To the Graduate Council:

I am submitting herewith a dissertation written by George Edward Rawson entitled "The Process of Program Development: The Case of TVA's Power Program." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Political Science.

David M. Welborn, Major Professor

We have read this dissertation
and recommend its acceptance:

Vernon O. Freefell

Anne H. Hopkins

Donald A. Clelland

Accepted for the Council:

L. Evans Reed
Vice Chancellor
Graduate Studies and Research

Thesis
79b
.R38
cop. 2

THE PROCESS OF PROGRAM DEVELOPMENT: THE CASE OF TVA'S POWER PROGRAM

A Dissertation

Presented for the

Doctor of Philosophy

Degree

The University of Tennessee, Knoxville

George Edward Rawson

March 1979

1180411

Copyright by George Edward Rawson 1978
All Rights Reserved

DEDICATION

For Betsy, who was patient, and Jeffrey, who was not.

ACKNOWLEDGEMENTS

The completion of this study has required a great deal of work and patience by several people to whom I am deeply indebted. The members of my committee, Anne Hopkins, Don Clelland, and Vernon Iredell read various drafts and provided helpful comments and suggestions. Paul Schulman was influential in the early stages of this work when he was most needed. My chairman, Dave Welborn, read all the drafts with care and great patience and provided assistance in all stages of the work. Kathy Vlasic typed the final copy with much greater care and patience than one has the right to expect. Mary Sohngen edited and proofread each chapter and provided encouragement when it was needed. The staff of the TVA technical library in Knoxville, especially Bill Whitehead and Coleen Siler, were helpful in locating essential documents and reports. My wife, Betsy, in addition to providing encouragement and understanding, typed the many drafts leading to the final copy.

ABSTRACT

The increased emphasis of social scientists on "relevancy" has caused political scientists to focus more attention on the "post-Congress" stage of government activity. Emphasis, as such, has been on public policies and their effects on society. One important aspect of public policies, programs, has received virtually none of this attention. Defined as the means by which public policies are carried out, programs have been criticized for their failure to change in response to the changing needs of society.

Using both a closed- and open-system perspective, this dissertation examines a single program that has experienced rapid and extensive change throughout its forty-five year history. The Tennessee Valley Authority is the subject of a case study that relies upon personal interviews with agency officials and secondary sources including newspapers, government reports, and the Authority's files and reports for its factual information.

Programs are identified as experiencing two manners of change: pace, which may be slow or rapid, and magnitude, which may be limited or extensive. From these two manners of change, four types of program change are distinguished: slow/limited, slow/extensive, rapid/limited, and rapid/extensive. Varying levels of four variables are found to be associated with each type of change: level of environmental complexity, change, and uncertainty; level of comprehensiveness of the gathering and analyzing of information in the decision-making process; organizational goal/mission; and level of autonomy.

TABLE OF CONTENTS

CHAPTER		PAGE
I.	THE PROBLEM OF PROGRAM CHANGE	1
	Introduction	1
	On Programs and Program Development	5
	Perspectives for Explaining Program Development	19
	TVA	36
	Organization	37
II.	THE POWER PROGRAM FROM BIRTH TO MATURITY	39
	Creation	40
	Forging a Policy	45
	Toward Program Maturity	59
	Recapitulation	68
III.	GOING NUCLEAR	74
	Origins of Change	74
	Browns Ferry	85
	Aftermath	94
	Conclusion	102
IV.	PROGRAM DEVELOPMENT IN AN UNCERTAIN ENVIRONMENT	105
	Environmental Changes	105
	Nuclear Expansion	116
	Summary	152
V.	CASE ANALYSIS	157
	Recapitulation	157
	Major Forces Affecting Program Development	162
	Alternative Perspectives on Program Development	176
	Conclusion	193
VI.	TOWARD A THEORY OF PROGRAM DEVELOPMENT	195
	Rapid Pace and Extensive Magnitude	199
	Rapid Pace and Limited Magnitude	204
	Slow Pace and Extensive Magnitude	208
	Slow Pace and Limited Magnitude	211
	Conclusion	214
SOURCES CONSULTED		216
VITA		226

LIST OF TABLES

TABLE		PAGE
1.	Changes in the Public's Perception of Pollution as a Problem: 1965-1970.	79
2.	Important Events and Decisions in the Development of TVA's Nuclear Power Program - by Year from 1966 through 1969	86
3.	Development of TVA's Power Program, by Year from 1970 through 1977	106
4.	Cost Overruns at TVA Nuclear Plants	150

LIST OF FIGURES

FIGURE		PAGE
I.1	Types of Program Change.	18
II.1	TVA's Total Generating Capacity And Change in Generating Capacity from 1946 Through 1965.	69
II.2	Percent of TVA's Generating Capacity by Year and Source.	72
IV.1	TVA's Total Generating Capacity and Change in Generating Capacity from 1970 Through 1985.	153
IV.2	Percent of TVA's Generating Capacity by Year and Source.	155
VI.1	The Open-System Perspective of Program Change	198
VI.2	Factors Associated with Different Types of Program Change.	215

CHAPTER I

THE PROBLEM OF PROGRAM CHANGE

INTRODUCTION

Dramatic social, economic and political changes are familiar to anyone who has experienced the 1960's and 1970's. Indeed, historians view the dynamism of the recent period as its fundamental characteristic. Within one limited sector of contemporary United States' society--the public programs of the Federal government--we have witnessed multiple instances of programs initiated, modified, and/or abandoned within relatively brief periods.

Some examples of shifting programs come to mind. For instance, the anti-poverty efforts initiated by the Office of Economic Opportunity in the 1960's led to changes so controversial that the 1970's have seen individual programs either terminated or transferred to other, more conservative organizations. At another level, the U. S. Post Office Department experienced in the 1960's increasing difficulty delivering mail efficiently, even as it accumulated massive debts. In the belief that creating a semi-independent government corporation was the solution, Congress in 1970 established the United States Postal Service (USPS). Discovering this reorganization did little to improve mail service, Congress took steps to terminate U.S.P.S. in 1978.

On the other hand, we see government programs so inordinately stable in the face of altered circumstances and expectations that we question the appropriateness and aptness of their established modes of

operation. The Veterans Administration (VA), for example, has been sharply criticized for its unwillingness to change to meet the needs of the Viet Nam veteran. VA programs relating to housing, education and hospitalization seem geared to the needs of veterans from different wars. In another instance, an obviously self-contradictory and, in the view of some observers, inappropriate program is the Department of Agriculture's action of subsidizing tobacco farmers in spite of mounting evidence linking smoking and lung cancer as well as the Department of Health, Education and Welfare's increasingly vigorous anti-smoking campaigns.

One example of a federally initiated program--the electric utility aspect of the Tennessee Valley Authority (TVA)--is the subject of the study which follows. TVA's modification of its use of power resources illustrates program changes over time. Founded in 1933, during its early years TVA relied almost exclusively on the flow of the Tennessee River for the production of electricity, but increased demand following World War II necessitated the use of other resources. Because it was located in the midst of large coal deposits, coal-fueled steam generating plants were the logical means for expanding the production of electric power. Between the end of World War II and the mid 1960's, several plants of this type were constructed. By 1965 they supplied 77.50 percent of TVA's generating capacity, making the authority the largest single consumer of coal in the U. S. In 1966 the TVA Board of Directors approved a recommendation to construct a nuclear power generating facility, thus initiating dramatic changes in the

agency's power program. By the mid 1970's, TVA had the world's largest nuclear power operation, with seventeen nuclear units either constructed or in some stage of development. When completed in 1985, the plants will have a generating capacity of 21,636,960 Kws., about half of all power generated by TVA and more than the capacity from all sources in 1965. This massive movement into nuclear power operations came at a time when serious questions about the technology were being raised with increasing frequency and intensity, and when private utilities and others were becoming more and more pessimistic about the nuclear solution to power needs.

As the result of these and other widely publicized instances, a major and common criticism of government today is that programs and the agencies which carry them out do not adapt well enough to changing needs and circumstances. "Good policy" at times is seemingly compromised by programs which are misconceived or which, over time, lose their suitability for the ends supposedly being sought. The sense of failure at the program level finds expression in many ways, in the politics which now surround environmental, health, safety, and economic regulation, in reform concepts such as sunset laws, zero-based budgeting and, once again, reorganization of the national administrative structure, and in the general anti-bureaucratic mood to be observed across the country.

These responses reflect the emotionalism which grows out of the lack of objective analytical tools by which to judge the dynamics of government programs as reflected in their development over time. The

central problem with which this study is concerned is the analysis of such dynamics: what are the roots of stability; what are the factors impelling change?

Examination of the literature indicates that the dynamics of government programs have not been thoroughly studied because of limited analytic and conceptual resources for such study as well as a paucity of frameworks for the examination of program development. Admittedly, the adoption of new technologies by organizations has received some attention, particularly in Jerald Hage and Michael Aiken's study which focuses on the intra-organizational determinants of the decision to adopt a new technology.[1] In addition, budgetary studies have been undertaken which use numbers of dollars expended as the basis for examining the size of a program. Although many of these studies focus at the organizational level, at least one has focused at the program level.[2]

The following study does not pretend to resolve all the dilemmas present in a study of program development. Rather, it aims to contribute to developing analytical resources by more precise conceptualization of the phenomenon of program change and to formulating a general framework and derivative propositions for the study of program development. The basis for this enterprise is the case summarized

---

[1]Jerald Hage and Michael Aiken, Social Change in Complex Organizations (New York: Random House, 1970).

[2]Peter B. Natchez and Irvin C. Bupp, "Policy and Priority in the Budgetary Process," American Political Science Review, 67 (September, 1973), pp. 951-63.

above: the power program of the Tennessee Valley Authority. Before the specific situation can be examined and analyzed, however, a theoretical and conceptual foundation must be laid. The remainder of this chapter is devoted to that task.

ON PROGRAMS AND PROGRAM DEVELOPMENT

Although the term "program" is familiar in discussions of government, it lacks precise, commonly accepted definition. In this, it is similar to the term "policy," a phenomenon currently the object of much analytical attention. Clearly, as used by political scientists, the terms are closely related in meaning. From the perspective of the discipline, the significance of encouraging research into the dynamics of programs lies in political scientists' increasing interest in the policy aspect of the political process.

John Grumm describes this shift in emphasis as follows:

> The study of the political process in contemporary political science has essentially meant the study of how policies are made. Recognition that the process does not necessarily stop with the policy decision has only recently begun to take hold, and new questions are being asked, such as: "What happens after the policy is made?" "Does it make any difference in the lives of people, in the environment, in the distribution of values, in the social system, or in the function of the political process itself?" In Lasswellian terms, political scientists are beginning to concentrate more on "Who gets what?" whereas in the past their interest was only with "When?" and "How?"[3]

---

[3]John G. Grumm, "The Analysis of Policy Impact," Policies and Policymaking - Handbook of Political Science, Vol. XI, ed. by Fred I. Greenstein and Nelson W. Polsby (Reading Massachusetts: Addison-Wesley Publishing Company, 1975), p. 439.

Essentially, analyzing "what happens after the policy is made" forces one to the level of government programs.

Consideration of the concept of program must begin, therefore, with consideration of the concept of policy. Policy is typically defined by political scientists in one of two basic ways.

1. Policy is viewed in a broad, holistic fashion in recognition of the multiple permutations of meaning that the term brings to mind. Helco's statement that "policy is a course of action intended to accomplish some end"[4] is an example. This definition, however, is so broad that it masks the wide variety of phenomena that are associated with policy.
2. The concept of policy is broken down into different aspects. Most helpful is the work of Charles O. Jones, who considers policy to be "the 'behavioral consistency and repetitiveness' associated with efforts in and through government to resolve problems."[5]

Jones identifies and defines five aspects of policy.

Goals: the desired ends to be achieved.
Plans or Proposals: specified means for achieving the goals.
Programs: authorized means for achieving goals.
Decisions: specific actions taken to set goals, develop plans, implement and evaluate programs.
Effects: the measurable impacts of programs (intended and unintended; primary and secondary).[6]

---

[4]H. Hugh Helco, "Review Article: Policy Analysis," British Journal of Political Science, 2 (January, 1972), p. 84.

[5]Charles O. Jones, An Introduction to the Study of Public Policy, 2d ed. (North Scituate, Massachusetts: Duxbury Press), p. 5.

[6]Ibid., p. 4.

Four of these phenomena: goals, planning, decision-making and effects (impacts), are the topic of an identifiable body of literature. Programs, however, as a distinct analytical phenomenon have, for the most part, been ignored.

Programs, as the instrumental aspects of policy, constitute the means through which policy is reflected in what government does and are the action components of policy. A program may be defined as: one of a concert of related, authorized, prescribed, and purposive activities of government, usually linked organizationally, which have the intended objective of contributing to the realization of goals established in policy.

The federal government's recent relationships with elementary and secondary public schools can be used as an example of the distinction between policy and program.[7] The Elementary and Secondary Education Act (ESEA) of 1965, breaking the long tradition that prohibited the federal government from taking action in this area, dealt with five distinct aspects of elementary and secondary education. One of these, covered by the so-called Title I provisions of the Act, concerned compensatory education for children from low income families. Based on the assumption that children from low income families could be broken out of the poverty cycle if given a quality education, the policy goal was to

---

[7]This discussion is based on Jerome T. Murphy, "The Education Bureaucracies Implement Novel Policy: The Politics of Title I of ESEA, 1965-72," in Allan P. Sindler, ed., Policy and Politics in America (Boston: Little, Brown, and Company, 1973), pp. 160-98, and James E. Anderson, David W. Brady, and Charles Bullock, III, Public Policy and Politics in America (North Scituate, Massachusetts: Duxbury Press, 1978), pp. 278-84.

raise the quality of life these children would experience as adults. To achieve this policy goal, the Act assigned two powers to the U. S. Office of Education (USOE): categoric grant-in-aid and audit of enforcement. USOE was provided almost a billion dollars for the grant-in-aid part of the program's first year, and was instructed to distribute the funds to states according to a formula based on state and local per-pupil expenditures and number of students from low income families. Audit enforcement permitted the USOE to examine the records of local school districts to ensure Title I funds were actually spent on children from low income families.

In terms of Jones' five analytical aspects of policy:

Goals: to break children from low income families out of the poverty cycle and, thus, allow them to attain a higher quality of life than their parents had achieved.

Plans or Proposals: to distribute funds to states in such a way that the more students in the state from low income families, the more money the state would receive.

Programs: to distribute funds through categoric grants-in-aid and to enforce through auditing.

Decisions: to establish the goal, plan, and program primarily in Congress and in the executive branch.

Effects: the improvement that actually occurred in these children's education and their eventual quality of life.

The attempt by the state of Vermont to control water pollution is another example of the difference between policy and program.[8] In

---

[8]This discussion is based on Lettie McSpadden Wenner, "Pollution Control: Implementation Alternatives," Policy Analysis, 4 (Winter, 1978), pp. 47-65.

1970, the Vermont state legislature passed legislation giving to the Vermont Water Resources Board (VWRB) authority to levy fines on polluters who exceeded allowable levels of pollution. This technique, generally called "user charges," is based on the assumption that the fines will serve as an incentive to polluters to control their pollution. The policy goal was to reduce the level of water pollution in Vermont to its lowest possible level, giving some deference, however, to the economic ramifications of its actions. The policy plan was to accomplish this goal by fining polluters at a high enough level that it would encourage them to treat their effluent discharges.

