen millirem per year and restricted release limits could go much higher (1994: 2). In other words, "there are loopholes big enough to drive a truck through, and they completely undermine the three millirem goal" (1994: 2).

Site Specific Advisory Boards

Site specific advisory boards (SSAB) were another controversial element of the staff's draft rule. Licensees would be required to bring together a SSAB when it is determined that the site can only meet criteria for restricted release. SSAB's would provide recommendations and advice to licensees and would be made staffed by people from the local community, citizens groups, government, workers, and others. It is unlikely that SSAB's would have been a part of a draft rule without the enhanced participatory rulemaking process. The SSAB's were designed as a answer to the call for greater public participation in the decommissioning process. Even with their incorporation, several commentators on the rule were concerned with the role of the SSAB's. One side of the debate featured calls for a strengthening of the SSAB's while others suggested that the Boards were unnecessary or would cause needless confusion and delay.

The Sierra Club urged the NRC to "closely monitor and review the formation of SSAB's . . . not to do so is an invitation to discord and litigation" (1994: 2). Public Citizen suggested that the SSAB's should play a larger role in each and every decommissioning practice than was incorporated in the staff rule.

Opposing the idea of SSABs, the U.S. Council on Energy Awareness felt that the SSAB's were an "unacceptable" and unnecessary because "it is not in the context of this rule an issue of public health and safety warranting a regulatory requirement by the NRC" (1994: 3). Other comments indicate that some felt that SSAB's would be "too prone to politicization" (Nebraska Department of Health, 1994: 1). And others felt that the

SSAB's were given too much responsibility, could shrink the role of local governments, and could hamper the efforts of "technical review boards" (Conference of Radiation Control Program Directors, 1994: 3).

Still other questions were raised regarding the actual implementation of SSAB's. For example, how would "stacking" of the board be minimized since the licensees would be responsible for the formation of SSAB's (U.S. Environmental Protection Agency, 1994: 6). How would other groups and individuals not formally a part of an SSAB be involved in the decommissioning process? How much information would be accessible to the SSAB's? Public Citizen suggested that information was key to the the SSAB's effectiveness as stakeholder involvement mechanisms: "Without [access to] all the relevant information, the SSAB will not be able to carry out its duties . . . and the public participation process will be a sham" (1994: 4).

FINAL THOUGHTS

In the late twentieth century, the politics of nuclear energy, radioactive waste, and radiation protection are the politics of gridlock. Implementation of major programs has become increasingly problematic. And no case offers a better example, than the failure of BRC.

Residual radioactivity is just one of the many decommissioning questions that have yet to be answered. As the twenty first century approaches, more and more commercial facilities will reach the end of their useful lives. Similarly, cleaning up DOE

sites has only just begun. Several decades and many billions of dollars from now the DOE's environmental restoration program likely will be ongoing.

The enhanced participatory rulemaking process offers a unique example of stakeholder involvement in decision making. Collaborative arrangements in decision making are not novel. However, the enhanced participatory rulemaking is an attempt to overcome the gridlock that has stymied the implementation of radiation policies. It may be that the enhanced participatory rulemaking offers the last best hope for radioactive waste policies.

Stakeholder involvement however, may not be the panacea that many claim it to be. It seems likely that increased resource expenditures in time, money, and effort will occur. Furthermore, it may be that the past history of nuclear energy politics has so poisoned the water, that establishing policies that are both effective and acceptable may only be wishful thinking. Nothing in the NRC's efforts prohibit external organizations from taking the Commission to court if they do not approve of the final rule on radiological criteria. Further, should the criteria prove unacceptable, opponents of previous residual radioactivity standards have shown they are capable of expanding the scope of conflict. What happens if Congress once again revisits this issue with legislation? State governments have been ill-pleased with many radioactive waste and radiation protection directives of the recent past. Will they find the guidelines developed through the enhanced participatory rulemaking acceptable?

Whether the final rule on radiological criteria for decommissioning turns out to be an effective and acceptable regulatory policy will have to be decided at a later date.

However a few conclusions about the process can be made. First, there are many policy problems to which a stakeholder based process could be applied. It will be necessary for decision makers in government to carefully decide which issues require proactive stakeholder involvement. In the current period of tight federal budgets, it is impossible to increase the costs of each and every rulemaking. Second, once the decision is made to go with a stakeholder involvement process, the effort should be undertaken with care that involvement does not resemble a thin-skinned attempt to "pull a fast one." Stakeholder based involvement should be used to improve the decision making process, not merely as a means to an end. Third, and arguably most important, stakeholder involvement also places a burden of responsibility upon those interests outside of government institutions. Citizens in a democracy have an inherent duty to participate in the political process. More public involvement has been the cry of many reformers for the past three decades. Stakeholder involvement processes provide just that opportunity. And when the process is used, stakeholders should not approach it as another means to delay potentially controversial policy solutions. Inevitably there will be winners and losers in the political process, but more importantly there are rules of the game. All who choose to enter the political arena should realize that things will not always go their way.

Whatever the final outcome, the enhanced participatory rulemaking is a significant changeover from past attempts at regulatory decision making. As cries for increased public involvement have rang out, government agencies have found that they can no longer ignore the sound. Moreover, as it has become increasingly difficult to establish public policies for complex and controversial issues, new ways of

conceptualizing the democratic process may be required. There are many more political animals waiting in the woods than ever before. And although the lion did not lie down with the lamb during enhanced participatory rulemaking, at least the lamb hasn't been eaten--not yet anyway.