The program was to consist of two distinct components: 1) setting of rates for fines; 2) imposition and collection of fines. Soon after the law was passed, conflict over rates erupted. The proposal that received most attention called for fines equal to what it would cost the polluter to treat excess waste. However, after a year of debate involving the VWRB, state legislators, the state attorney-general, and representatives of industry, the program as established empowered VWRB to impose fines only after proving the polluter was not acting in good faith in trying to control his effluent discharge. To date, VWRB has not imposed a single fine. The policy decision was the 1972 amendment to the original 1970 Act. The policy effect has been the change that has occurred in the level of water pollution in Vermont, in this case, totally inadequate because of the amended policy program chosen to accomplish the policy goal. Again, the policy program is analytically distinguishable from both the policy and other policy aspects.

The relationship between programs and the policies they reflect is an extremely complex one. On the simplest level, a specific program is chosen because those making the policy decision perceive it to be the most likely program to accomplish the policy goal. In Vermont's attempt to lower water pollution levels, the technique of "user charges" was originally chosen by the Vermont legislature because it was considered the most effective manner in which water pollution could be reduced. The potential second-order effects of the program, however, served to weaken it to a point where it became almost totally ineffective.

Further, programs and policies may not relate on a simple one to one level. A single policy may have several programs, or a single program may be intended to serve several policy goals. In the example above concerning Title I of ESEA, USOE's categorical grant-in-aid and enforcement program was but one of dozens of programs begun in the 1960's to aid children from low income families. Head-start, Neighborhood Youth Corps (NYC), and the Job Corps are but a few examples of programs with a similar policy goal of breaking the poverty cycle and improving the quality of life its clients would experience as adults. An example of a single program with multiple policy goals is the U. S. Department of Energy's breeder-reactor program. Although the program's future is presently unclear, in its present form it has two distinct policy goals: 1) to help the United States attain energy self-sufficiency and 2) to help relieve the nation of the pollution that results from the use of fossil fuels.

Making a simple distinction between policy goals and policy programs obviously masks the great complexity presented by the hierarchy of goals and means (programs) involved in government enterprise. What may be considered a program matter when viewed from one perspective may be seen as a goal matter when viewed from another. For example, within the Department of Agriculture one can identify several distinct types of programs: research and education programs, regulatory programs, credit programs, soil conservation programs, marketing assistance programs, farm security programs, and price support programs.[9] These programs are the means used by the Department of Agriculture to accomplish its general policy goal of enhancing agricultural production in the United States as well as the quality of life enjoyed by American farmers. In addition, each of these programs has its own policy goals and programs. For example, the Rural Electrification Administration, the Farm Credit Administration, and the Farmers Home Administration, all credit agencies within the Department of Agriculture,[10] have formulated their own policy goals and have established several programs designed to accomplish these goals. The process of formulating these goals, when viewed from the perspective of the Department of Agriculture, is a program-related activity, but when viewed from the perspective of the individual agency, is a goal-related activity.

---

[9]Anderson, Brady and Bullock, Public Policy and Politics in America, pp. 373-84.

[10]Ibid., pp. 373-4.

Thus, because conducting government affairs involves multiple levels of goal setting and program activity, neat and comprehensive distinctions cannot be drawn. In the study of programs, then, it is important to keep in mind and to specify the level of goal and program on which interest is focused.

For that reason, programs are complex phenomena, and the manner in which programs change is also extremely complex. Programs may be relatively stable over time, or they may change in important respects. Selecting the features of programs on which to focus while examining program development is not an easy matter. Observation reveals three important variable characteristics of programs upon which analysis can focus: size, scope, and technology.

1. Program size is the simplest of the three to define, identify and observe. Programs may become larger or smaller in the amount of financial and human resources they command and in the work they do. Change in program size can be measured by charting the numbers of people employed, and the numbers of dollars expended, the work load, and the quantity of outputs.

   Schulman, for example, has documented the changing size of financial and human resources devoted to the U. S. space program. During the period from the early 1960's to 1972, this program experienced dramatic changes in the size of its expenditures and the number of personnel it employed. NASA expenditures increased from less than a

billion dollars in 1961 to $5.2 billion in 1965. By 1973, however, this figure had declined to $2.8 billion. The change in the number of people employed in the space program was no less dramatic. From a base of less than 50,000 people in 1960, the program employed 420,000 in 1965. By 1972, however, this figure had dropped to 108,000.[11]

2. Program scope may be defined as the variety of activities or means employed in the pursuit of policy goals. The dynamics of program scope may be conceptualized as movement in the mix so as to narrow or broaden the range of activities or means associated with a program. For example, during much of the 1950's and the early 1960's the Department of Agriculture was confronted with large quantities of surplus food it was forced to buy under agricultural price support laws.[12] The Department's program for dealing with this surplus consisted of several different means, the principal one being storage. By the late 1950's, cost for the storage of surplus food reached almost a billion dollars a year, and had become an issue in Congress.

---

[11]Paul R. Schulman, "Nonincremental Policy Making: Notes Toward an Alternative Paradigm," American Political Science Review, 69 (December, 1975), pp. 1354-70.

[12]This discussion is based on Anderson, Brady, and Bullock, Public Policy and Politics in America, pp. 384-7.

under the Kennedy administration, the scope of program activities was expanded to include the Food for Peace program. With this increase in program scope, surplus food, in addition to being stored, could now be sold on credit to foreign countries or provided free if specific emergency conditions existed.

Program scope is susceptible to decreases as well as increases. For example, the United States Army, Navy, and Air Force all experienced decreases in their program scope with the establishment of NASA. The new space agency took from the three major branches of the service the means they had developed with which to explore space and use it to help them accomplish their policy goals.

3. Program technology has to do with the character of the activities or means employed, or the particular features of the "transformation process . . . where mechanical and intellectual energies are brought to bear in the efficient utilization of scarce resources."[13] Technology may refer to physical devices in the transformation process such as computers. It may also refer to modes of human interaction in those processes. That is, to the way people interact with other people and/or physical devices.

Changes in both types of program technology are common

---

[13]Richard M. Steers, Organization Effectiveness: A Behavioral View (Santa Monica, California: Goodyear Publishing Company, 1977), p. 70.

features in 20th Century America. These changes may occur as one technology is substituted for another, an old technology is deleted from a program without replacement, or a new technology is added to a program while an old technology is maintained. Probably the single most prominent change in program technology that has ever occurred was the establishment of the first Ford assembly line. Ford's replacement of the "one at a time" technology of automobile construction with the assembly line, although it involved change in physical components, was primarily a change in interaction patterns among workers. The uncertainty that characterizes human interaction in the work place was replaced with the certainty of the relationship between a human being and a constant-speed conveyor belt.

An example of the addition of a new physical technology is the addition of rail rapid transit to the San Francisco rapid transit program. Although the adoption of this new technology was accompanied by its own administrative apparatus, the Bay Area Rapid Transit District, when viewed from a transportation perspective, the addition of rail technology to bus technology was a distinct expansion of the rapid transit program's technology.

Program development over time, then, may be described in terms of the dynamics or the stability and change in program size, scope, and technology. Furthermore, changes in each of the three program

characteristics may be described in terms of their pace and magnitude.

1. Pace of change refers to the rapidity with which alterations in size, scope, and technology take place. Pace can vary from no change, or extremely slow change, to rapid change, as the following continuum suggests.[14]

Pace

none/slow ——————————— rapid

The three components of any program measured in any given time period may fall at any point along this continuum. That is, program size, scope, and technology may each change at a pace someplace between "not at all" and "very rapid." A program's size, for example, may increase rapidly while its technology and scope do not change at all. Medicare and Medicaid provide an all-too-common example of this process. Designed to help the aged and poor purchase medical care, the program's scope and technology have changed little. The size of the program expenditures has changed rapidly, however, from $2 billion in fiscal year 1967 to over $30 billion in fiscal year 1977.

2. Magnitude of change refers to increments of change in program size, scope, and technology. Changes may occur rapidly, but individually and collectively they may not amount to much. Or they may occur slowly but result in

---

[14]The following two continua make no assumption about direction of change. That is, the concern is pace and magnitude of change regardless of whether that change is an increase or decrease in the program's size, scope, or technology.

fundamental alterations in program characteristics. It is important not only to ask how quickly the changes in a program development process have come, but also about how much change there has been. It is the latter question which the concept of increment addresses. As in the case of pace of change, the possibilities regarding changes in magnitude can be suggested by a continuum, with no change or extremely limited increments of change at one extreme and extensive increments of change at the other.

Magnitude

none/limited ———————————— extensive

As with pace of change, each of the three components of programs may fall anywhere along the continuum, and the position of the three components may differ for the same program. The Medicare and Medicaid example above is also very relevant in a discussion of magnitude of change. Despite the limited change in the programs' scope and technology, the increments of change each fiscal year since 1966/1967 have been extensive, averaging about $3 billion a year.

As was noted above, the size, scope, and technology of a single program may each change at a different pace and magnitude. Therefore, use of the phrase "program change" implies these individual aspects have somehow been aggregated together. The exact manner in which these three aspects relate to each other to form a program is of

important theoretical significance. Although the attaining of a mature theory of program development will require such problems be overcome, the lack of prior conceptualization and focus on the program phenomenon limits the extent of the present undertaking to a level below such theoretical problems. Therefore, the case part of this study will present change in program size, scope, and technology separately.

The first step in the analysis of program development is to describe the essential character of change. This can be done by placing a program in one of four categories, as in Figure 1.1, based upon the pace and magnitude of change in essential program features. They are: none or slow pace/limited magnitude (Quadrant I), none or slow pace/extensive magnitude (Quadrant II), rapid pace/none or limited magnitude (Quadrant III), and rapid pace/extensive magnitude (Quadrant IV). Although from a theoretical perspective, it would be advantageous to place programs at finer gradations on the continua, precise positioning would require other cases as reference points. The dearth of studies on program change, however, deprives us of these reference points.

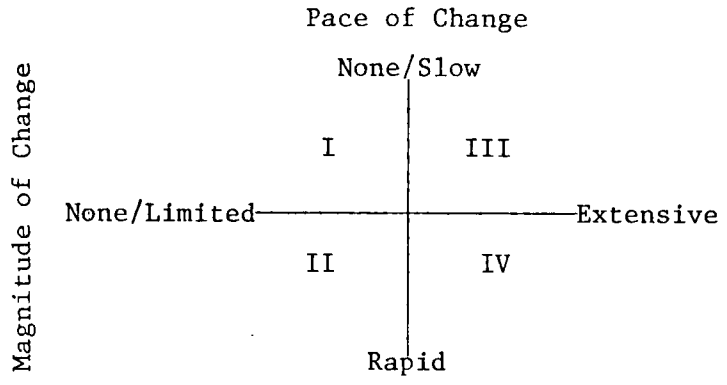


Figure I.1
Types of Program Change

But describing change through such placement must be followed by further analysis aimed at explaining why a particular program has developed as it has, or in comparison, why programs develop in different ways. As has been said, the purpose of this study is to develop a general framework and specific hypotheses to serve that analytical purpose. But it would be appropriate at this point to set out those theoretical perspectives which seem most appropriate to the task and which will be employed in the study of the development of TVA's power program, the empirical base on which the framework will be constructed.

PERSPECTIVES FOR EXPLAINING PROGRAM DEVELOPMENT

There are two general perspectives which seem to be plausible prospects as foundations for explaining program development. For convenience's sake, they may be designated as the closed-system perspective and the open-system perspective. The critical distinction between the two is in the assumption they make about the sources of stability and change. The closed-system perspective assumes that these sources are to be found within the organization carrying out the program. In this analytical perspective emphasis would be placed on variables internal to the organization, especially those associated with decision-making processes. The open-system perspective, on the other hand, assumes the impetus for change in a program occurs, at least in part, in the program environment. Therefore, program change is perceived as a result of organizational reaction to changes in the environment. The remainder of this section will set up the concepts necessary when

applying both of these perspectives to the process of program development.

A Closed-System Perspective

The most useful variant of the closed-system perspective for the analysis of program development would seem to be that body of decision-making theory known as incrementalism. Indeed, given the absence of explicit attention to the phenomenon of program development, the incremental model of decision and change is probably that to which most analysts would reach instinctively for treatment of program change. Furthermore, its assumption of essential stability and limited change are compatible with the stereotype of government programs as ordinarily stable and resistant to change.

Charles Linblom's seminal piece describing the incremental model, "The Science of Muddling Through,"[15] was published in 1959. Since that time, incrementalism has become one of the most widely used notions in the social sciences. In fact, it has been used to describe and explain so many things that some scholars believe it is in danger of losing "its value as an analytical device."[16]

James E. Anderson succinctly states the manner in which the term incrementalism is most often used:

---

[15]Charles E. Lindblom, "The Science of Muddling Through," Public Administration Review, 19 (Spring, 1959), pp. 79-88.

[16]James E. Anderson, Public Policy-Making (New York: Praeger Publishers, 1975), p. 95.

> The term is used . . . to designate a decision-making process that is characterized by limited analysis (incremental decision-making process) and that yields decisions differing only marginally from previous decisions (incremental level change).[17]

Although the incremental model focuses on both the decision-making process and the change that it produces, these two dimensions can be separated for purposes of description.

Incremental change is analogous to small change. However, as Braybrooke and Lindblom note, the designation of change as large or small is a value judgement.[18] Therefore, if change is to be distinguished as more or less incremental or non-incremental it must be done relative to a stated criterion. The most frequently used criterion is the base. Wildavsky describes the concept of base as it is used in the budgeting literature as follows:

> The base is the general expectation among the participants that programs will be carried on at close to the going level of expenditures but it does not necessarily include all activities. Having a project included in the agency's base thus means more than just getting it in the budget for a particular year. It means establishing the expectation that the expenditure will continue, that it is accepted as part of what will be done, therefore, that it will not normally be subjected to intensive scrutiny.[19]

The notion of a base, however, has applicability beyond budgets. Wanat, although concerned with budgets, addresses the concept of a base in more general terms:

---

[17]Ibid., p. 93.

[18]David Braybrooke and Charles Lindblom, A Strategy of Decision (New York: The Free Press, 1963), p. 62-3.

[19]Aaron Wildavsky, The Politics of the Budgetary Process, 2d ed. (Boston: Little, Brown and Company, 1974), p. 17.

> Whenever incrementalism is being discussed two concepts must be elaborated: the status quo or base and increment or marginal adjustment. Logically, to speak of incremental decision making there must first be some antecedent condition, the present, fixed, or stable point, and second, a new condition or status that is only slightly different from the initial situation as a result of the decision. Thus, the base is the starting point and the increment is the change from that condition.[20]

Incrementalism also presents a second yet similar manner of focusing on change. Generally labeled means-end adaption, it involves the continuous adaption of means to ends and ends to means. That is, change occurs as a continuous process of adaption with emphasis on aligning means and ends to each other. Thus, when organizational means are changed, the end is changed to bring it more in line with the means. This is followed by a change in means to bring it more in line with the new end.

In examining program change through the incremental perspective, either as increments to a base or the adaption of means and ends, one focuses on the differences in a program from one time period to the next. The magnitude of change is measured in proportion to what existed prior to the change.

Incrementalism asserts that the size of the change, that is, its magnitude, will be limited during any one time period. Although no distinct assumption is made about the pace of change, the emphasis placed on repeated-limited change suggests a process of slow development. However, as Braybrooke and Lindblom suggest, repeated

---

[20] John Wanat, Introduction to Budgeting (North Scituate, Massachusetts: Duxbury Press, 1978), p. 116.

small change can result in large change.[21] Therefore, incrementalism suggests a type of program change analogous to Types I and II on page 18. That is, program change occurs slowly and results in either a limited or extensive change. From the standpoint of the analysis of program development, the question is, does it?