REFERENCES

REFERENCES

- Aberbach, Joel D. 1990. *Keeping a Watchful Eye*. Washington, D.C: The Brookings Institution.
- Abrams, Nancy E. and Joel R. Primrack. 1987. "Helping the Public Decide." In *Resolving Locational Conflict*, ed. Robert W. Lake. New Brunswick, New Jersey: Center for Urban Policy Research.
- Abramson, Rudy. 1991. "EPA Contests Looser Curbs on Nuclear Waste Disposal." *Los Angeles Times*. July 27: A22.
- Abramson, Rudy. 1990. "Cut in Nuclear Waste Regulation Planned." *Los Angeles Times*. June 28: A13
- Adams, Steven R. 1989. "Surface Contamination Criteria for Free Release." Paper presented at the St. Michaels Workshop on Residual Radioactivity and Recycling Criteria, St. Michaels, Maryland.
- Almond, Gabriel A. and G. Bingham Powell. 1966. *Comparative Politics: A Developmental Approach*. Boston: Little, Brown and Company.
- Altman, John A. and Ed Petkus, Jr. 1994. "Toward a Stakeholder-Based Policy Process: An Application of the Social Marketing Perspective to Environmental Policy Development." *Policy Sciences* 27: 37-51.
- Anderson, Jack and Dale Van Alta. 1991, "No Childs Play in Recycled Waste." *Washington Post*. September 9: C16.
- Anderson, James E. 1962. *The Emergence of the Modern Regulatory State*. Washington D.C: Public Affairs Press.
- Ashe, A. Marice. 1993. "The Low-Level Radioactive Waste Policy Act and the Tenth Amendment: A 'Paragon of Legislative Success' or a Failure of Accountability." *Ecology Law Quarterly* 20: 267-319.
- B & W Fuel Company. 1994. *Comments on Staff Draft Radiological Criteria for Decommissioning*. 59 FR 4868. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

- Bangart, Richard L. 1992. *Establishing a Database For 20.302/20.2002 Disposal Requests*. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.
- Barke, Richard. 1986. *Science, Technology, and Public Policy*. Washington, D.C: CQ Press.
- Battelle, Pacific Northwest Laboratories. 1989. *Below Regulatory Concern Owners Group: Radionuclide Characterization of Potential BRC Waste Types From Nuclear Power*. Palo Alto, California: Electric Power Research Institute.
- Baumgartner, Frank R. and Bryan D. Jones. 1993. *Agendas and Instability in American Politics*. Chicago: University of Chicago Press.
- Becker, Jonathan Becker and Patti Goldman. 1991. *Deregulating Radioactive Waste Disposal* Washington D.C: Public Citizen.
- Becker, Jonathan. 1993. *The Dark at the End of the Tunnel*. Washington, D.C: Public Citizen.
- Bentley, Arthur F. 1935. *The Process of Government*. Bloomington, Indiana: The Principia Press.
- Bergman, C. and B.G. Petterson. 1994. "Radiation Applications and Waste Management: Taking the Final Steps." *IAEA Bulletin* 36: 36-40.
- Berry, Jeffrey M. 1989. *The Interest Group Society*. Glenview, Illinois: Scott Foresman and Company.
- Bingham, Richard D. and Claire L. Felbinger. 1989. *Evaluation in Practice: A Methodological Approach*. New York: Longman.
- Boorstin, Daniel J. 1983. *The Discoverers*. New York: Random House.
- Bowen, Catherine D. 1966. *Miracle at Philadelphia*. Boston: Atlantic Monthly Press.
- Brown, William. 1992. "In Good Conscience." *New Scientist* 136: 30-32.
- Brown, L.D. 1988. "The Implications of the ALARA Principle for Regulatory Dose Limits." Paper presented at the International Symposium on Uranium and Electricity, Saskatoon, Canada.
- Bryson, John M. and Barbara C. Crosby. 1992. *Leadership for the Common Good*. San Francisco: Jossey-Bass Publishers.

Bullard, Clark W. 1992. "Low-Level Radioactive Waste: Regaining Public Confidence." *Energy Policy* 20: 712-720.

Burke, John P. 1992. *The Institutional Presidency*. Baltimore: Johns Hopkins University Press.

Burko, Casey. 1990. "Nuclear Waste Plan Under Fire." *Chicago Tribune*. October 29: 1, 10.

Burns, Michael E. and William Briner. 1988. "Setting the Stage." In *Low-Level Radioactive Waste Regulation: Science, Politics, and Fear*, ed. Michael E. Burns. Chelsea, Michigan: Lewis Publishers.

Cameron, Francis X. 1991. *Evaluation of the Feasibility of Initiating a Consensus Process to Address Issues Related to the Below Regulatory Concern Policy*. SECY-91-132. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

Campbell, John L. 1988. *Collapse of an Industry: Nuclear Power and the Contradictions of U.S. Policy*. Ithaca, New York: Cornell University Press.

Caplin, J., G. Page, D. Smith and C. Wiblin. 1994. *Summary of Comments Received From Workshops on Radiological Criteria for Decommissioning*. Atlanta, GA: Advanced Systems Technology.

Carson, Rachel. 1962. *Silent Spring*. Greenwich, Connecticut: Fawcett Publications, Inc.

Carter, Luther J. 1987. *Nuclear Imperatives and Public Trust*. Washington, D.C: Resources for the Future, Inc.

Chilk, Samuel J. 1993. *SECY-93-106 - Withdrawal of Below Regulatory Concern Policy Statements in Accordance With the Energy Policy Act of 1992*. SECY-93-106. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

Clarfield, Gerald R. and William M. Wiecek. 1984. *Nuclear America*. New York: Harper and Row.

Clemens, Bruce, Thomas N. McGalliard, Laurence F. Miller, and Thomas W. Kerlin. 1993. *Establishing Cleanup Standards for Radioactive Scrap Metal*. Knoxville, Tennessee: The University of Tennessee's Energy, Environment, and Resources Center.

Coates, Dennis, Victoria Heid and Michael Munger. "Not Equitable, Not Efficient: U.S. Policy on Low-Level Radioactive Waste Disposal." *Journal of Policy Analysis and Management* 13: 526-538.

- Colvin, Joe F. 1994. *Radiological Criteria for Decommissioning*. 59 FR 4868. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.
- Comar, Cyril. 1987. "Risk: A Pragmatic De Minimis Approach." In *De Minimis Risk*, ed. Chris Whipple. New York: Plenum Press.
- Confederated Tribes and Bands of the Yakima Indian Nation. 1994. *Comments on Radiological Criteria for Decommissioning, Draft Federal Register Notice for Changes to 10 CFR 20*. 59 FR 4868. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.
- Conference of Radiation Control Program Directors. 1994. *Comments on Draft Radiological Criteria for Decommissioning*. 59 FR 4868. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.
- Congressional Quarterly. 1991. "House Panel Blocks Waste Rule Change." *Congressional Quarterly Report* 49: 2860.
- Cox, James R. 1993. "Naturally Occurring Radioactive Materials in the Oilfield: Changing the NORM." *Tulane Law Review* 67: 1197-1231.
- D'Arrigio, Diane. 1990. "Radioactive Waste: As Close As Your Neighborhood Landfill." *Utne Reader*. September/October: 109
- Dahl, Robert A. 1967. *Pluralist Democracy in America*. Chicago: Rand McNally.
- De Tocqueville, Alexis. 1945. *Democracy in America*. 2 Vols, ed. Phillips Bradley. New York: Vintage Books.
- Dickens, Charles. 1966. *Hard Times*, ed. George Ford. New York: W.W. Norton and Company.
- Dunlap, Riley E. 1992. "Trends in Public Opinion Toward Environmental Issues: 1965-1990." *Society and Natural Resources* 4: 285-312.
- Dunlap, Riley E. and Angela G. Mertig. 1992. "The Evolution of the U.S. Environmental Movement from 1970 to 1990: An Overview." In *American Environmentalism*, ed. Riley E. Dunlap and Angela G. Mertig. Philadelphia: Taylor and Francis.
- Easton, David. 1967/1992. "The Current Meaning of Behavioralism." In *Approaches to the Study of Politics*, ed. Bernard Susser. New York: MacMillan Publishing Company.

Einstein, Albert. [1939] 1991. "Letter to Franklin D. Roosevelt." In *The American Atom*, ed. Philip L. Cantelon, Richard G. Hewlett, and Robert C. Williams. Philadelphia: University of Pennsylvania.

Eisenhower, Dwight D. [1953] 1991. "Atoms for Peace" Address to the United Nations General Assembly. In *The American Atom*, ed. Philip L. Cantelon, Richard G. Hewlett, and Robert C. Williams. Philadelphia: University of Pennsylvania Press.

Eisner, Marc Allen. 1993. *Regulatory Politics in Transition*. Baltimore: The Johns Hopkins University Press.

Energy Policy Act of 1992, Pub. L. No. 102-486, sec. 2901, 106 Stat. 3122 (1992).

English, Mary R. 1992. *Siting Low-Level Radioactive Waste Disposal Facilities*. New York: Quorum Books.

English, Mary R., Amy K. Gibson, David L. Feldman, and Bruce E. Tonn. 1993. *Stakeholder Involvement: Open Processes for Reaching Decisions About the Future Uses of Contaminated Sites*. Knoxville, Tennessee: The University of Tennessee's Waste Management Research and Education Institute.

Farmelo, Graham. 1992. "The Day Chicago Went Critical." *New Scientist* 136: 26-29.

Feldman, David F., Jean H. Peretz, and Barbara D. Jendrucko. 1994. "Policy Gridlock in Waste Management: Balancing Federal and State Concerns." *Policy Studies Journal* 22: 589-603.

Fisher, Stewart R., William L. Partain, and Teresa Sype. 1995. "Lessons Learned From Commercial Experience With Nuclear Plant Deactivation to Safe Storage." *Nuclear News* 38: 34-38.

Fiskel, Joseph. 1987. "De Minimis Risk: From Concept to Practice." In *De Minimis Risk*, ed. Chris Whipple. New York: Plenum Press.

Foster, Catherine. 1990. "States Seek Viable Disposal Options." *The Christian Science Monitor*. April 27: 6.

Freeman, R. Edward. 1984. *Strategic Management*. Boston: Pitman.

Freudenberg, William R. and Rodney K. Baxter. 1985. "Nuclear Reactions: Public Attitudes and Policies Toward Nuclear Power." *Policy Studies Review* 5: 96-110.

- Freudenburg, Nicholas and Carol Steinsapir. 1992. "Not In Our Backyards: The Grassroots Environmental Movement." In *American Environmentalism*, ed. Riley E. Dunlap and Angela G. Mertig. Philadelphia: Taylor and Francis.
- Frisch, O.R. and R. Peierls. [1940] 1991. "On the Construction of a Super-Bomb; Based on a Nuclear Chain Reaction in Uranium." In *The American Atom*, ed. Philip L. Cantelon, Richard G. Hewlett, and Robert C. Williams. Philadelphia: University of Pennsylvania Press.
- Gamson, William A. and Andre Modigliani. 1989. "Media Discourse and Public Opinion on Nuclear Power: A Constructionist Approach." *American Journal of Sociology* 95: 1-37.
- Gershey, Edward L., Robert C. Klein, Esmeralda Party, and Amy Wilkerson. 1990. *Low-Level Radioactive Waste: From Cradle to Grave*. New York: Van Nostrand Reinhold.
- Godwin, R. Kenneth. 1992. "Money, Technology, and Political Interests: The Direct Marketing of Politics." In *The Politics of Interests*, ed. Mark P. Petracca. Boulder, Colorado: Westview Press.
- Goggin, Malcolm L. 1986a. "Introduction. Governing Science and Technology Democratically: A Conceptual Framework." In *Governing Science and Technology in a Democracy*, ed. Malcolm L. Goggin. Knoxville, Tennessee: The University of Tennessee Press.
- Goggin, Malcolm L. 1986b. "Science and Technology: Who Should Govern?" In *Governing Science and Technology in a Democracy*, ed. Malcolm L. Goggin. Knoxville, Tennessee: University of Tennessee Press.
- Graber, Doris A. 1993. "Media Impact on the Political Status Quo: What is the Evidence?" In *Media and Public Policy*, ed. Robert J. Spitzer. Westport, Connecticut: Praeger Press.
- Greenpeace. 1994. *Comments on Draft Radiological Criteria for Decommissioning*. 59 FR 4868. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.
- Greenwood, Ted. 1981. "Nuclear Waste Management in the United States." In *The Politics of Nuclear Waste*, ed. E. William Colglazier. New York: Pergamon Press.
- Hayes, Michael T. 1981. *Lobbyists and Legislators*. New Brunswick, Connecticut: Rutgers University Press.
- Hayes, Michael T. 1992. *Incrementalism and Public Policy*. New York: Longman.