The reason that program change occurs at a slow pace, according to the incremental perspective, is the decision-making process that produces that change. When used to describe the decision-making process, the term "incrementalism" refers to a very limited gathering of information and a very limited amount of analysis. The level of information and analysis utilized in the decision-making process is very limited because of the limitations of time, mental capacity, and the resources available to decision-makers. Because of these limitations, the decision-maker restricts his focus to those alternatives that "differ in a relatively small degree from policies presently in effect."[22] Thus, according to the incremental perspective, extensive change from the status-quo is not even considered by decision-makers. The output of this process is necessarily a change of Type I, or eventually, Type II.

---

[21]Brabrooke and Lindblom, A Strategy of Decision, pp. 64-5.

[22]Lindblom, "The Science of Muddling Through," p. 84.

An Open-System Perspective

Organizations receive resources from and supply services to entities outside their boundaries. Therefore, it does not seem feasible to assume, as a closed-system perspective does, that the major sources of program stability and change are to be found only within the boundaries of the organization. The open-system perspective assumes that program change is caused by a combination of internal dynamics and external forces impinging upon the organization whose program is in question. Although the change may flow from conscious decisions on the part of the organization, that decision is, at least in part, a reaction to changes external to the organization.

The open-system perspective suggests four distinct sets of phenomena as being particularly relevant to program change: 1) the forces in the organization's environment to which the decision-makers react; 2) the organization's decision-making process, because program changes flow from the decisions made by the organization; 3) the autonomy of the organization, or the capacity of the organization to resist or ignore environmental forces; 4) the organizational goals that the decision-makers seek to maximize.

1. Organizational Environment. The central difference between the closed- and open-system perspective is the importance

assigned the environment as a source of stability and change. Although the open-system perspective recognizes the role of intra-organizational forces in program change, the principal impetus is considered to be outside the organization's boundary.

The literature on organizational environments generally conceives of the environment as a condition or state within which the organization must function. For example, Steers notes the concept

> external environment refers to those forces that arise outside an organization's boundaries that affect internal organizational decisions and actions (for example, economic and market conditions, government regulations). The influence of such environmental factors on organizational dynamics is generally believed to consist of the following: (1) the relative degree of environmental stability; (2) the degree of environmental complexity; and (3) the degree of environmental uncertainty.[23]

Most commonly, the environmental forces of stability and complexity are conceptualized as continua. Duncan, for example, notes that the environment can vary along dimensions of simple-complex and static-dynamic. The elements that determine the level of complexity of an environment are the number of important components in it, and the degree to which these components are different from one another. The static-dynamic dimension of the environment relates to the level of stability in the environment, and especially in the established relationships between the focal organization and its environment. Duncan notes that as the organization's environment varies along these two

---

[23]Richard M. Steers, Organizational Effectiveness: A Behavioral View (Santa Monica, California: Goodyear Publishing Company, Inc., 1977), p. 9.

dimensions, the level of environmental uncertainty also varies. That is, as environmental complexity and/or instability increases, the level of uncertainty also increases.[24]

Several other authors focus on the same environmental forces, but use different terms to describe them. Thompson, for example, identifies the environment as existing along continua labeled homogeneous-heterogeneous and stable-shifting.[25] Lawrence and Lorsch use a very similar scheme in their discussion of "diverse" and "dynamic" environments in the plastics industry.[26] Because the terms seem more descriptive of the phenomena under consideration, Duncan's simple-complex and static-dynamic will be used here. Also, following the precedent of Thompson,[27] these terms will be considered dichotomizations rather than continua. The level of complexity in the environment will be identified as simple or complex, and the rate of change will be identified as static or dynamic. Thus, the environment will be perceived as simple/static, simple/dynamic, complex/static, or complex/dynamic. Further, the level of environmental uncertainty is considered to be directly proportional to the level of environmental change and complexity.

---

[24]Robert B. Duncan, "Characteristics of Organizational Environments and Perceived Environmental Uncertainty," Administrative Sciences Quarterly, 17 (September, 1972), pp. 313-27.

[25]James D. Thompson, Organizations in Action (New York: McGraw-Hill Book Company, 1967), pp. 70-2.

[26]Paul R. Lawrence and Jay W. Lorsch, "Differentiation and Integration in Complex Organization," Administrative Sciences Quarterly, 12 (June, 1967), pp. 1-47.

[27]Thompson, Organizations in Action, pp. 72-3.

Change in the level of these environmental forces of change, complexity, and uncertainty are the environmental stimuli for program change. Programs, more than any other aspect of policy, because they are the means and activity by which public policies are carried out, are the instrument through which the organization interacts with the environment. Therefore, environmental change can affect programs more than the other policy aspects. A change in the level of environmental variables that affects the organization is probably most effectively responded to by a change in the program. Further, one would suspect the more dynamic, complex, or uncertain the environment becomes, the more rapid and extensive program change would become. That is, organizational environments that are complex/dynamic, and thus highly uncertain, are associated with Type IV change. If the environment is in a less uncertain state such as simple/dynamic or complex/static, one would assume the organization would implement less extensive change but do so at a rapid pace, that is Type III, to maintain some certainty in the environment.

The ability of the organization to respond to environmental change, however, is predicated upon its perceiving that change. Therefore, the extent to which the organization's decision-making process attempts to discover environmental change is an important variable in the explanation of program change. This exemplifies a second difference between the closed- and open-system perspectives. Although the closed-system perspective assumes the organization will examine only those alternatives that will lead to states marginally different from

the status quo, the open-system perspective is more sensitive to the importance of the variance in the phenomena and asks how comprehensive is the decision-making process?

2. Organization's decision-making process. The most essential characteristic of the decision-making process for affecting program change is its level of comprehensiveness. A comprehensive search for and analysis of information enhances the probability decision-makers will perceive areas in which program change is necessary. A decision-making process characterized by information gathering that emphasizes the importance of the status quo, as the closed-system perspective depicts the process, is unlikely to reveal the need for any level of program change beyond Type I or Type II. A comprehensive and aggressive search for information that accurately depicts conditions in the organization's environment could reveal the need for Type III or Type IV change.

In addition to perceiving the need for program change, however, the organization must be capable of implementing that change. That is, when environmental change occurs, assuming it is perceived by the organization, the organization must have the necessary discretion to respond to that change. The third aspect of the open-system perspective concerns this phenomenon.

3. Organizational autonomy. Autonomy, as the term is used here, concerns the level of discretion exercised by the organiztion over its own behavior. This concept differs from the others in the open-system perspective in one important manner: it is less a

stimulus for change and more a necessary precondition. The exercise of this autonomy has two prerequisites for the organization: control over its principal resources[28] and legitimacy.[29] An understanding of the level of control an organization exercises over its principal resources seems especially important for understanding program change. Indeed, Thompson has identified organization desire to control these resources as a major reason for organizational growth.[30]

If an organization desires to increase the size of its present program, expand its scope, or add a new technology, it generally must do so at the expense of other organizations. Even if the program is a new service or product and does not involve taking over another organization's function, there will generally be competition from other organizations to provide the service or product. Thus, program change will generate opposition from organizations in the focal organization's environment. These organizations will attempt to inhibit the change by imposing constraints on the organization and, thus, limit its autonomy. This can be done by either gaining control over its essential resources or undermining its legitimacy.

On the other hand, if the organization controls its necessary

---

[28]For a discussion of this point, see Jeffrey Pfeffer and Gerald Salancik, The External Control of Organizations, (New York: Harper and Row, Publishers, 1978), pp. 94-106.

[29]Legitimacy, as the term is used here, refers to the recognized right of the organization to operate a program. The basic source of legitimacy for all federal government agencies is Congress and their enabling legislation.

[30]Thompson, Organizations in Action, p. 44.

resources and its actions are perceived as legitimate by those who have the ability to inhibit the program change, little can be done to prevent the change regardless of which type it is. Indeed, the major restraint on the occurrence of continuous Type IV change, under the condition of high autonomy, is the organization's need to limit its program change to prevent undermining of its legitimacy. That is, as program change increases in pace and magnitude, the level of opposition to the change will increase. Eventually this opposition could become powerful enough to threaten the legitimacy of the organization as well as the change.

Program change, regardless of its type, does not occur randomly. That is, programs do not change at every possible opportunity simply for the sake of changing. Before any type of program change is implemented by the organization, the change must be judged for its benefit or detriment to the organization. The criterion upon which this judgment is based, according to the open-system perspective, is the organization's goal.

4. Organizational goal. The literature of organizational goals is the most perplexing of all the areas of organizational theory. This is reflected in the wide ranging definitions of the phenomenon and the extremely varying consequences that goals can have on organizations.

The main difficulty that researchers face in trying to define

the concept of organizational goal is that many organizations have several goals. Indeed, some scholars have identified as many as five goals simultaneously existing within an organization. Perrow, for example, identifies societal, output, system, product, and derived goals.[31] However, the more common scheme that distinguishes only two types of goals will be used here. Mohr, among others, distinguishes internal goals, which he labels reflexive, from external goals, which he labels transitive. It is the internal goal of an organization

> that inducements will be sufficient to evoke adequate contributions from all members of the organizational coalitions. The term 'adequate' in this context can only mean adequate for survival.[32]

Thus, the internal goal of the organization is organizational maintenance. An external goal, according to Mohr, is "an intended impact of the organization upon its environment."[33] Thus, it is asserted, organizations strive to simultaneously affect their environments and to survive.

There are many ways, however, in which an organization can affect its environment and still ensure its survival. External goals, because they are often established outside the organization by legislatures or some other type of governing body, must be interpreted by organizational members. The dominant interpretation of the organization's

---

[31]Charles Perrow, Organizational Analysis: A Sociological View (Belmont, California: Brooks/Cole Publishing Company, 1970), p. 135.

[32]Lawrence B. Mohr, "The Concept of Organizational Goal," American Political Science Review, 67 (June, 1973), p. 476.

[33]Ibid.

goal is often labeled the organization's mission. Halperin refers to this concept of mission as "organizational essence," which he defines as "the view held by the dominant group in the organization of what the missions and capabilities should be."[34]

The ability to define the organization's mission is important because of its consequences for the organization. The mission determines "what kind of people with what expertise, experience, and knowledge should be members of the organization."[35] Thus, once the mission is defined, people are brought into the organization under its aegis. Their justification for existence in the organization is thus related to that mission, and such recruits would be inclined to subscribe to it.

According to the closed-system perspective, organizations do not have well defined goals. That is, there is no dominant organizational mission. This condition is necessary if the process of means-end adaption is to occur. If the organization were dominated by a single mission, changing that mission to fit a means would be very difficult. Rather, subscribers to the mission would demand a change of means. Therefore, the establishment of a single mission in the organization prevents a process of means-end adaption from occurring. Thus, the possibility of Type III or Type IV change occurring is

---

[34]Morton H. Halperin, Bureaucratic Politics and Foreign Policy (Washington, D.C.: The Brookings Institution, 1974), p. 28.

[35]Ibid.

greatly enhanced as the organization continually implements program (means) change in an attempt to accomplish its mission.

This section has presented two perspectives that are potentially useful in explaining the process of program development. The first, assuming a closed-system, emphasizes specific intra-organizational dynamics. The second, assuming an open-system, emphasizes specific intra-organizational forces but also directs attention to the role of forces in the organization's environment. The next three chapters will examine the development of TVA's power program using as guides both of these perspectives.

Methodology

The core of this dissertation is a case study. Two definitions of case study are offered here to distinguish the nature of the phenomenon: 1) Hofferbert defines a case study as "an in-depth examination of a particular instance of something. This is in contrast to an aggregation of characteristics of many instances;"[36] 2) Babbie defines a case study as "a comprehensive description and explanation of the many components of a given social situation."[37] There are two aspects of both these definitions that characterize the present study and distinguish it from non-case studies. It is both comprehensive and focused on a single event. Although non-case studies may perform one of

---

[36]Richard I. Hofferbert, The Study of Public Policy (New York: The Bobbs-Merill Company, Inc., 1974), p. 89.

[37]Earl R. Babbie, Survey of Research Methods (Belmont, California: Wadsworth Publishing Company, Inc., 1973), p. 37.

these tasks, a true case study is characterized by the presence of both of these phenomena. The present study is comprehensive in that it examines all things believed to be of importance in the development of TVA's power program, and it focuses on that single phenomenon.

Since the behavioral revolution in the social sciences, no methodology has been the focus of such unrelenting criticism as the case study. The criticisms tend to focus on two things. "First, the case may incompletely perceive its object of study."[38] At the root of this criticism is the subjectiveness of the researcher in isolating the phenomenon he plans to study. This subjectiveness is an affront to the value-free premise of science. Indeed, as Isaak notes, "It is often said that to be scientific is to be objective, as opposed to subjective."[39] This criticism is valid in that there is no alternative to the subjective decisions of the researcher in distinguishing important from unimportant events. Yet is not the same subjectiveness found in all methodologies? Even the supposedly objective mathematical techniques used by many social scientists are subject to subjectivity in several ways. The choice of a specific mathematical technique and the manner in which variables are to be operationalized are both subjective decisions. Indeed, the choosing of a methodology with which to attack a problem is a subjective choice of the researcher, the appropriateness of which is not scientifically verifiable.

---

[38]Heclo, "Review Article: Policy Analysis," p. 96.

[39]Alan C. Isaak, Scope and Methods of Political Science (Homewood, Illinois: The Dorsey Press, 1975), p. 27.

The second common criticism of the case study method is that "its object of study may misrepresent the universe to which it has reference."[40] Thus, the study may lack external validity and cannot be used as a basis for generalization. This, however, does not appear to be a criticism of the case study method, but rather of case studies as they are generally done. Most such studies do not attempt to generalize their findings to a broader theoretical framework. Heclo puts the problem in its proper perspective as follows:

> It does seem necessary, however, to disabuse oneself of the idea that theory will grow naturally from a critical mass of cases. We have suggested that case studies of policy should be distinguished by their theoretical perspective, for without such perspective the study is at best an interesting contribution to historical scholarship and at worst an uninteresting episodic narrative. . . There appears to be nothing about the case study technique which is inherently nontheoretical or unscientific; the problem lies in assuming that theoretical contributions will emerge automatically from narrative.[41]

This dissertation does not make this assumption. Rather, the final two chapters will be devoted to contributing to a theory of program development.

The case study method was chosen for use in this study because of one important advantage. It provides the opportunity for the researcher to examine the phenomenon in much greater detail than any other methodological tool. The task undertaken in this work requires the identification of a series of components that could potentially

---

[40] Heclo, "Review Article: Policy Analysis," p. 96.

[41] Ibid., p. 93.

affect a program's development, and an understanding of the dynamic nature of the relationships involved. With this as the main criterion, two options were perceived to exist: an in-depth case study of a single program or a cursory review of several programs. However, examination of the finer elements and inner workings of a single organization, that the case study method availed, seemed potentially more rewarding. Also, the choice of a power program with a heavy nuclear contingent as an area of focus provides the opportunity to examine decisions made under various types of environmental pressures. Since TVA first became involved in nuclear power, the environment in which decisions have been made has changed from one of optimism and permissiveness to one of increasing uncertainty and hostility. In addition, by maintaining focus on a single organization, much that is important in a decision-making process, such as organizational structure, will remain constant.

TVA

Although the central concern of this study is program development, a second justification offered is the importance of the focal organization. Since its inception in 1933, TVA has continually been the center of much controversy. The agency has weathered disputes concerning such things as its right to exist, its role as a government corporation in a privately-oriented economy, and its use of strip-mined coal. Today, it finds itself in the midst of the nuclear power controversy. With seventeen units planned, under construction, or operating

at seven different sites in the Valley, it will soon be the largest producer of nuclear generated power in the country.

TVA, by working with its suppliers at both the development and construction stages, has played a major role in the development of nuclear technology. Also, the agency pioneered in the building of large scale nuclear units that could be used as the foundation of a power system. Until its large scale program got underway, nuclear generating units in the United States were restricted to performing a back-up function for larger fossil fuel plants. In addition, even when considered only as back-up units, the high cost of nuclear plant construction made the units economically feasible only in areas of high fossil fuel costs. TVA, however, brought nuclear power to an area of the country where coal, the cheapest of the fossil fuels, was found in abundance.

The importance of TVA was enhanced even further when President Carter designated the agency an "experimentor" for utilities in coping with the energy crisis. TVA's national significance justifies this study as contributing to our understanding of this unique federal agency.

ORGANIZATION

The remainder of this study is divided into five chapters. Chapter II examines the development of TVA's power program from its beginning until its decision to build its first nuclear power plant. Although this study emphasizes the nuclear power dimension, this

aspect of the program developed in the context of an already large and well established power program. Chapter III will examine development of the power program from 1966 until the early 1970's, when the agency enjoyed a simple/stable environment with a high level of certainty. Chapter IV examines the power program from the early 1970's through 1977 when dramatic changes in TVA's environment began to take place. Chapter V employs an analysis of the case to examine the appropriateness and utility of the closed- and open-system perspectives in explaining the development of TVA's power program. Chapter VI generalizes from the information gained in Chapter V from application of both these perspectives and presents a series of propositions concerning the reasons programs develop at varying paces and magnitudes.

CHAPTER II

THE POWER PROGRAM FROM BIRTH TO MATURITY

As the Tennessee River meanders through the wooded hill country of north Alabama, its temperament abruptly changes from tranquility to tumultuous furvor. In a 37-mile stretch known as Muscle Shoals, the river drops an astonishing 134 feet. The furious condition of the river created by this rapid drop was viewed, in the nineteenth century, as an impediment to navigation. In the early twentieth century, however, the rapidly flowing water was viewed as potential electrical power. In the Nineteenth Century, several attempts were made by the government to bring a measure of control to the Muscle Shoals section of the river. The most notable attempts were two canals, one constructed by the state of Alabama in 1839, and one by the United States in 1890.[1] These efforts, however, failed to make the river navigable. Only when American involvement in World War I seemed likely were significant steps taken to harness the river's resources. It is at this point that the history of the TVA and its power program begins. That history, at least down to 1966, most importantly concerns the forging of the agency's goals, policies and missions, and the development of programs reflective of them. The purpose of this chapter is to examine the nature and development of basic TVA goals and policies in relation to its power program, covering the period from 1916 to 1966, when TVA decided to build its first nuclear power plant.

---

[1]Marguerite Owen, The Tennessee Valley Authority (New York: Praeger Publishers, 1973), p. 6.

CREATION

One of the most interesting and significant features of TVA's legislative mandate is the vague and almost incidental treatment which is given to the production and supply of electrical power in the Valley. Indeed, many agency critics have contended since its beginning that the power program was expanded beyond the dimension intended by Congress. Understanding the power program as an extension of basic TVA goals and policies requires examination of the context in which they were formulated. This, in turn, requires examination of the origin and major features of the legislation which created TVA in 1933.

Europe was in a state of war in 1916 and despite the fact that the United States would not enter the clash until the following year, preparation for war was underway. The "preparedness legislation of 1916" had as one of its purposes increasing domestic production of nitrate, an essential ingredient of munitions as well as a base component of fertilizer, and authorized the executive branch to construct both a nitrate plant and a dam to supply it with electricity.[2] Muscle Shoals emerged as the logical site because of its potential for generating electricity and its location "in the great fertilizer-consuming area of the nation."[3]

Neither the nitrate plant nor the dam was finished in time to contribute to the war effort, the fertilizer plant being completed in

---

[2]Thomas A. McCraw, TVA and the Power Fight; 1933-1939 (New York: J. B. Lippencott Company, 1971), p. 1.

[3]Owen, The Tennessee Valley Authority, p. 5.

1919 and the dam six years later. A dispute over what to do with the plant and partially completed dam commenced shortly after the plant was constructed. The first bill to turn the properties over to some form of government corporation was introduced in 1919. Although the bill passed the Senate, it failed in the House.[4]

In the Senate, jurisdiction over the Muscle Shoals question was in the Committee on Agriculture. George W. Norris (R., Nebraska), member and eventually chairman of the committee, was champion of the cause of public control of both the dam and the dormant plant. He first introduced a bill to establish a government corporation to operate the facilities in 1921. Little support for Norris' measure materialized. Proposals for the private ownership of the Muscle Shoal's facilities were also made. The most dramatic of these was Henry Ford's. Ford "promised vaguely to build a city employing a million men, and institute a new Muscle Shoals currency based on the 'energy dollar.'"[5] The private ownership proposals, including Ford's, were initiated and rejected in the early and mid-1920's.

As the various proposals were rejected by Congress, Norris picked up support because of the high cost of maintaining the Muscle Shoals facilities and the continual pressure from the "farm bloc . . . that somebody, anybody, operate the nitrate plants for fertilizer."[6]

---

[4]Victor C. Hobday, Sparks at the Grassroots (Knoxville: The University of Tennessee Press, 1969), p. 6.

[5]McCraw, TVA and the Power Fight: 1933-1939, p. 19.

[6]Ibid., p. 21.

In 1928, the supporters of public power gained a majority vote in both houses of Congress. The bill, however, was pocket vetoed by President Coolidge, who gave no specific reason for his action. In 1931, Norris tried again. After gaining the approval of both houses of Congress for a second time, the bill was vetoed by President Hoover because of his disapproval of government competition with the private sector of the economy.

During the 1932 campaign for the Presidency, Franklin Roosevelt made known his willingness to sign a bill that would keep the Muscle Shoal's facilities under government control. After his election, the private power companies operating in the Valley lobbied Congress to prohibit the now imminent TVA from having the authority to construct and operate transmission lines from its dams. If denied this authority, the new agency would have to rely on the private power companies to distribute its electricity. The lobbying was fruitless, however, as President Roosevelt and Senator Norris, backed by the supporters he had so effectively cultivated over the 12 years prior to 1933, pushed the necessary legislation through Congress.[7]

The legislation that President Roosevelt signed was a victory for proponents of public ownership of the Muscle Shoal's facilities. It established a wholly government-owned corporation; on the theory that its activities would be much like those of a business firm, substantial independence of action and partial autonomy from political

---

[7]For analysis of the final vote, see Aaron Wildavsky, "TVA and Power Politics," American Political Science Review, 55 (September, 1961), pp. 577-9.

control were provided. The agency was to be headed by a three-person board of directors appointed by the President, with the advice and consent of the Senate, to nine-year overlapping terms. The President would designate one of the members to be chairman. It is through this appointment process that the President exercises the greater part of his formal authority over the agency. The legislature exercises its authority through the Senate's advice and consent during appointment of board members, House and Senate budget hearings, and by the traditional process of legislative oversight. No formal mechanisms are established in the Act to allow direct input into the agency by the governments of the states within which the TVA operates or by the residents of its service area. In addition to a measure of independence, the law imposed only a very broad and general set of goals, leaving policy direction and program emphases essentially undefined. The preamble to the Act charges the agency

> To improve the navigability and to provide for the flood control of the Tennessee River; to provide for reforestation and the proper use of marginal lands in the Tennessee Valley; to provide for the agricultural and industrial development of said valley; to provide for the national defense by the creation of a corporation for the operation of Government properties at and near Muscle Shoals in the State of Alabama, and for other purposes.[8]

Although electricity is not specifically mentioned in the preamble, Section 10 states that

> The board is hereby empowered and authorized to sell the surplus power not used in its operations, and for operation of locks and other works generated by it, to States, counties,

---

[8]U. S. Statutes at Large, 48 Stat. 58.

> municipalities, corporations, partnerships, or individuals, according to the policies hereinafter set forth; and to carry out said authority, the board is authorized to enter into contracts for such sale for a term not exceeding twenty years, and in the sale of such current by the board it shall give preference to States, counties, municipalities, and cooperative organizations of citizens or farmers, not organized or doing business for profit, but primarily for the purpose of supplying electricity to its own citizens or members.[9]

This diverse set of charges was interpreted by TVA officials to mean "unified resource development," a goal of high level TVA officials since its beginning. For example, in its first annual report, the agency's activities were described as follows:

> Surveys and studies are under way leading to a single unified plan for the development of the entire Tennessee River system for navigation, flood control, and power development. A single integrated plan for a river basin of more than 40,000 square miles will represent a new level of accomplishment, and will result in very great economies and prevention of waste as compared with separate uncoordinated developments.[10]

Despite this sense of the agency's general goal, TVA did not have a mission. That is, in 1933 there was no dominant point-of-view inside or outside of TVA that specified how the goal would be interpreted, and thus, how the agency would go about achieving "unified resource development."

This absence of a prescribed mission was apparently intended by both President Roosevelt and Congress. Roosevelt requested from Congress "a corporation clothed with the power of government but possessed of the flexibility and initiative of a private enterprise;"[11]

---

[9] Ibid.

[10] Annual Report of the Tennessee Valley Authority and Appendixes - for the Fiscal Year Ended June 30, 1934 (Washington, D.C.: United States Government Printing Office, 1935), p. 4.

[11] House Doc. 15, 73d Cong., 1st Sess. (1933).

the Senate-House Conference Committee that produced the final document stated, "We intend that the corporation shall have much of the elasticity of a private business corporation."[12]

Even after the first board of directors was chosen, little political direction was offered. As McCraw notes, the first board of directors sought Roosevelt's guidance:

> They all talked with Roosevelt during the summer of 1933, and received support and encouragement, but little specific direction. Operating outside the regular departments of the government, the board looked to the President as its immediate superior. Any twentieth-century president is, or should be, prodigiously busy, and Franklin Roosevelt, as the chairman of the TVA board put it, did little more than say, in effect, "Go to it." That was almost the extent of his instructions.[13]

So in the context of the "flexibility" and the "elasticity" provided by the law, the three directors were left to establish an organization, policies, and programs with, as Owen notes, "no traditions to guide them and precedents to follow."[14]

FORGING A POLICY

Given the vagueness of this statutory mandate, not surprisingly, the TVA in its early years was beset by conflict both within the agency itself and between it and its environment. Early conflict

---

[12] House Report No. 130, Operations of Muscle Shoals Properties, etc., 73rd Cong., 1st Sess., 1933.

[13] Thomas K. McCraw, Morgan vs. Lilienthal: The Feud within the TVA (Chicago, Loyola University Press, 1970), pp. 4-5.

[14] Owen, The Tennessee Valley Authority, p. 20.

within the agency rose within its board of directors. The board's first chairman was Arthur E. Morgan. At the time of his election by President Roosevelt, Morgan was president of Antioch College in Ohio. Morgan, by education and training, was a hydraulic engineer who had gained a national reputation for his work in designing a system of dams for the Miami Valley in Ohio.[15]

Upon choosing Morgan, the President gave him some discretion in designating his colleagues, although his first choice was rejected by Roosevelt for political reasons. His second choice was Harcourt A. Morgan. Of no relation to the chairman, Harcourt A. Morgan was also a college president. After a long career with the University of Tennessee in agricultural development, he became its president in 1919. He was well known throughout the south, especially in farming circles, and provided a local image for the board.[16]

The third member of the board, also chosen by Arthur Morgan, was David E. Lilienthal. This was a major step for the 33-year-old Lilienthal in what was to be a long and distinguished career in public service. At the recommendation of Justice Louis Brandeis, Morgan chose Lilienthal for his knowledge of public utilities law. A graduate of Harvard Law School, Lilienthal was a member of the Wisconsin Rail-Road Commission at the time of his appointment.[17]

---

[15]McCraw, Morgan vs. Lilienthal: The Feud within the TVA, pp. 6-11.

[16]For a brief discussion of Harcourt A. Morgan's background and service to the TVA, see James Rorty, "TVA's H.A. Morgan," Commonwealth, 48 (June 18, 1948), pp. 226-30.

[17]Lilienthal's activities throughout his life, are recounted in David E. Lilienthal, The Journals of David E. Lilienthal, Vols. 1-6 (New York: Harper and Row Publishers), 1964-1966.

One of the first official acts of the board was to divide power among the three members. At the recommendation of Harcourt Morgan, each board member was given responsibility for certain areas of TVA's programs, the division being made according to each member's areas of interest and expertise. Harcourt Morgan was given responsibility for the agricultural program,[18] Lilienthal was assigned the power program, and Arthur Morgan was placed in charge of engineering and construction.[19]

Conflict between Arthur Morgan and Lilienthal erupted almost immediately. Although the feud had many roots, including the distinctly different personalities of the moralist Morgan and the goal-oriented Lilienthal, the two principal sources were their different views as to the purpose of TVA and Lilienthal's handling of the power program. Lilienthal's view of the agency's purpose was quite simple: TVA was created and existed to improve the economic plight of the Valley's residents. Arthur Morgan, however, envisioned the Tennessee Valley as a place where bold new ideas could be translated into action.

> In making this change from hit-or-miss individualism to planned and controlled development, it is well that policies be tested in a limited area, rather than that the inevitable trial-and-error method should first

---

[18]Much more than the other board members, Harcourt Morgan would dominate his area. For a discussion of the early development of the agricultural program, see Philip Selznick, TVA and the Grass Roots (Berkeley: University of California Press, 1949).

[19]McCraw, Morgan vs. Lilienthal: The Feud within the TVA, p. 32.

> be applied on a nation-wide scale. For many reasons the Tennessee Valley is a suitable site for such a prcject. Any temporary inconvenience resulting from its being used as the laboratory of the nation should be more than offset by the direct appropriations by the Federal Government. The nation as a whole can afford this investment, for it can thereby learn how to plan in other regions. Both the Tennessee area and the nation should profit.[20]

It was not that Arthur Morgan opposed economic advancement for the Valley's residents, rather he viewed this as just one part of the many improvements needed.[21] Power, or any other program, was secondary relative to the needs of the Valley as a whole.

> Although there was strong pressure from some directions to make the tail wag the dog, to give controlling prominence to certain important but incidental features, as well as vigorous efforts to introduce certain seemingly innocent provisions which would have gone far toward killing the effectiveness of the measure, it was, as it passed through Congress to the accompaniment of much heat and stress, welded into a single organic whole, emerging finally as the clear expression of a definite and far-reaching plan.[22]

The subject over which these two very different men finally reached intense disagreement was Lilienthal's handling of the power program. Despite the fact that Arthur Morgan and Lilienthal believed the public had the right to control electric utilities,[23] they

---

[20]Arthur E. Morgan, "Planning in the Tennessee Valley," Current History 38 (September, 1936), p. 665.

[21]For a more extensive discussion of Arthur Morgan's view of the purpose of TVA, see McCraw, Morgan vs. Lilienthal: The Feud within the TVA, pp. 33-36.

[22]Morgan, "Planning in the Tennessee Valley," p. 663.