Health Physics Society. 1994. *Radiological Criteria for Decommissioning*. 59 FR 4868. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

Heclo, Hugh. 1978. "Issue Networks and the Executive Establishment." In *The New American Political System*, ed. Anthony King. Washington, D.C.: American Enterprise Institute for Public Policy Research.

Herman, Edward S. 1986. "Gatekeeper Versus Propaganda Models: A Critical American Perspective." In *Communicating Politics*, ed. Peter Golding, Graham Murdock, and Philip Schlesinger. New York: Holmes and Meier.

Herson, Lawrence J.R. 1984. *The Politics of Ideas*. Prospect Heights, Illinois: Waveland Press, Inc.

Hill, Charles W.L. and Thomas M. Jones. 1992. "Stakeholder Agency Theory." *Journal of Management Studies* 29: 131-154.

Hogwood, Brian W. and B. Guy Peters. 1983. *Policy Dynamics*. New York: St. Martin's Press.

Horwitz, Robert B. 1994. "Judicial Review of Regulatory Decisions: The Changing Criteria." *Political Science Quarterly* 109: 133-169.

Humphrey, Craig R. and Frederick H. Buttel. 1986. *Environment, Energy, and Society*. Malabar, Florida: Krieger Publishing Company.

Hunt, John P. and Neil H. Katz. 1984. "Nonviolent Protest and Third-Party Public Opinion: A Study of the June 1978, Seabrook, New Hampshire, Antinuclear Power Protest." In *Citizen Participation in Science Policy*, ed. James C. Petersen. Amherst, Massachusetts: University of Massachusetts Press.

Idelson, Holly. 1991. "Interior Subcommittee Dumps Proposed NRC Waste Rule." *Congressional Quarterly Weekly Report* 49: 2781.

Idelson, Holly. 1992a. "Environmentalists Get a Boost From Committees Markups." *Congressional Quarterly Weekly Report*. Volume 50, Number 15: 941-942.

Idelson, Holly. 1992b. "House Gives Energy Bill Big Win; Lengthy Conference Expected." *Congressional Quarterly Weekly Report* 50: 1530-1532.

Institute for Energy and Environmental Research. 1994. *Comments on Draft Radiological Criteria for Decommissioning of the Nuclear Regulatory Commission, 10 CFR Part 20, dated January 26, 1994*. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

Jasper, James M. 1990. *Nuclear Politics*. Princeton, New Jersey: Princeton University Press.

Jefferson, Thomas. [1807] 1944. "Letter to Governor James Sullivan." In *The Life and Selected Writings of Thomas Jefferson*, ed. Adrienne Kock and William Peden. New York: The Modern Library.

Jennings, Bruce E. 1986. "Representation and Participation in the Democratic Governance of Science and Technology." In *Governing Science and Technology in a Democracy*, ed. Malcolm L. Goggin. Knoxville, Tennessee: University of Tennessee Press.

Johnson, Charles W. and Charles O. Jackson. 1981. *City Behind A Fence*. Knoxville, Tennessee: University of Tennessee Press.

Jones, Charles O. 1984. *An Introduction to the Study of Public Policy*. Monterey, California: Brooks/Cole Publishing Company.

Joppke, Christian. 1992/1993. "Decentralization of Control in U.S. Nuclear Energy Policy." *Political Science Quarterly* 107: 709-725.

Joppke, Christian. 1993. *Mobilizing Against Nuclear Energy*. Berkeley and Los Angeles: University of California Press.

Kaplan, Abraham. 1963. *The Conduct of Inquiry*. New York: Harper and Row.

Kearney, Richard C. 1993. "Low-Level Radioactive Waste Management: Environmental Policy, Federalism, and New York." *Publius* Summer: 57-73.

Kelman, Steven. 1987. *Making Public Policy*. United States: Basic Books.

Keystone Center. 1992. *Keystone Center Annual Report, 1991-1992*.

Kocher, David C. 1986. "National and International Considerations of a De Minimis Dose." Presented at the Nineteenth Midyear Topical Symposium of the Health Physics Society, Knoxville, Tennessee.

Krimsky, Sheldon. 1984. "Beyond Technocracy: New Routes for Citizen Involvement in Social Risk Assessment." In *Citizen Participation in Science Policy*, ed. James C. Petersen. Amherst, Massachusetts: University of Massachusetts Press.

Kronick, Jane C. 1984. "Public Interest Group Participation in Congressional Hearings on Nuclear Power Development." In *Citizen Participation in Science Policy*, ed. James C. Petersen. Amherst, Massachusetts: University of Massachusetts Press.

Langbein, Laura Irwin. 1980. *Discovering Whether Programs Work*. Oakland, New Jersey: Scott Foresman and Company.

Latham, Earl. 1952. *The Group Basis of Politics*. Ithaca, New York: Cornell University Press.

Lean, Geoffrey, ed. 1985. *Radiation: Doses, Effects, Risks*. Nairobi, Kenya: United Nations Scientific Committee on the Effects of Atomic Radiation.

Lindblom, Charles E. and Edward J. Woodhouse. 1993. *The Policy-Making Process*. Englewood Cliffs, New Jersey: Prentice Hall.

Lippman, Thomas W. 1990. "Nuclear Waste Disposal Rules to be Relaxed." *Washington Post*. June 28: A10.

Loaharanu, Paisan. 1994. "Food Irradiation in Developing Countries: A Practical Alternative." *IAEA Bulletin* 36: 30-35.

Longino, Helen. 1986. "Science Overrun: Threats to Freedom from External Control." In *Governing Science and Technology in a Democracy*, ed. Malcolm L. Goggin. Knoxville, Tennessee: University of Tennessee Press.

Loomis, Burdett A. and Eric Sexton. 1995. "Choosing to Advertise: How Interests Decide. In *Interest Group Politics*, ed. Allan J. Cigler and Burdett A. Loomis. Washington, D.C.: CQ Press.

Low-Level Radioactive Waste Policy Amendments Act of 1985, Pub. L. No. 99-240, sec. 10, 99 Stat. 1859 (1986).

Machi, S. and R. Iyer. 1994. "Nuclear and Radiation Applications in Industry: Tools for Innovation." *IAEA Bulletin* 36: 2-7.

Madison, James, Alexander Hamilton, and John Jay. 1982. *The Federalist Papers*, ed. Garry Wills. New York: Bantam Books.

- Mazur, Allen. 1988. "Controversial Technologies in the Mass Media." In *Technology and Politics*, ed. Michael E. Kraft and Norman J. Vig. Durham, North Carolina: Duke University Press.
- McCabe, Amy S., E. William Colglazier and Michael R. Fitzgerald. 1993. "Public Acceptance and Nuclear Waste: Do New Technologies Matter?" Presented at the annual Waste Management Symposia, Tucson.
- McCann, Michael W. and Helena Silverstein. 1993. "Social Movements and the American State: Legal Mobilization as a Strategy for Democratization." In *A Different Kind of State? Popular Power and Democratic Administration*, ed. Gregory Albo, David Langille and Leo Panitch. Toronto, Ontario: Oxford University Press.
- McCraw, Thomas K. 1984. *The Prophets of Regulation*. Cambridge, Massachusetts: The Belknap Press of Harvard University Press.
- McCubbins, Matthew D. and Thomas Schwartz. 1984. "Congressional Oversight Overlooked: Police Patrols Versus Fire Alarms." *American Journal of Political Science* 28: 166-179.
- McFarland, Andrew S. 1993. *Cooperative Pluralism*. Lawrence, Kansas: University of Kansas Press.
- McGarity, Thomas O. 1991. *Reinventing Rationality: The Role of Regulatory Analysis in the Federal Bureaucracy*. New York: Cambridge University Press.
- McQuail, Denis. 1986. "Diversity in Political Communication: Its Sources, Forms, and Future." In *Communicating Politics*, ed. Peter Golding, Graham Murdock, and Philip Schlesinger. New York: Holmes and Meier.
- Meier, Kenneth J. 1993. *Politics and Bureaucracy*. Pacific Grove, California: Brooks Cole Publishing.
- Menkes, Joshua and R. Scott Frey. 1987. "De Minimis Risk as a Regulatory Tool." In *De Minimis Risk*, ed. Chris Whipple. New York: Plenum Press.
- Meyers, Sheldon. 1987. "Applications of De Minimis Risk." In *De Minimis Risk*, ed. Chris Whipple. New York: Plenum Press.
- Mickelson, Sig. 1989. *From Whistle Stop to Sound Bite: Four Decades of Politics and Television*. New York: Praeger.

Minns, J.L. 1992. "Disposal of Slightly Contaminated Radioactive Wastes from Nuclear Power Plants." *Radiation Protection Management* 9: 71-78.

Mitchell, Robert Cameron, Angela G. Mertig, and Riley E. Dunlap. 1992. "Twenty Years of Environmental Mobilization: Trends Among National Environmental Organizations." In *American Environmentalism*, ed. Riley E. Dunlap and Angela G. Mertig. Philadelphia: Taylor and Francis.

Moeller, Dade W. 1994. "Radioactive Materials, Radiation Exposures, and Units of Dose." Presented at the Harvard Conference on Low-Level Radioactive Waste Management, Boston.

Morone, Joseph G. and Edward J. Woodhouse. 1989. *The Demise of Nuclear Energy*. New Haven: Yale University Press.

Mostaghel, Deborah M. 1994. "The Low-Level Radioactive Waste Amendments Act: An Overview." *Depaul Law Review* 43: 379-423.

Murray, Raymond L. 1989. *Understanding Radioactive Waste*. Columbus, Ohio: Battelle Press.

Nebraska Department of Health. 1994. *Comments on Draft Radiological Criteria for Decommissioning*. 59 FR 4868 Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

Nelkin, Dorothy. 1984. "Science and Technology Policy and the Democratic Press." In *Citizen Participation in Science Policy*, ed. James C. Petersen. Amherst, Massachusetts: University of Massachusetts Press.

Nimmo, Dan and James E. Combs. 1985. *Nightly Horrors*. Knoxville, Tennessee: University of Tennessee Press.

Noll, Roger G. and Bruce M. Owen. 1983. *The Political Economy of Deregulation: Interest Groups in the Regulatory Process*. Washington, DC: American Enterprise Institute for Public Policy Research.

Nownes, Anthony. 1991. "Interest Groups and the Regulation of Pesticides; Congress, Coalitions, and Closure." *Policy Sciences* 24: 1-18.

Nuclear Information and Resource Service. 1994. *Comments on the NRC Staff Draft Radiological Criteria for Decommissioning Product of the Enhanced Rulemaking on Residual Rulemaking (ERROR)*. 59 FR 4868 Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

Nuclear Energy Agency, Organization for Economic Cooperation and Development. 1984. *Nuclear Power and Public Opinion*. OECD.

Nuclear Energy Institute. 1994. *Comments on Radiological Criteria for Decommissioning*. 59 FR 4868. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

O'Leary, Rosemary. 1993. *Environmental Change: Federal Courts and the EPA*. Philadelphia: Temple University Press.

Oak Ridge National Laboratory. 1993. *Integrated Data Base for 1993: U.S. Spent Fuel and Radioactive Waste Inventories, Projections, and Characteristics*. Oak Ridge, Tennessee: Office of Scientific and Technical Information.

Oppenheimer, Robert. [1943] 1991. "Memorandum to Leslie R. Groves." In *The American Atom*, ed. Philip L. Cantelon, Richard G. Hewlett, and Robert C. Williams. Philadelphia: University of Pennsylvania Press.