[23]For statements of both men's philosophy toward public power, see their individual statements in "Will Government Operation of Power Utilities Benefit the Public?" Congressional Digest 13 (October, 1934), pp. 242-8.

disagreed over the relationship between TVA and the private utilities in the Tennessee Valley. Arthur Morgan desired cooperation between TVA and the private power producers. Lilienthal, on the other hand, did not trust the private power representatives, perceiving them as reapers of excess profits. Although Harcourt Morgan did not enter the fray immediately, and for the first few years attempted to mediate relations between his two colleagues, ultimately he sided with Lilienthal and through this action had a dramatic impact on the resultant shape of TVA.

It appeared, at one point in 1936, that the conflict between the men over the power program might be settled. A recommendation was made to TVA and the private power companies in the Valley that they form a pool.

> [The] basic idea was that suppliers of electricity in the Tennessee Valley, chiefly TVA and Commonwealth and Southern would make their production available to a neutral pool organization which would then distribute the power to municipal, private, and cooperative purchasers at a predetermined and uniform wholesale price. The pool would buy bulk power from the plants with the lowest costs of production, regardless of whether they were publicly or privately owned, and a savings for all retail distributors would result. Additional advantages would accrue from joint use of transmission lines--Lilienthal's staff estimated a potential total saving of 15% to 25% of the cost of transmitted power. The basic aim of the plan was an integration of power resources into a grindlike system for the benefit of the public.[24]

In the midst of negotiations over the pooling proposal, nineteen private power companies that were engaged in a suit challenging

---

[24]McCraw, Morgan vs. Lilienthal: The Feud within TVA, p. 68.

the constitutionality of TVA succeeded in gaining an injunction to prevent further construction by the agency. Negotiations concerning pooling were immediately broken off by President Roosevelt, at the request of Lilienthal and against the wishes of Arthur Morgan. Again the two men were pitted against each other and the proposal that had offered promise of solving a major aspect of their feud actually contributed to their mutual distrust.

The conflict became more open as time went on. Morgan went so far as to actively oppose Lilienthal's reappointment to the board when his term expired in 1936. The feud culminated in Roosevelt's removing Morgan from the board in 1938.

Conflict concerning the direction TVA activities would take was not restricted to the agency's leadership. Hostilities between TVA and its environment erupted as soon as the agency was established. Because the private power companies in the Tennessee Valley feared the new agency would encroach on their established service areas, dozens of law suits were brought. Until the constitutional question of TVA's right to generate and sell electricity could be settled, the future of the entire power program would remain uncertain. In 1937 alone, the agency was simultaneously involved in twelve separate legal battles over its power program. Of all these cases, two stand out in importance: Ashwander v. T.V.A.[25] and Tennessee Electric Power Co. v. T.V.A.[26]

---

[25] Ashwander v. T.V.A. (297 U.S. 288, 56S.C. 466, 80 L.Ed. 688 (1936)).

[26] Tennessee Electric Power Co. v. T.V.A. 306 U.S. 188, 59 S.C. 366, 83L. ed. 543 (1939)).

In September of 1934, a group of Alabama Power Company stockholders, including George Ashwander, challenged TVA's constitutional right, as a government agency, to exercise contracts related to electrical power. TVA appealed to the Supreme Court after losing in a lower court. Although Ashwander et al. had contested the constitutionality of TVA activities, the Supreme Court ruling was directed only at the agency's right to sell surplus power from Wilson Dam. Chief Justice Hughes, in the majority opinion, stated,

> The Government acquired full title to the dam site, with all riparian rights. The power of falling water was an inevitable incident of the construction of the dam. That water power came into the exclusive control of the Federal Government, the mechanical energy was convertible into electric energy, and the electric energy thus produced, constitute property belonging to the United States . . .
>
> Authority to dispose of property constitutionally acquired by the United States is expressly granted to the Congress by section 3 of Article IV of the Constitution.[27]

The Tennessee Electric Power Company case, decided by the Supreme Court in 1939, was brought by seventeen private power companies and one distributor to prevent TVA from duplicating or competing with their services in any manner. The companies argued that competition from an agency of the U. S. government violated without due process their constitutional right of property. Justice Roberts, in the majority opinion, reasoned that,

> Cooperation by two federal officials, one acting under a statute whereby funds are provided for the

---

[27] Ashwander v. T.V.A.

> erection of municipal plants, and the other under a statute authorizing the production of electricity and its sale to such plants, in competition with the appellants, does not spell conspiracy to injure their business. As the court below held, such cooperation does not involve unlawful concert, plan, or design, or cooperation to commit an unlawful act or to commit acts otherwise lawful with the intent to violate a statute.
>
> In no aspect of the case have the appellants standing to maintain the suit.[28]

In denying the companies proper standing to sue, the Court did not address the constitutional issue raised. However, this ruling prevented private power companies from taking further legal action against TVA for its role as an electric utility and ended six years of legal disputes concerning the legality of its power program.

By this time, the two dominant programs within TVA, power and agriculture, were firmly entrenched in a pattern that still exists today. Harcourt Morgan, left by the feuding Arthur Morgan and Lilienthal to run the agricultural program at his discretion, rejected the idea of an aggressive program that would be implemented by TVA. Rather, he chose to work through existing power structures, especially the agricultural extension service.[29]

The power system that Lilienthal fought so hard to establish, however, took the other route. With the support of Harcourt Morgan, Lilienthal aggressively constructed a power program whereby TVA would generate and distribute electricity in the fullest spirit of President

---

[28] Tennessee Electric Power Co. v. T.V.A.

[29] Selznick, TVA and the Grass Roots, pp. 117-35.

Roosevelt's desire for a "yardstick" with which to compare the cost of electricity sold by private power companies.[30] Although one could interpret the "yardstick" function to mean TVA should generate electricity only for the purpose of revealing its true cost, Lilienthal had a less passive interpretation. He believed that the "yardstick" function required TVA to determine the cheapest possible manner of generating electricity, and then to actually do it. Fully cognizant of the potential advantages of the economies of scale, Lilienthal opted for what he called the "principle of 'more not less.'"[31]

> What had proved to be a good business principle for Henry Ford in the pricing of his first automobiles, what was good business in the mass production field generally, would be good business in electricity supply.[32]

The power program that was implemented by TVA, over the repeated objections of Chairman Arthur Morgan, required rapid/extensive changes in the size and scope of the program. Only the program's technology of hydro-electric dams remained unchanged. Program size nearly tripled between 1933 and 1939 from the 184,000 Kw capacity of Wilson Dam, taken over by TVA in 1933, to 509,000 Kws, an increase resulting from completion of the first two dams TVA built: Norris and Wheeler.

---

[30]For a discussion of Roosevelt's concern for "yardsticks," see McCraw, TVA and the Power Fight: 1933-1939, pp. 33-34.

[31]David E. Lilienthal, TVA: Democracy on the March (New York: Harper and Brothers Publishers, 1944), p. 21.

[32]Ibid., p. 22.

The important expansions in program scope that occurred were the result of the decisions that TVA would serve as a principal source of electricity independent of the private power companies and that the agency would be active in the distribution of that electricity. The former decision rapidly and extensively changed the scope of TVA's power program from the incidental generating of electricity at its dams to a required commitment to meet the demands of the agency's clients. The importance of this change in scope, although immediate, would not be fully realized until the demand for electricity by agency clientele began to exceed the capacity of the Tennessee River to supply it.

The distribution pattern that TVA established, and which is still used today, distinguished three types of users: large industrial users that are served directly; urban areas that either constructed new distribution facilities or purchased operating facilities from private power companies; and cooperatives that provided power to consumers in rural areas. Because consumers in rural areas lacked the capital necessary to construct such facilities, TVA took an active role in helping the cooperatives get established. Pritchett, describing how the first such system was established, indicated the close relationship that still exists between the cooperatives and TVA:

> The first organization of this sort for the disposition of TVA power was the Alcorn County Electric Power Association, formed in 1934 as a non-profit membership corporation to buy from the TVA and operate the electric system in and around Corinth, Miss., which the TVA had secured in its Mississippi Power Co. purchase. Membership in the association costs $100, payable by a one dollar a month surcharge on electric bills. The association, with TVA guidance and advice, set up an operating

> organization, and agreed to pay its debt to the TVA over a period of years out of surplus revenues. The TVA was to construct additional rural lines for the association's system, which would be paid for in the same way. The association was to receive TVA power at regular wholesale rate.[33]

This strategy was so successful that by 1942 Pritchett could note,

> The T.V.A. had thus . . . carried through a program of negotiation and purchase which put practically every city in Tennessee, as well as in many adjacent states, in the power business. In all, 83 municipalities were contracting for T.V.A. power by July, 1942.[34]

These rapid/extensive changes in the size and scope of TVA's power program seem more the cause than the effect of the conditions in the environment. If the power program had been implemented in the same manner as the agricultural program, that is, by supplementing the status-quo, its environment would probably have been characterized by a simple/static condition and a high level of certainty. However, the disruption of the status-quo caused an increase in the levels of complexity, change, and uncertainty in the environment as the private companies attempted to limit the ability of TVA to implement the decisions it had made. The level of complexity increased as the number of private power companies hostile to TVA increased. The level of change increased as the relationship between TVA and the private power companies deteriorated. Finally, the level of uncertainty increased

---

[33] C. Herman Pritchett, The Tennessee Valley Authority: A Study in Public Administration (Chapel Hill: The University of North Carolina Press, 1943), pp. 73-4.

[34] Ibid., p. 73.

as the number of court cases threatening agency autonomy in relation to its power program increased.

More important, perhaps, than these dramatic changes were their consequences for future agency policy. In Chapter I, "policy" was defined as the sum of five aspects: goals, plans, programs, decisions, and effects. During this time period the interrelationship of all five of these aspects forged a policy that distinguished TVA as a unique organization. The principal decision made during the time period was that establishing a broad scope to TVA's power program. The most immediate effect of this decision was the hostility engendered in the environment and the resultant increases in the level of environmental change, complexity, and uncertainty. A more indirect effect of the decision, however, and more important for long-run program development, was that it specified (planned) that the generation and distribution of electricity would be an important means in TVA for achieving its goals. Lilienthal's victory over Arthur Morgan ensured the establishment of programs relating to economic development as the means by which the goal of unified resource development would be pursued.

In terms of long-run program development, the most important aspects in the forging of TVA policy were the emergence of economic development as the planned means for pursuing unified resource development and the establishment of a power program of extremely broad scope. When Arthur Morgan was removed from the TVA Board of Directors in 1938, his dreams of wide ranging social and economic experiments in the Valley were ended. The pragmatic Lilienthal, with the support

of Harcourt Morgan, placed emphasis on economic development by emphasizing power and agriculture. By 1939, the power and agriculture programs were firmly entrenched in TVA.

Because the high capital investment required to generate electricity prohibits competition in this area, the decision to become the principal source of electricity in the Valley established TVA as a monopoly. With this monopoly condition came the responsibility to meet the demands of the clientele. Thus, TVA had committed itself to change its power program at a pace and magnitude sufficient to meet any increases in demand.

Eventually, the provision of low-cost electrical energy would emerge as a mission for TVA. However, this would take years to develop. Roscoe Martin, writing in the early 1950's, could note the emergence of power production as the agency's dominant activity.

> TVA itself regards its power program as secondary, as the author of the essay on power (above) testifies: he calls power production auxiliary, even incidental, to the major program purposes. Yet the production and sale of power have come to dominate program action if not program thinking in TVA. Here is where TVA takes its stand, here is where the battle lines are drawn in Congress, here is where attacks on the agency center. The process by which TVA evolved as a great electric power utility was a gradual one, with no one step calculated to produce the end result achieved. That result is an over-all program in which a secondary activity, the production and sale of surplus power, has come to overshadow other program goals, some say to the considerable disadvantage of the whole.[35]

---

[35]Roscoe C. Martin, "Retrospect and Prospect," in TVA: The First Twenty Years, ed. by Roscoe C. Martin (University, Alabama: University of Alabama Press, 1956), pp. 266-7.

As Martin notes, no single decision or event can be isolated as responsible for the prominence of the power program over other programs. However, there is reason to believe the initial decision to construct an independent power program is the origin of the mission. By consciously becoming the only source of electrical energy in the Valley, the agency became responsible to supply whatever demand arose.

After the Tennessee Electric Power Company ruling in 1939, TVA's power program received little outside attention. With the private power companies removed as a hostile force, the agency's environment changed from a complex/dynamic to a simple/static one. Because the role of TVA's power program was clearly defined as providing as much electrical energy as possible, the complexity, change, and uncertainty in the environment were reduced to a much lower level.

In this environment and under the pressure for production occassioned by World War II, TVA's power-generating capacity increased by a factor of five between 1939 and the end of 1945. Although the new generating capacity was almost entirely the result of the completion of new dams, the agency also constructed a coal-fired steam plant in an attempt to keep up with war time demand. This facility, constructed in southeast Tennessee at Watts Bar, was the first non-hydro means of generating electricity built by the agency. Although TVA owned several small fossil-fuel plants, they had all been purchased when TVA bought out the private power producers in the Valley in the 1930's. TVA's right to construct such non-hydro generating capacity had never been established, however, and agency attempts to construct more coal-fired steam plants would dominate its post war activities.

TOWARD PROGRAM MATURITY

TVA had served the country well in time of war, and had even played an important part in the development of the atomic bomb through its role as supplier of power to the Oak Ridge facilities.[36] The war years, ironically, might be distinguished as a time of peace for TVA. However, when the war ended the power program entered a second stage of development, and conflict was renewed. The two major issues were TVA's expanding its technology to include coal-fired steam plants and its self-financing to provide funds for expanding the power program. The resolution of these matters in TVA's favor led to a solidly-based power program.

After World War II, consumption of electricity in the Valley increased at a dramatic rate. TVA's dams, which had supplied all of TVA's generating capacity through 1938, were still supplying slightly over 80 percent at the conclusion of World War II. The increase in demand that followed the war made it obvious to TVA officials that the Tennessee River was no longer adequate for supplying the bulk of its generating capacity. Given this increased demand, if TVA was to fulfill its commitment as sole supplier of electricity in the Tennessee Valley, it would have to expand its program's technology beyond hydroelectric sources. Its non-hydro electric sources, which comprised 19.35 percent of its generating capacity at the end of World War II,

---

[36]For a discussion of the role of TVA in national defense, especially during World War II, see Don McBride, TVA and the National Defense (TVA Library, Knoxville, unpublished manuscript, 1975).

were either purchased from private power companies in the 1930's or constructed under war-time conditions. Thus, the addition of any non-hydro generating source would be a distinct expansion of technology.

In response to increased demand, TVA turned to the abundant coal reserves of the region. In its request to Congress for fiscal year 1949 appropriations to construct more coal-fired steam plants, TVA was opposed by private utilities. The private utilities, especially those whose service areas bordered TVA's, feared that if TVA were allowed to construct additional non-hydro means of producing electricity it would expand its boundaries and offer services to customers of private utilities.

Gordan Clapp, who had been appointed to the board as its chairman by President Truman in 1946, presented TVA's side of the story to a House appropriations subcommittee in April of 1948. Essentially, Clapp asserted that the enlarging technologic versatility was necessary if TVA was to increase the size of its power program to a level adequate to meet the demand of its established service area.

> The TVA is the sole supplier of electricity for this entire region that we serve, an area of some 80,000 square miles. We are the generating company, the transmitting company, and the wholesaler. We have contracts over a period of 20 years from their initial dates. We are committed by the terms of those contracts entered into under the policies established by law, to do our utmost to keep up with their load growth in supplying electricity and we are talking here about a fast-pace normal load development that is coming about in the Tennessee Valley region.[37]

---

[37] U.S. Congress, House, Subcommittee of the Committee on Appropriations, Government Corporations Appropriations Bill for 1949, 80th Congress, 2d Sess., 1948, pp. 422-3.