Ornstein, Norman and Shirley Elder. 1978. *Interest Groups, Lobbying, and Policymaking*. Washington, D.C.: Congressional Quarterly Press.

Page, Benjamin I. and Robert Y. Shapiro. 1992. *The Rational Public*. Chicago: University of Chicago Press.

Parler, William C. 1993. *Status Report on the Enhanced Participatory Rulemaking*. SECY-93-114. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

Pasqualetti, Martin J. 1991a. "Nuclear Oversight: A Critical Analysis of the Public Element in Decommissioning Policy." In *Energy, the Environment, and Public Policy*, ed. David L. McKee. New York: Praeger.

Pasqualetti, Martin J. 1991b. "The Place of Economics in Decommissioning Policy." *Energy Journal* 12: 3-12.

Peckinpugh, Timothy L. 1988. "The Politics of Low-Level Radioactive Waste Disposal." In *Low-Level Radioactive Waste Regulation: Science, Politics, and Fear*, ed. Michael E. Burns. Chelsea, Michigan: Lewis Publishers.

Peierls, Rudolph and Otto Frisch. [1940] 1991. "On the Construction of a 'Super-Bomb,' Based on a Nuclear Chain Reaction in Uranium." In *The American Atom*, ed. Philip L. Cantelon, Richard G. Hewlett, and Robert C. Williams. Philadelphia: University of Pennsylvania.

- Peters, B. Guy. 1984. *The Politics of Bureaucracy*. New York: Longman.
- Peters, B. Guy. 1993. *American Public Policy: Promise and Performance*. Chatham, New Jersey: Chatham House Publishers.
- Petersen, James C. 1984. "Citizen Participation in Science Policy." In *Citizen Participation in Science Policy*, ed. James C. Petersen. Amherst, Massachusetts: University of Massachusetts Press.
- Petracca, Mark P. 1992. "The Rediscovery of Interest Group Politics." In *The Politics of Interests*, ed. Mark P. Petracca. Boulder, Colorado: Westview Press.
- Piller, Charles. 1991. *The Fail-Safe Society*. Berkeley: University of California Press.
- Press, Charles and Kenneth VerBurg. 1988. *American Politicians and Journalists*. Glenview, Illinois: Scott, Foresman, and Company.
- Price, Jerome B. 1990. *The Antinuclear Movement*. New York: MacMillan.
- Public Citizen. 1994. *Comments on Staff Draft Radiological Criteria for Decommissioning 10 CFR Part 20*. 59 FR 4868. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.
- Pytte, Alison. 1990. "Bill Would Scrap NRC Waste Rule." *Congressional Quarterly Weekly Report* 48: 2907.
- Quadrex Corporation. 1993. *DOE Weapons Complex Scrap Metal Inventory*. Morgantown, West Virginia: EG&G Washington Analytical Services Center.
- Quinn, Patrick. 1990. "Below Regulatory Concern." *Hazmat World* 3: 45-48.
- Rauch, Jonathan. 1994. *Demosclerosis*. New York: Times Books.
- Reagan, Michael D. 1987. *Regulation: The Politics of Policy*. Boston: Little Brown and Company.
- Rieselbach, Leroy N. 1994. *Congressional Reform, The Changing Modern Congress*. Washington, D.C.: CQ Press.
- Rivlin, Alice. 1992. *Reviving the American Dream*. Washington, D.C.: The Brookings Institution.

- Rosa, Eugene A. And Riley E. Dunlap. 1994. "The Polls-Poll Trends: Nuclear Power, Three Decades of Public Opinion." *Public Opinion Quarterly* 58: 295-307.
- Rosa, Eugene A. And William R. Freudenburg. 1993. "The Historical Development of Public Reactions to Nuclear Power: Implications for Nuclear Waste Policy." In *Public Reactions to Nuclear Waste*, ed. Riley E. Dunlap, Michael E. Kraft, and Eugene A. Rosa. Durham, North Carolina: Duke University Press.
- Rosenbaum, Walter A. 1987. *Energy, Politics, and Public Policy*. Washington, D.C: CQ Press.
- Rydell, Randy J. 1984. "Solving Political Problems of Nuclear Technology: The Role of Public Participation." In *Citizen Participation in Science Policy*, ed. James C. Petersen. Amherst, Massachusetts: University of Massachusetts Press.
- Saleska, Scott. 1989. *Nuclear Legacy*. Washington, D.C.: Public Citizen.
- Saleska, Scott. 1990. "Low-Level Radioactive Waste: Gamma Rays in the Garbage." *The Bulletin of Atomic Scientists* 46: 18-25.
- Salisbury, Robert H. 1990. "The Paradox of Interest Groups in Washington--More Groups, Less Clout." In *The New American Political System*, ed. Anthony King. Washington, DC: AEI Press.
- Schattschneider, E.E. 1975. *The Semisovereign People*. Hinsdale, Illinois: Dryden Press.
- Schiller, Dan. 1986. "Transformations of News in the US Information Market." In *Communicating Politics*, ed. Peter Golding, Graham Murdock, and Philip Schlesinger. New York: Holmes and Meier.
- Schlozman, Kay Lehman and John T. Tierney. 1986. *Organized Interests and American Democracy*. New York: Harper and Row Publishers.
- Science Applications International Corporation. 1989. *Below Regulatory Concern Owners Group: Nonradiologic Characterization and Environmental Assessment of BRC Waste*. Palo Alto, California: Electric Power Research Institute.
- Scrimgeour, Dr. Donald P. and Lisa Hanson. 1993. *Advisory Groups in the U.S. Department of Energy Environmental Cleanup Process: A Review and Analysis*. Golden, Colorado: Colorado Center For Environmental Management.
- Sevareid, Eric. 1967. *Politics and the Press*. Knoxville, Tennessee: University of Tennessee.

- Shulman, Seth. 1989. "When a Nuclear Reactor Dies \$98 Million is a Cheap Funeral." *The Smithsonian* 20: 56-69.
- Sierra Club. 1994. *Comment; Draft Radiological Criteria for Decommissioning*. 59 FR 4868. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.
- Simmons, James and Nancy Stark. 1993. "Backyard Protest: Emergence, Expansion and Persistence of a Local Hazardous Waste Controversy." *Policy Studies Journal* 21: 470-491.
- Skene, Neil, ed. 1993. *Congressional Quarterly Almanac, Volume XLVIII, 1992*. Washington, D.C.: Congressional Quarterly Incorporated.
- Spitzer, Robert J. 1993. "Introduction: Defining the Media-Policy Link." In *Media and Public Policy*, ed. Robert J. Spitzer. Westport, Connecticut: Praeger Press.
- Starr, Chauncey. 1985. "Risk Management, Assessment, and Acceptability." *Risk Analysis* 5: 97-102
- Stello, Victor. 1988. *Current and Potential Applicability of De Minimis and Below Regulatory Concern Concepts to Commission Policies*. SECY-88-69. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.
- Stoel, Tom. 1981. "Citizen Groups: A Creative Force." *EPA Journal* 7: 22-24.
- Strauss, Lewis L. [1955] 1991. "My Faith in the Atomic Future." In *The American Atom*, ed. Philip L. Cantelon, Richard G. Hewlett, and Robert C. Williams. Philadelphia: University of Pennsylvania Press.
- Surrey, John. 1992. "Ethics of Nuclear Decommissioning." *Energy Policy*. July: 632-640.
- Swinwood, J.F., T.D. Waite, P. Kruger, and S.M. Rao. 1994. "Radiation Technologies for Waste Treatment: A Global Perspective." *IAEA Bulletin* 36: 11-15.
- Sylves, Richard Terry. 1987. *The Nuclear Oracles*. Ames, Iowa: Iowa State University Press.
- Taylor, Andrew. 1992. "Bills Negotiate House Thicket, Encounter Partisan Divide." *Congressional Quarterly Weekly Report* 50: 870-871.
- Taylor, James M. 1990. *Summary of Public Meetings on Below Regulatory Concern Policy*. Washington D.C.: Nuclear Regulatory Commission Public Documents Room.

Taylor, James M. 1992. *Enhanced Participatory Rulemaking Process*. SECY-92-045. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

Taylor, James M. 1994. *Staff Action Plan for an Enhanced Participatory Rulemaking for Recycle/Reuse Criteria*. SECY-94-221. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

Taylor, James M. and William C. Parler. 1992a. *Final Plan for the Enhanced Participatory Rulemaking Process on the Radiological Criteria for Decommissioning*. SECY-92-249. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

Taylor, James M. and William C. Parler. 1992b. *Status Report on the Enhanced Participatory Rulemaking Process on the Radiological Criteria for Decommissioning*. SECY-92-191. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

Tesh, Sylvia N. 1993. "Environmentalism, Preenvironmentalism and Public Policy." *Policy Sciences* 26: 1-20.

Thomas, Clive S. and Ronald J. Hrebenar. 1992. "Changing Patterns of Interest Group Activity: A Regional Perspective." In *The Politics of Interests*, ed. Mark P. Petracca. Boulder, Colorado: Westview Press.

Thompson, Fred and L.R. Jones. 1982. *Regulatory Policy and Practices*. New York: Praeger Publishers.

Trachtman, Leon E. 1986. "Science and Technology: Who Governs?" In *Governing Science and Technology in a Democracy*, ed. Malcolm L. Goggin.

U.S. Atomic Energy Commission. 1974. *Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Inspections*. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room. Knoxville, Tennessee: University of Tennessee Press.

U.S. Congress. House. Committee on Energy and Environment. 1985. *Low Level Radioactive Waste Policy Amendments Act*. H. Report 99-314, part 1-2. Washington, D.C.: Government Printing Office.

U.S. Congress. Senate. Committee on Energy and Natural Resources. 1985. *Low-Level Radioactive Waste Policy Act Amendments of 1985: Report Together With Minority Views, To Accompany S. 1517*. 99th Cong., 1st Sess., S. Doc. 199.

U.S. Congress. House. Committee On Interior and Insular Affairs. 1990. *Nuclear Regulatory Commission's Below Regulatory Concern (BRC) Policy: Oversight Hearing Before the Subcommittee on Energy and Environment of the Committee on Interior and Insular Affairs, House of Representatives, One Hundred First Congress, Second Session, Hearing Held in Washington, D.C., July 26, 1990*. Washington, D.C.: U.S. Government Printing Office.

U.S. Congress. House. Committee on Interior and Insular Affairs. 1991. *The Radiation Protection Act of 1991, Below Regulatory Concern: Hearing Before the the Subcommittee on Energy and the Environment of the Committee on Interior and Insular Affairs, House of Representatives, One Hundred Second Congress, First Session, on H.R. 645, Radiation Protection Act of 1991, Hearing Held in Washington, D.C., September 12, 1991*. Washington, D.C.: U.S. Government Printing Office.

U.S. Council for Energy Awareness. 1994. *Comments on Staff Draft Radiological Criteria for Decommissioning*. 59 FR 4868. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

U.S. Department of Energy. 1989. *Comments on the Nuclear Regulatory Commission's Proposed Policy Statement on Exemptions from Regulatory Control*. 53 FR 49886. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

U.S. Department of Energy. Secretary of Energy Advisory Board. 1993. *Earning Public Trust and Confidence: Requisites for Managing Radioactive Waste*. Washington, D.C.: U.S. Government Printing Office.

U.S. Environmental Protection Agency. 1989. *U.S. Environmental Protection Agency's Detailed Comments on the Nuclear Regulatory Commission's Advanced Notice of a Policy Statement for Exemptions From Regulatory Control*. 53 FR 49886. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

U.S. Environmental Protection Agency. 1993. "Radiation Site Cleanup Regulations." *Federal Register* 58: 54474-54476.