Even if TVA officials perceived themselves as morally "committed" to their course of action, their legal right to that course of action was still in question. Disputes in the courts over TVA's right to generate electricity at its dams had subsided since the Supreme Court ruling in the Tennessee Electric Power Company case. However, the indirectness of the ruling left the private power companies with some reason to believe they might still be able to inhibit growth of the agency's power program. Their challenge to TVA's right to construct non-hydro generating capacity was carried to the Congress during the annual appropriations hearings for fiscal year 1949.

TVA's request for funds from Congress was actually a request for three things: (1) TVA wanted to increase the size of its power program and needed the funds to construct new generating capacity. (2) The agency wanted to expand its program technology. TVA's small contingent of coal plants were obtained or constructed under unusual conditions, and this first plant constructed in peace-time would represent an expansion of program technology. (3) Most importantly, if Congress were to appropriate the funds for the plant, it would be legitimizing TVA's role as electric utility for the entire Tennessee Valley. Prior to this time, the agency's generating capacity could be justified as either incidental to navigation and flood control or necessary for the war effort. Thus, congressional authorization for this plant would mean it approved of the role TVA had established for itself.

Joe Swidler, of TVA's general council, presented the agency's case as follows:

> Mr. Swidler. Well, I think the constitutionality of the construction of the steam plant can be supported on a number of different bases, either under normal circumstance or under the special circumstances which now exist.
>
> To take the normal situation first - that is, putting to one side the defense emergency - I think it can be supported under the commerce and property clauses of the Constitution, among other sources of constitutional authority. Under the property clause, the power of the Federal Government to improve its property in order to make it valuable and marketable is well recognized. That is the constitutional basis for the reclamation program.
>
> Mr. Coudert. How about the statutory authority?
>
> Mr. Swidler. Section 4 (i) of the statute grants that authority, and it is recognized also in sections 14 and 15 of our statute. Section 4 (i) grants general authority to TVA to construct - "dams, reservoirs, transmission lines, power houses and other structures, and navigation projects at any point along the Tennessee River or any of its tributaries."[38]

Despite Swidler's effort, and the support of President Truman, the House rejected the 1948 bill to appropriate funds for the construction of a coal-fired steam plant by a vote of 245 to 185. The 1948 vote against appropriating funds was almost entirely along party lines and reflected the majority hold of the Republican Party in the 1948 House of Representatives. Although the Senate had approved the measure, adamant opposition by the House members of the conference committee led to its omission from the final bill. Thus, for the time being, change in power program size and technology were at the no/slow side

---

[38] Ibid., p. 431.

of the continuum. However, the surprise victory by Truman and the recapture of Congress by the Democrats led to congressional approval the following year.[39]

The importance of this vote went well beyond simply allowing TVA to meet increasing demand for electricity. The vote, by Congress, legitimated TVA's expansion into a new technological area. Although much conflict lay ahead for the agency, the issue would no longer be the legitimacy of non-hydro generating capacity; rather it would focus on the need for individual plants.

Even with this newly established legitimacy for its non-hydro generating activities, TVA was still dependent on Congress for funds to construct new power plants. The agency was experiencing increasing demand in both the western and eastern ends of its service area. The demand in the eastern end was primarily from AEC facilities at Oak Ridge. TVA used this fact to link the need for new coal-fired steam plants, in its eastern area, to the issue of national defense. Although in 1952 the House voted to cut construction funds from TVA's budget, the Senate passed the measure and the funds were included in the compromise reached by the House-Senate Conference Committee.

The major problem TVA then faced was its need for additional generating capacity to serve the western part of its service area. A proposal to construct new generating facilities in Fulton, Tennessee

---

[39]For a discussion of the votes for both years, see Aaron Wildavsky, Dixon - Yates: A Study in Power Politics (New Haven: Yale University Press, 1962), pp. 10-3.

resulted in a dispute of several years' duration. Private power companies increased their opposition to a level not seen since the early years of the agency's existence, leading to what has been called the Dixon-Yates controversy. Dixon and Yates, both representatives of private power companies, feared TVA would use a power plant in the western part of Tennessee as an excuse to extend its services beyond the western border of Tennessee.[40] In 1951, President Truman refused to request funds for the Fulton steam plant in the administration's 1952 budget. Although Truman included the funds the following year, Eisenhower removed them shortly after taking office.[41] In 1952, several members of Congress from the Valley initiated efforts to gain the appropriation for TVA. However their proposal was defeated in both the House and the Senate.[42]

In view of the problems in securing appropriations for expansion, self-financing through bond sales became an increasing topic of discussion among those concerned with TVA. The idea was quickly rejected by Chairman Gordan Clapp, however, who stated, "The plan . . . would give TVA foes a wedge to force 'mismanagement' and perhaps destroy TVA's ability to maintain low-cost production."[43]

---

[40]Aaron Wildavsky, "TVA and Power Politics" American Political Science Review 55 (September, 1961), p. 582.

[41]Wildavsky, Dixon - Yates: A Study in Power Politics, pp. 17-20.

[42]Ibid., p. 21. Also, in "TVA and Power Politics," Wildavsky provides an interesting analysis of these and other key votes affecting TVA.

[43]New York Times, August 20, 1953, p. 36.

The Dixon-Yates controversy was settled when the city of Memphis announced it would construct its own generating capacity. This was done, however, only after it became clear that Congress would not approve funds for a TVA coal-fired steam plant in the western part of its service area.[44] Although the Fulton plant was no longer a necessity, demand for electricity was increasing throughout the rest of the TVA service area. Thus, self-financing remained a matter of interest.

Clapp maintained his hostility to the notion of self-financing throughout his tenure on the Board. When his term expired in May of 1954, President Eisenhower nominated as replacement General Herbert D. Vogel, who was retiring from the Army Corps of Engineers. The following year the agency requested that Congress amend the TVA Act to allow for the sale of an unlimited amount of bonds to finance construction and other aspects of the power program.

The debate over the self-financing amendment went on for four years. Again, TVA's chief opponent was the private utilities. The following exchange between Congressman McGregor, of Ohio, and Walter Samis, President of Ohio Edison Company, typifies the debate.

> Mr. McGregor. . . . In your opinion why does TVA want this legislation. They have told us it has been successful as far as they have been concerned with the old program, but now they are asking for something new. In your opinion why do they want it?
>
> Mr. Sammis. They want to obtain money in my judgment to expand their facilities. . . . Of course, by obtaining

---

[44] Wildavsky, "TVA and Power Politics," p. 587.

> permission from Congress to issue revenue bonds they have, as I see the picture, a lot more latitude in which to work than they would if they were solely under the control of Congress and could not spend money for additional units in existing plants, or additional units in new plants without congressional approval.[45]

Sammis and representatives from other private power companies feared TVA would use the "latitude" provided by self-financing to overbuild. If the agency possessed more generating capacity than it needed for its own service area, it might be tempted to expand that service area to include areas served by private power companies. The ease with which TVA had established supremacy in its service area following the Tennessee Electric Power Company decision was a haunting spectre for private power companies across the country. The persistence of these companies resulted in a compromise bill acceptable to both parties: TVA would be allowed to finance construction of its power program through the sale of bonds; however, it would not be able to expand its service area. With this limitation written into the bill, the best organized and financed of TVA's critics withdrew from the political arena within which the agency operates.

Two other problems had to be worked out before the bill could be passed. The board of directors, all of whom by now had been appointed by Eisenhower, viewed the self-financing amendment as "most

---

[45] U.S. Congress, House, Committee on Public Works Subcommittee on Flood Control, Tennessee Valley Authority Financing, 85th Cong., 1st Sess., 1957, p. 240.

helpful in effective management and cost control."[46] Yet some congressmen viewed this as a weakening of their control over the agency. Congress countered with two measures designed to maintain this control. First, they placed a limit of $750 million on the amount of bonds TVA could have outstanding at any one time. If TVA wanted to exceed this limit it would be required to gain congressional approval. Second, Congress proposed it be given power, by concurrent resolution, to alter TVA's construction program. Such a resolution would not be subject to presidential veto. This was unacceptable to the White House, and the limitation was ultimately deleted. Congressional Quarterly reported on the resulting activity as follows:

> President Eisenhower signed the original bill only on the express understanding that this provision, which he termed "a clear invasion of the prerogatives of the Chief Executive," would be repealed. The repealer (S 2471) was enacted within a week, leaving TVA's power construction program at least technically free from both Congressional and Executive Branch control.[47]

Thus, TVA entered the 1960's less restricted by formal congressional controls than at any time in its history. Although the Senate would still have to approve presidential nominees to the TVA board, and the agency would be subject to annual budget hearings and potential oversight hearings, the central element of conflict between TVA and Congress, financing the power program and by implication the character of that program, was removed.

---

[46] Arnold R. Jones, "The Financing of TVA," Law and Contemporary Problems 26 (Autumn, 1961), p. 730.

[47] TVA Revenue Bonds, Congressional Quarterly Almanac, Vol. 15, 1959, p. 261.

The complex/dynamic environment affecting the size and character of the power program in which TVA had functioned from the end of World War II until 1959 subsided to a simple/static condition. The uncertainty caused by environmental complexity and rapid change was replaced with a high level of certainty. The agency had entered an era described by one TVA official as "a time in which we decided what needed to be done and then we went out and did it."

The years from 1959 to 1965 witnessed rapid growth in the size of TVA's power program with generating capacity increasing from 11.4 million Kw. in 1960 to 14.7 million Kw. in 1965, 87 percent of the increase being produced in the new coal-fired plants. During these years, however, there was no attempt by the agency to expand either its program technology or its program scope.

RECAPITULATION

The vast amount of information thrust upon the reader justifies a brief recapitulation at this time. The incremental perspective will be used because of the two perspectives presented in Chapter I it is the better developed. During the 1946 to 1966 time-period, TVA's power program experienced change in its size and technology while its scope remained unchanged.

Figure II.1 presents change in the size of TVA's power program as increments to a base measured as total generating capacity. In almost every year the TVA power program experienced significant growth in size. Further, the size of the increments seem unrelated to the size of the base. In several years when the base was quite small the

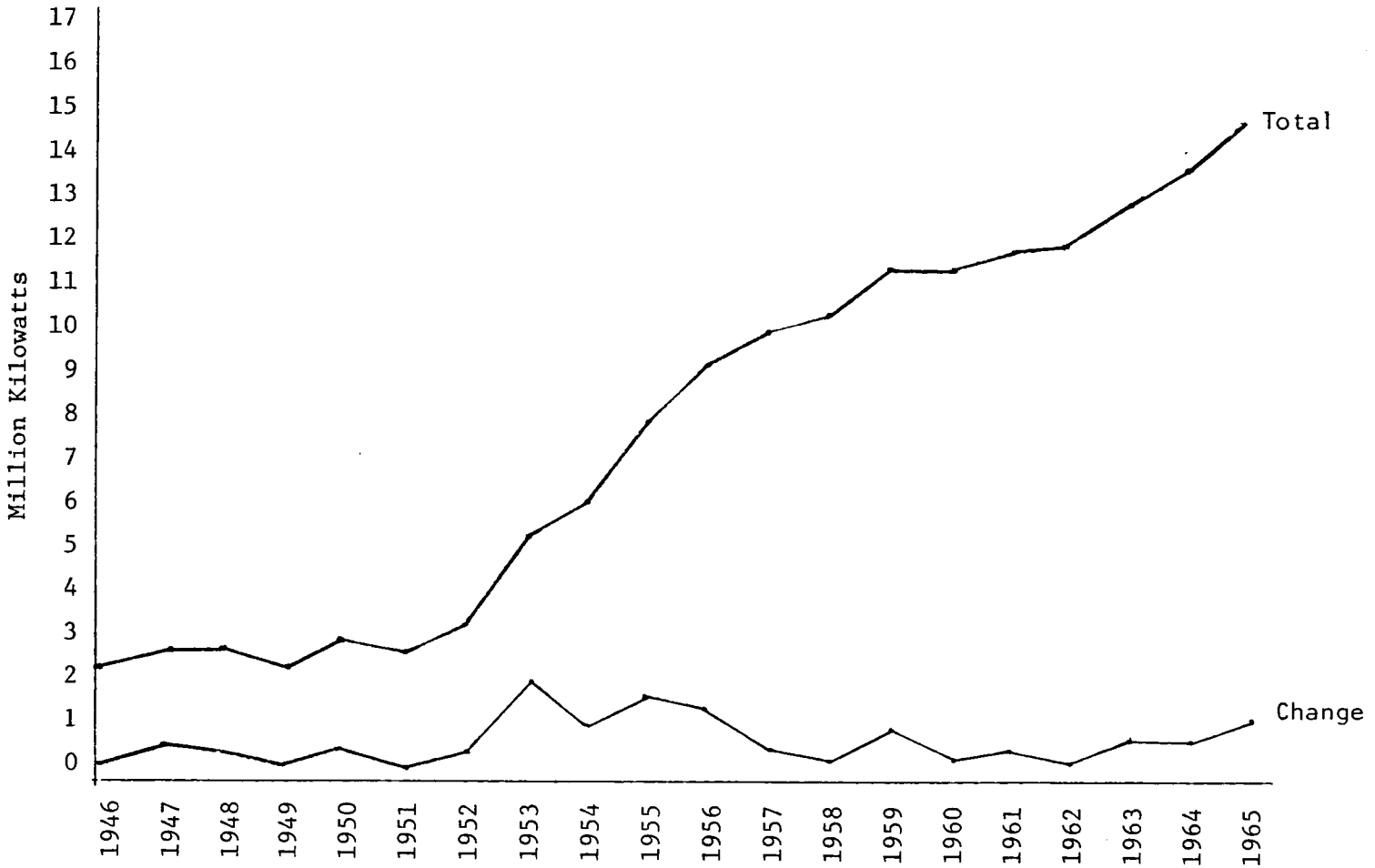


Figure II.1

TVA's Total Generating Capacity and Change in Generating Capacity from 1946 Through 1965

size of the increment of change was quite large. The change that occurred between 1952 and 1953, for example, amounted to an increment two-thirds the size of the base. In essence, the figure shows that the power program's size changed at a rapid pace and extensive magnitude during this period. Also, the large size of the increments relative to the base indicates a pattern of non-incremental change.

The change in technology occurred in 1949 when Congress appropriated funds for TVA to construct its first coal-fired steam plant in peace time. Change in technology, according to the incremental perspective, is a change that adapts either ends to means or means to ends. Although it could be described as an increment to a base, adaption is more descriptive because often the change will be in units not readily comparable to the existing base. Since emphasis is on adaption and not goal-achievement, the change will never be very large. The increased demand for TVA electricity that followed World War II required change in either means or ends. The agency could not continue to provide low-cost electrical energy for economic development through its technological means of hydro-electric generators. The agency had only two alternatives to choose from: altering of means or altering of ends. The altering of means would require the adoption of a new technology. Further, because the demand was increasing rapidly, the change would have to occur at a rapid pace and cover an extensive magnitude. The altering of ends would require abandoning the end of providing low-cost electrical energy as a means of economic development and would require TVA to abandon its position as the sole source of electricity in the Tennessee Valley. The choice of either of these two alternatives would be a

distinct change and not an incremental adaption. TVA's decision to adopt a new technology was non-incremental because rather than adapt a means to an end or an end to a means, a new means was added to the program while the ends were held constant.

Once Congress approved of TVA's decision to expand its technology, the prominence of coal-fired generating capacity in the power program rose dramatically. Figure II.2 depicts the rapid pace at which coal-fired steam plants were constructed, as well as the extensive magnitude of change in the size of the hydro and coal systems relative to each other. Although TVA's hydro generating capacity increased from 1.8 million Kw. in 1946 to 3.1 million Kw. in 1965, it declined as a percent of total generating capacity from 80.7 percent to 22.5 percent. The coal-fired generating capacity, which made up the other 77.5 percent in 1965, had increased from 0.4 million Kw. to 10.6 million Kw. over the same time period.

More importantly, however, this figure depicts the nature of the matured power program in the early and middle 1960's. The change depicted in the figure shows TVA had changed from an organization that generated electricity at dams to an electric utility. TVA, in 1966, was the nation's largest consumer of coal. Further, the prominence of the power program within TVA had increased dramatically. As measured by expenditures, the power program had accounted for half of TVA's activity in 1951; by the end of 1966 this figure had increased to 75 percent.

The power program had not only captured an increased share of TVA expenditures, it had also increased in importance to TVA officials. Aubrey Wagner, who had been designated Chairman of the TVA board by

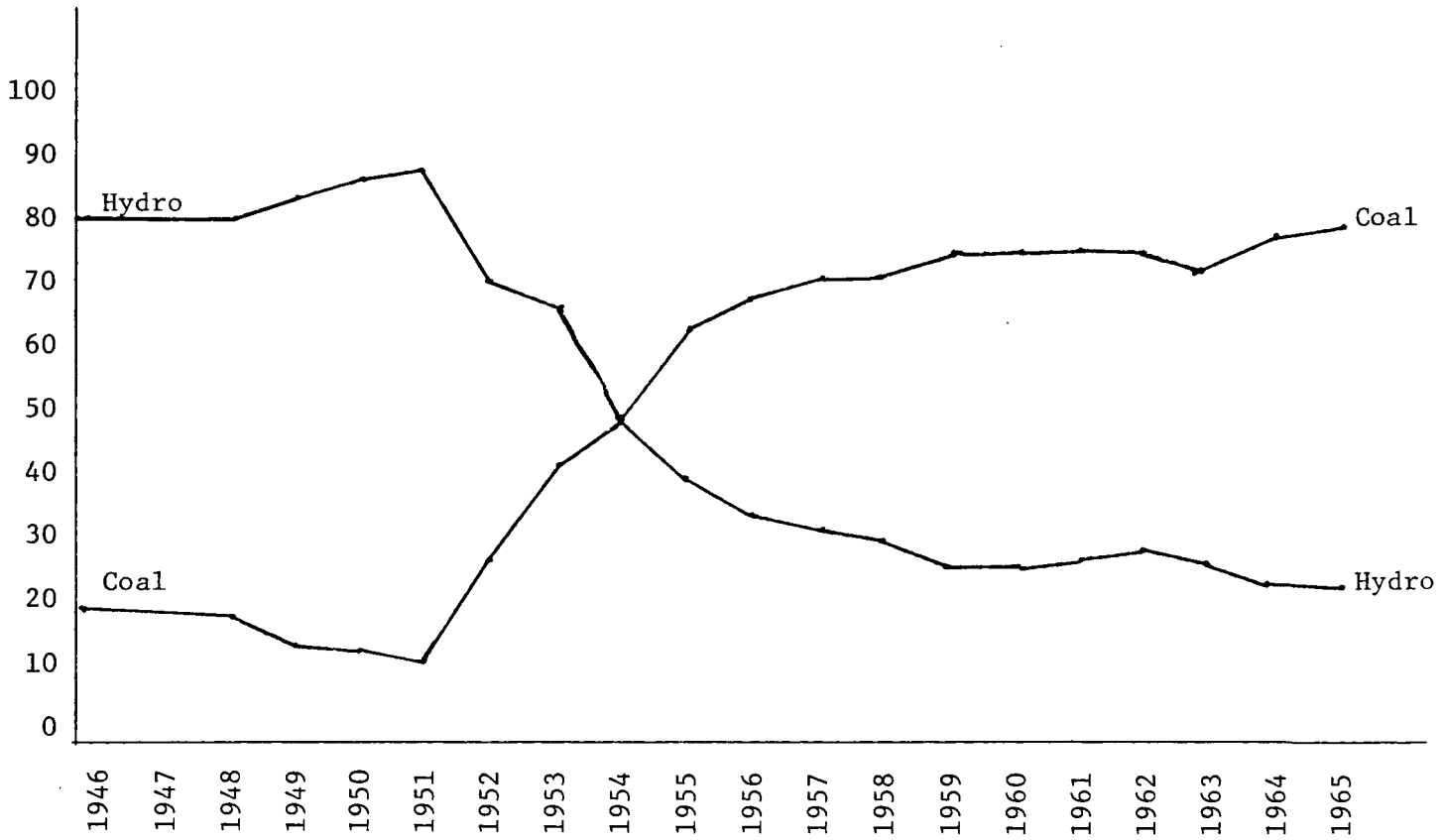


Figure II.2

Percent of TVA's Generating Capacity by Year and Source

President Kennedy in 1961, noted the importance of the power program to a Senate subcommittee.

> The TVA power program is part of an overall program for the development of the natural resources of the area, as Senator Hill very completely described. Its general purposes are to promote the economic development and the welfare of the regions, and to strengthen the national economy and the national defense. The act is specific about the policy to be followed in the sale of electricity. Electric power is required to be sold at the lowest possible rates and in such a manner as to encourage increased use of electricity, especially in the home and on the farm (secs. 10, 11, 12, 15d(f), 15d(h)). The basic premise is that low electric rates encourage high levels of use, and that high use of electricity contributes importantly to an improved economy and a better life.[48]

Wagner's statement indicates that TVA's power program had evolved beyond what Roscoe Martin had noted in 1957 to be the dominant force in "program action if not program thinking." In the above quote, Wagner indicates that the power program is TVA's way of contributing to economic development, regional welfare, and the nation's economy and defense. It is through the provision of low-cost electrical energy that TVA fulfills these obligations. Thus, the provision of low-cost electrical energy, by this time, had come to dominate not only "program action" but "program thinking" and could be distinguished as the dominant TVA mission. As will be seen in the next chapter, the fully matured mission maintained Lilienthal's interpretation of the "yardstick" function as something to be actively pursued.

---

[48] U. S. Congress, Senate, Subcommittee on Flood Control-Rivers and Harbors of the Committee on Public Works, Increase in Statutory Limitation of TVA to Issue Bonds, 89th Cong., 2d Sess., 1966.

CHAPTER III

GOING NUCLEAR

The most significant feature of the development of TVA's power program from 1966 through 1977 was the rapid and extensive increase in nuclear generating capacity. Although TVA did not commit itself to nuclear power in any manner until 1966, the agency had been examining this technology since the end of World War II. This chapter will examine that background, TVA's decision to build its first nuclear power plant, the reaction to that decision, and subsequent program development through 1969.

ORIGINS OF CHANGE

In the most general sense, the 1966 decision to build a nuclear power facility at Browns Ferry was a consequence of developing pressures arising from the expanded use of coal, TVA's growing expertise in the use of nuclear power, and the economics of power production. TVA's interest in nuclear energy can be traced to the very beginning of the United States' concern to develop peaceful uses of atomic power. The fact that TVA demonstrated an interest in atomic power at this early stage was a natural outgrowth of Lilienthal's interpretation of TVA's function as a "yardstick."[1] If the agency was

---

[1]Lilienthal, at this time was Chairman of the Board of Directors, having been appointed to that position by President Roosevelt in 1941. He remained in that position until October of 1946 when he resigned to become part of the Atomic Energy Commission.

to be an active leader in low-cost generating of electricity, it had a responsibility to investigate this new potential source of energy.

Shortly after World War II the Atomic Energy Commission (AEC) invited interested parties, including TVA, to participate in the "Daniel's pile program,"[2] an early attempt to demonstrate the feasibility of producing electricity from the atom.[3] Although the project was terminated after a short period of time, it placed within the TVA organization technicians who had been exposed to the potentials of atomic power. Simultaneously, the AEC organized a committee, later called the Parker Committee, to examine the potential peaceful uses of the atom. One of the members of the committee was G. O. Wessenauer who had become TVA's manager of power in 1944, remaining in that position until 1970. He thus directed TVA's power program during the early decisions to build nuclear power plants.

During the early 1950's, TVA made two attempts to increase its understanding of the new potential source of energy. First, in 1953 it began assigning employees to AEC facilities, allowing agency members to gain both knowledge and experience in various phases of the

---

[2]Interview with G. O. Wessenauer, Chattanooga, Tennessee, May, 1977.

[3]The role of this program in immediate post-war atomic activities is related in Richard G. Hewlett and Oscar E. Anderson, Jr., A History of the United States Atomic Energy Commission Vol. I, The New World, 1939/1946 (University Park: The Pennsylvania State University Press, 1962) and Richard G. Hewlett and Francis Duncan, A History of the United States Atomic Energy Commission Vol. II, Atomic Shield, 1947/1952 (University Park: The Pennsylvania State University Press, 1969).

production of nuclear power. Second, in 1954 TVA, under an agreement with AEC, carried out a one-year study of the feasibility of a nuclear power plant in the TVA system. This study, at TVA's own expense and relying mainly on its own personnel, compared the various types of nuclear plants that were deemed the most promising. In a report issued in January of 1955, TVA noted that

> One result of our study has been to reaffirm our earlier conclusion that an economical TVA power reactor will eventually become possible; that this point might be reached within ten years; and that we should continue our interest and expand our participation in the nuclear power program.[4]

TVA's decision to build its first nuclear power plant came 11 years later.

A year after the self-financing amendment was added to the TVA Act, the next major step in the nuclear program was taken. In 1960, TVA joined with the AEC in a project for an Experimental Gas Cooled Reactor (EGCR). TVA operated the reactor, and also aided in design, construction, the training of personnel, and in testing and inspection at a cost to TVA of $2 million. In 1962 the project was expanded from a prototype model to a large scale (750 Mw) reactor, to determine whether a large scale EGCR was economically feasible.

Several years later, G. O. Wessenauer explained the importance of these early projects in terms of personnel and experience. At a

---

[4]Nuclear Power Staff of the Division of Power Supply in TVA, TVA Nuclear Power Cost Study - 1954 (Chattanooga, TVA, January, 1955).

1970 AEC hearing concerning one of TVA's nuclear units, Wessenauer said:

> In 1960, TVA agreed to operate the Experimental Gas Cooled Reactor for AEC at Oak Ridge, and immediately began developing a technical and operating staff which included 43 engineers and physicists with many years of training and experience in nuclear technology, and 21 certified nuclear reactor operators and senior operators. The staff was responsible for the entire preoperational program. . . . Many of these trained and experienced people are now assigned to TVA engineering and operating organizations that are directly involved in the planning, design, construction, and operation of Browns Ferry nuclear plant.[5]

Not long after TVA embarked upon the second phase of the EGCR project, a dramatic development in nuclear generation of electricity took place. On December 12, 1963, the Jersey Central Power and Light Company issued a press release revealing its intention to build a large scale nuclear power plant for commercial operation. In the economic analysis that accompanied the decision, the company claimed, "The decision to construct the Oyster Creek nuclear station was based solely on economic and engineering considerations."[6] The importance of this event is noted by Metzger as follows:

> If there ever was a key point in the development of nuclear power reactors it was December 1963, when the Jersey Central Power and Light Company announced that it was going to build a boiling-water nuclear reactor at Oyster Creek, New Jersey, with no direct government subsidy. It was optimistically predicted that

---

[5]Testimony of G. O. Wessenauer before the AEC on April 23 and 24, 1970. Browns Ferry Unit no. 3 Hearing Record, p. 5.

[6]Jersey Central Power and Light Company, "Report on Economic Analysis for Oyster Creek Nuclear Electric Generating Station." This report is reprinted in the Hearings of the Joint Committee on Atomic Energy, 88th Cong., 1st Sess.

> cheap, competitively priced nuclear electric power could be produced, and it seemed as though the civilian nuclear power reactors had come of age. . . .[7]

The Oyster Creek optimism quickly spread into TVA,[8] as the ten-year period the agency had predicted would find it in nuclear power was drawing to a close.

During the period when nuclear possibilities began to receive attention, two situations were affecting the agency's power program. First, the problems inherent in the burning of large amounts of coal were becoming evident and were magnified for TVA, the nation's largest consumer of coal. Second, the fully matured belief that TVA's mission included providing electrical energy at the lowest possible cost combined with optimism about the potentials of nuclear sources to enhance the attractiveness of the nuclear option.

The political difficulties that TVA experienced when it started driving its generators with steam were recounted in the preceding chapter. The choice of a fuel to create this steam was not part of the problem, because the agency's location among the coal fields of Kentucky and Tennessee made the cheapest of the fossil fuels even cheaper because of low transportation costs. But coal, although the cheapest of the fossil fuels, is also the dirtiest because of the SO_2 it emits while burning. Although air pollution did not become a major

---

[7] H. Peter Metzger, The Atomic Establishment (New York: Simon and Schuster, 1972), p.

[8] Interview with James Watson, Chattanooga, Tennessee, May 1977.

problem for TVA itself until late in the 1960's, the general issue of air and water pollution was becoming of increasing public interest. As Table 1 indicates, concern over air and water pollution increased dramatically between 1965 and 1966. Further, by 1967, a majority of the population perceived both to be a problem in the area they lived relative to "other parts of the country."

TABLE 1

CHANGES IN THE PUBLIC'S PERCEPTION OF POLLUTION AS A PROBLEM: 1965-1970*

Year	Percent Perceiving Air Pollution as a Problem	Percent Perceiving Water Pollution as a Problem
1965	28	35
1966	48	49
1967	53	52
1968	55	58
1970	69	74

*Source: Hazel Erskine, "The Polls: Pollution and Its Costs," Public Opinion Quarterly 36 (Spring, 1972), p. 121. "Compared to other parts of the country, how serious, in your opinion, do you think the problem of air/water pollution is in this area--very serious, somewhat serious, or not very serious." Responses are those who perceived the problem as either very serious or somewhat serious.

From TVA's point of view, the more immediately significant objections to coal came from the method of mining. Strip-mining was proceeding on a large scale in the mid-1960's, making the resultant degradation of the environment an issue of increasing national impor-

tance. Public demand for government action led the 1965 legislatures of both Kentucky and Tennessee to consider bills that would regulate strip mining. The potential results of such legislation produced a high level of uncertainty for coal mine owners and operators.

This environmental concern and its effect on the economics of the coal industry influenced TVA as consumer. Because of the variations in possible environmental legislation, suppliers were reluctant to invest the large amounts of capital necessary to ensure delivery of the large quantities of coal which TVA required. Although coal prices were relatively constant, the number of bidders for TVA coal contracts decreased dramatically, in just a few years, from in excess of 100 to 5 or 6. TVA officials attributed this change to a general decrease in competition in the energy supply industry, with the larger coal companies and oil companies buying out the smaller coal companies.[9] TVA's critics, however, blamed the agency for creating this change in the competitive situation by driving small dealers out of business because TVA set such high minimum quantities for bids. For instance, in 1966 when TVA accepted bids for the proposed Cumberland Steam Plant to be used for comparison with the potential Browns Ferry nuclear plant, it set minimum size to the contract of 20,000 tons per per week for 10 years. Thus, bidders were asked to guarantee delivery of over 10 million tons of coal in an uncertain market.