U.S. Environmental Protection Agency. 1994. *Comments on Draft Radiological Criteria for Decommissioning*. 59 FR 4868. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

U.S. General Accounting Office. 1993. *Radioactive Waste, EPA Standards Delayed by Low Priority and Coordination Problems*. GAO/RCED-93-126. Washington, D.C.: U.S. General Accounting Office.

- U.S. General Accounting Office. 1994. *Nuclear Health and Safety, Consensus on Acceptable Radiation Risk to the Public is Lacking*. GAO/RCED-94-190. Washington, D.C.: U.S. General Accounting Office.
- U.S. Nuclear Regulatory Commission. 1986. "10 CFR Part 2, Radioactive Waste Below Regulatory Concern; Policy Statement." *Federal Register* 51: 30839-30847.
- U.S. Nuclear Regulatory Commission. 1988. "10 CFR Parts 30, 40, 50, 51, 70, and 72, General Requirements for Decommissioning Nuclear Facilities." *Federal Register* 53: 24018-24056.
- U.S. Nuclear Regulatory Commission. 1990a. *Below Regulatory Concern*. NUREG/BR-0157. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.
- U.S. Nuclear Regulatory Commission. 1990b. "Below Regulatory Concern; Policy Statement." *Federal Register* 55: 27522-27537.
- U.S. Nuclear Regulatory Commission. 1991. *NRC Will Work Towards Consensus on BRC Policy Issues, Deters Action on Waste Disposal Issues*. Press Release. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.
- U.S. Nuclear Regulatory Commission. 1992. "Radiological Criteria for Decommissioning of NRC-Licensed Facilities; Workshops." *Federal Register* 57: 58727-58730.
- U.S. Nuclear Regulatory Commission. 1993a. "10 CFR Part 20, Radiological Criteria for Decommissioning of NRC-Licensed Facilities; Generic Environmental Impact Statement (GEIS) for Rulemaking, Notice of Intent to Prepare a GEIS and To Conduct a Scoping Process." *Federal Register* 58: 33570-33574.
- U.S. Nuclear Regulatory Commission. 1993b. *Decommissioning Case Studies*. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.
- U.S. Nuclear Regulatory Commission. 1994a. "10 CFR Part 20, Radiological Criteria for Decommissioning of NRC-Licensed Facilities; Enhanced Participatory Rulemaking, Availability of the Staff's Draft Rule." *Federal Register* 59: 4867-4868.
- U.S. Nuclear Regulatory Commission. 1994b. *Draft Proposed Rule on Radiological Criteria for Decommissioning*. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.
- U.S. Nuclear Regulatory Commission. 1994c. *Information Digest*. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

U.S. Nuclear Regulatory Commission. 1995. *Briefing on Lessons Learned from Enhanced Participatory Rulemakings - Public Meeting*. Transcript of a Public Meeting Held in Rockville, Maryland, March 29, 1995. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

University of California, Los Angeles. 1994. *Draft Radiological Criteria for Decommissioning*. 59 FR 4868. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

University of Massachusetts, Lowell. 1994. *Comments on Draft Radiological Criteria for Radiological Decommissioning*. 59 FR 4868. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

Wald, Matthew I. 1990. "Disposal of Mild Radioactive Waste to be Less Restricted in New Policy." *New York Times*. June 26: A12

Washington State. Department of Health. 1994. *Comments on Revision of 10 CFR part 20 - Radiological Criteria for Decommissioning*. 59 FR 4868. Washington, D.C.: Nuclear Regulatory Commission Public Documents Room.

Wasserman, Harvey. 1990. "Dumping On Us." *The Nation* 250: 76.

Weart, Spencer R. 1988. *Nuclear Fear*. Cambridge, Massachusetts: Harvard University Press.

Weart, Spenser. 1992. "Fears, Fantasies, and Fallout." *New Scientist* 136: 34-37.

Weinberg, Alvin. 1987. "Science and Its Limits: The Regulators Dilemma." In *De Minimis Risk*, ed. New York: Plenum Press.

Werner, James D. and Dan W. Reicher. 1992. *Testimony of James D. Werner, Senior Environmental Engineer and Dan W. Reicher Senior Attorney of the Natural Resources Council to the Subcommittee on Energy and the Environment of the House Interior Committee on Establishment of National Standards For the Cleanup of Radiologically Contaminated Sites*. Washington, D.C.: Natural Resources Defense Council.

Whipple, Chris. 1987. "Application of the De Minimis Concept in Risk Management." In *De Minimis Risk*, ed. Chris Whipple. New York: Plenum Press.

Whitman, Walt. [1856] 1973. "Song of the Open Road." In *The Portable Walt Whitman*, ed. Malcolm Cowley. New York: The Viking Press.

Yalow, Rosalyn S. 1988. "Biologic Effects of Low-Level Radiation." In *Low-Level Radioactive Waste Regulation: Science, Politics, and Fear*, ed. Michael E. Burns. Chelsea, Michigan: Lewis Publishers.

Zimmerman, Joseph F. 1988. "Regulating Atomic Energy in the American Federal System." *Publius* 18: 51-65.

Zinberg, Dorothy S. 1984. "Public Participation in Nuclear Waste Management Policy: A Brief Historical Overview." In *Public Reactions to Nuclear Power: Are There Critical Masses*, ed. William R. Freudenburg and Eugene A. Rosa. Boulder, Colorado: Westview Press.

VITA

Thomas Newton McGalliard was born in Hickory, North Carolina on April 25, 1967. During his formative years he lived in several southern municipalities before finally locating with his family in the East Tennessee community of Knoxville. After graduating from Farragut High School in 1985 he entered the University of Tennessee and in May 1989 received a Bachelor of Arts in Liberal Arts majoring in History. After a short-term career as a bookstore manager and a self-actualizing trip to Europe he reentered the world of academia first at the University of North Carolina, Wilmington and later once again at the University of Tennessee, Knoxville. In August 1995 he received a Master of Arts majoring in Political Science.

He is currently employed as a researcher with the Energy, Environment, and Resources Center at the University of Tennessee and lives in the small oasis of Crystal Lake subdivision with his four adopted dogs, a ten year old truck, and a growing collection of books.