---

[9]G. O. Wessenauer, "The Fuel Market as Seen by the User," paper presented to the Atomic Industrial Forum, Hilton Head, South Carolina, September 13-16, 1970, p. 5.

Criticism of the ravages of strip-mining was not only directed against mine owners and operators. TVA, because it was perceived by many as a conservation agency, and, also, because it was the nation's largest consumer of coal, received its own share. The agency responded, in July of 1965, by requiring bidders for TVA coal contracts to include restoration costs in their bids. This policy, however, came under criticism because the bids were no higher than before this requirement was inserted. Conservationists assumed this to mean bidders had no intention of restoring the land.

The large quantity of coal that TVA was consuming in order to keep its generators turning made the agency very dependent on forces in its environment, especially the condition of the coal market and government regulations related to the production of coal. Since the self-financing legislation had passed in 1959, TVA's environment had been in a simple/static state with a high level of certainty. The increasing complexity caused by the growing number of critics of the agency and the dramatic drop in the number of bidders for TVA coal contracts greatly concerned agency officials. The most troublesome aspect of this situation, however, was the uncertainty that surrounded the coal market. This was dramatized early in 1966 when TVA let bids for large quantities of coal and none of adequate size were received.[10] Whether the cause was potential government regulation or a decrease in competition, the end result of a high level of uncertainty was the

---

[10] Knoxville Journal, July 30, 1966.

same. Thus, although one could not distinguish TVA's environment in 1966 as complex, dynamic or characterized by a high level of uncertainty, it was certainly moving in that direction.

Regardless of how uncertain the coal situation would become, TVA officials were very cognizant of the large quantities of this fossil fuel the power program would need for the indefinite future. In an attempt to help assure its availability, the agency expanded its program scope at this time to include the ownership of large coal reserves. Although TVA, in the past, had purchased coal reserves and contracted out their mining operations to acquire the coal, it had always been on a small experimental basis. However, during the 1966 fiscal year, TVA expended $7.4 million for mineral rights to 30,590 acres of land at Camp Breckenridge, Kentucky. TVA estimated the retrievable amount of coal in the Camp at 225 million tons. This rapid expansion of program scope to include an important aspect of the coal business was of only limited magnitude, however. Although the coal reserves were of enormous size, they were purchased to supply a major portion of the fuel for only one generating plant. Further, the expansion included only the ownership of the coal. TVA has made no attempt to actually mine coal but, rather, has contracted out this aspect of the coal supply business.

These changes in the coal situation were extremely important for the development of TVA's power program. In the mid-1960's, four fuel options were open to any utility desiring to expand its generating capacity: coal, oil, natural gas, and uranium. The choice of one of these alternatives was a complex phenomenon relating to such things

as economic cost, availability, and lead-time required for plant construction. All of these things are relative, and the feasibility of any of these fuels is directly related to the feasibility of the other three. Thus, a lessening in the desirability of coal would enhance the other alternatives.

The negative condition of the coal situation and the Oyster Creek report of 1964 encouraged TVA to take another in-depth look at nuclear power. TVA authorized such a study, and a report on the feasibility of a nuclear plant in the TVA system was completed in October of 1965.[11] The report was very optimistic.

> If attention is given to the design of certain features, there should be no serious doubts as to the reliability or feasibility of either the BWR or the PWR proposals. The core heat transfer and hydraulics calculations involve no particularly novel methods, and the core physics calculations tend to be conservative. This leads to an acceptable degree of confidence in either reactor system.[12]

The economic findings were equally optimistic.

Although the report offered no firm conclusion, when read in light of the coal situation in 1965, it must be viewed as a go-ahead to those concerned either with nuclear power or simply with maintaining a viable alternative to the use of coal. In any event, the month after the report was completed,[13] James E. Watson, who was then TVA's

---

[11] Light Water Nuclear Plant Feasibility Study (Chattanooga, Tennessee: Tennessee Valley Authority-Division of Power Planning and Engineering, 1965).

[12] Ibid., p. 18.

[13] The report was classified "Administratively Confidential" and its contents, and probably even its existence, were not general knowledge.

Assistant Manager of Power, told the Tennessee Valley Public Power Association's accounting section, "I believe it's safe to say we are going to see a nuclear generating plant in the TVA system before not very long."[14]

Less than two months after Watson's remarks, another event made simpler TVA's entry into the nuclear field. In early January of 1966, the AEC abruptly cancelled the Experimental Gas Cooled Reactor Project. The cancellation, attributed to high cost by the AEC, released dozens of TVA employees who had been gaining experience in nuclear power throughout the project's six year existence.

These developments took place during a time marked by extreme optimism about the future of nuclear energy among power people and others. Although the use of nuclear power to generate electricity was still the principal area of concern, the potential application of the rapidly developing technology seemed limited only by man's imagination. The following statement, taken from an AEC report on prospects for the industry, indicates several of the areas into which rapid expansion was expected:

> Expanding radiation applications in areas such as medicine, industry and space; the decision to move ahead with the world's largest desalting plant as a nuclear-powered, dual-purpose facility; and increasing interest in commercial applications of peaceful nuclear explosives; all added to the bright promise for the nuclear industry's future. All segments of the industry should feel the impact of the expansion that lies ahead.[15]

---

[14] Memphis Press-Scimitar, November 16, 1965.

[15] U.S. Atomic Energy Commission, The Nuclear Industry - 1966 (Washington, D.C.: U.S. Atomic Energy Commission, 1966), p. 1.

Nuclear power was "coming into its own" as a source of electricity. In 1966, first-time orders for nuclear-fueled, steam-generated electric capacity exceeded all other fuel types combined. The AEC described the optimism prevalent among those involved in nuclear power:

> The year 1966 will no doubt be remembered as the year that nuclear energy was fully recognized as competitive with fossil fuel for producing electric power in many areas of the United States and in the world . . . The rapid expansion of the nuclear power market promises a bright future for the nuclear industry.[16]

BROWNS FERRY

Each year, TVA conducts an annual review of power needs.[17] Forecasts are made concerning peak demand for every month between the present and the date new capacity could be brought on line. Less rigorous forecasts are made for later periods to help the agency plan for dramatic variations in load requirements that might occur a long time in the future.

In 1966, TVA was planning for generating capacity needs five years in the future. Projections showed an additional 2,000 Mw. would be necessary to meet system demand. In February, the agency responded to these projections by requesting bids for the construction of two

---

[16] Ibid., p. 5.

[17] For an extensive discussion of this point, see W. Zumwalt, "Short- and Long-Term Load Forecasting Models," The Tennessee Valley Authority Experience, Vol. 1, ed. by Hans Knop (2361 Laxenbury, Austria: International Institute for Applied Systems Analysis, 1974), pp. 311-32.

1,000 Mw. generating units. Although TVA had followed this procedure in the past, this time something was different. The agency announced that it would accept bids for either coal-fired or nuclear units. A nuclear unit of such magnitude would be one-fifth larger than any nuclear unit then under construction and one-third larger than any unit then in operation. Thus began the transformation from possibility to reality of nuclear technology as a part of TVA's power program. In just three years' time, the nuclear effort would be well established, and the foreshadowing of future conflict would have begun to appear. Table 2, indicating some of the major events that occurred during this period, is presented as a prelude to the rest of the chapter.

TVA requested that bids be submitted by March 29, 1966, and that they include fuel cost for an extended period of time. The inclusion of fuel cost was necessary so that TVA could examine the cost of actually generating electricity as opposed to simply constructing the plant.

TVA's announcement that it would accept bids for either a nuclear or coal plant was a milestone in the development of civilian nuclear power. Before this time, nuclear power was considered feasible only in areas where fossil fuels were very expensive. TVA, however, was considering building a nuclear plant in the midst of large deposits of the cheapest of the fossil fuels. If electricity could be produced in the Tennessee Valley cheaper with nuclear fuel than coal, there would be no area of the country in which nuclear power plants would not have a distinct cost advantage over all types of fossil fuel plants.

TABLE 2

IMPORTANT EVENTS AND DECISIONS IN THE DEVELOPMENT OF TVA'S NUCLEAR POWER PROGRAM - BY YEAR FROM 1966 THROUGH 1969

1966 - Bids are requested for a new generating station powered by either coal or nuclear fuel.

Congress increases TVA's debt ceiling from $0.71 billion to $1.75 billion.

A $122.7 million contract is awarded to G. E. for two 1,100 Kw. nuclear powered BWR's to be constructed at Browns Ferry, Alabama.

TVA and G. E. enter into a flexible contract for fuel for Browns Ferry. The contract will allow TVA to both take over parts of the fuel cycle and take advantage of predicted future costs in the price of uranium.

TVA expands its power program's scope by buying the rights to 225 million tons of reclaimable coal at Camp Breckenridge, Kentucky.

1967 - TVA announces it will activate its option for a third nuclear unit at Browns Ferry and construct a large coal-fired steam plant.

Bids are requested for two large-scale nuclear units. TVA makes no commitment to construct the plant. Rather, it is concerned with gaining information on the present state of the nuclear market.

1968 - TVA awards Westinghouse a $72 million contract for two 1,175 Mw. capacity nuclear PWR reactors for the Sequoyah Nuclear Power Plant. The contract for fuel is again a flexible one.

TVA request bids for the supply of large amounts of nuclear fuel. All bids are rejected as too expensive or of insufficient amount.

Senator Muskie introduces in the U. S. Senate the first thermal pollution bill.

1969 - Construction delays and an increase in the time required for AEC to license a nuclear plant cause an increase in nuclear power plant lead time of about two years.

The FWPCA asserts Alabama's thermal pollution standards are too lax.

Despite the significance of its decision, little attention was directed toward TVA as they embarked upon a study of the bids.

Criticism of the agency's action was isolated and sporadic. In the past, when TVA had attempted to undertake new or different programs the private utilities had been the mainstay of the opposition. As was noted above, the private utilities had been concerned that TVA would expand its service area. Since the self-financing legislation of 1959 had fixed TVA's external boundaries, the private utilities no longer feared that TVA would construct excess capacity and then use it as an excuse to expand into the service area of neighboring utilities. In this instance, when TVA announced it was accepting bids for a possible nuclear power plant, the private utilities raised no opposition.

Given the timing of the Browns Ferry decision, this dearth of concern on the part of private utilities is especially important. TVA, at the time it was examining the bids for the nuclear and coal plants, had already committed the majority of funds under the $750 million debt ceiling established in 1959. Shortly after accepting the bids, it had to appeal to Congress to raise that limit by $1 billion. Because of the much larger capital expenditure required for a nuclear power plant than a coal-fired plant, TVA's debt ceiling has been an important factor throughout the development of the nuclear power dimension of its power program. An opponent of TVA as effective as the private utility industry had been in the past could have used this as means to hamper development of the program. However, during testimony

before the House Committee on Public Works, no individual or group attempted to link the increase in TVA's debt ceiling directly to its nuclear power program. In fact, there was no opposition to the ceiling increase from any source.[18]

There were, however, two sources of criticism of TVA's potential move to nuclear power. First, there was a volley of criticism levied by opponents of the TVA concept. Opponents of broad-scale government intervention in the economy perceived this as an illegitimate move by a government corporation. They perceived TVA as expanding into yet another arena, nuclear power, that could be better served by the free enterprise system. To these people, any change that TVA made would be considered, as a matter of principle, an unwelcome one. The voice of these critics was primarily news editorials in sources outside of the Tennessee Valley area. For example, an editorial in the Roanoke Times, from Roanoke, Virginia, accused TVA of acting "without congressional authorization," and labeled its activity "typical of TVA's expansionist policy."[19]

The second and principal source of criticism of TVA's potential move to nuclear power was the coal industry. The industry attacked the decision on two fronts: the limited liability of utilities for nuclear accidents and the uncertainty about the cost of nuclear-generated electricity. Brice O'Brien, general counsel for the National

---

[18]U. S. Congress, House, Committee on Public Works, TVA Bond Issue Increase 89th Cong., 2d Sess., 1966.

[19]Roanoke Times, July 5, 1967.

Coal Association, appeared before the Joint Atomic Energy Committee and attacked the limited liability clause of the Price-Anderson Act.[20] O'Brien, claiming the legislation indicated utilities' lack of faith in the safety of nuclear power used this conclusion to criticize TVA's potential move to nuclear power.[21]

Concerning uncertainty about the cost of nuclear power, Joseph E. Moody, President of the National Coal Policy Conference, Incorporated, wrote an open letter to TVA officials in which he labeled "grossly unfair" the agency's "attempt to equate an assured cost based on the utilization of coal with the speculative and conjectural costs which the utilization of nuclear power of necessity entails."[22] Moody's letter was widely circulated and was printed in many newspapers throughout the country. Despite these scattered outbursts of criticism

---

[20]The Price-Anderson Act is a much disputed bill passed by Congress in 1957 that limits the liability of any of the parties involved in case of a nuclear power plant accident. Harold P. Green, a critic of nuclear power in general, and the Price-Anderson Act in particular, describes the Act as follows: "The Price Anderson Act requires every nuclear power plant operator to carry $82 million in liability insurance, the maximum available from the insurance industry. Over and above this, there is a government indemnity of $478 million which protects anyone who may have liability. When these sums are exhausted at the level of $560 million of liability, the Act explicitly cuts off any further liability. For example, if a nuclear power plant accident were to result in a liability of a billion dollars, liability claims would be settled on the basis of somewhat more than fifty cents on the dollar. The effect of this is that there is zero possibility that anyone in the nuclear industry would have to pay one penny's worth of liability claims out of his own pocket." Harold P. Green, "The Risk Benefit Calculus in Nuclear Power Licensing," in Nuclear Power and the Public, ed. by Harry Forman (Garden City, New York: Doubleday & Company, Inc., 1972), p. 170.

[21]Knoxville News-Sentinel, July 21, 1966.

[22]Memphis Commercial Appeal, March 29, 1966.

against TVA's expanding its program technology to include nuclear plants, the increasing levels of complexity, change and uncertainty that were beginning to characterize the use of coal were not related to uranium or nuclear technology.

In addition to being a milestone in the development of civilian nuclear power, TVA's decision to let bids for a coal or nuclear plant foreshadowed a dramatic change in the agency's power program. This decision to seriously consider a nuclear plant for the TVA system was the culmination of twenty years of direct and indirect involvement in the construction and operation of nuclear power plants. This high level of comprehensiveness displayed by the TVA decision-making process is mandated by the agency's mission. If TVA is to "lead the way" in providing low-cost electrical energy, it must constantly analyze potential alternatives to traditional types of generating capacity. When these alternatives become technologically feasible, the agency must pioneer in their large-scale application.

It was under these conditions that bids were received for new generating capacity. In addition to several bids to construct coal-fired steam plants, bids to construct nuclear units were received from General Electric Company (G.E.) and Westinghouse. TVA, with the assistance of S. M. Stoller Associates of New York, a private engineering consulting firm, examined the bids for over two months. Their "economic evaluations" included:

> the cost of plant investment; fuel; plant operation and maintenance; transmission investment, operation,

maintenance, and losses; nuclear insurance; and other direct costs.[23]

On June 17th TVA announced it was awarding to G.E. a $122.7 million contract for the construction of two 1,000 Mw. nuclear-powered boiling water reactors (BWR). The units were to be built at Browns Ferry in northern Alabama. The total project cost was estimated at $247 million. The first unit was to be generating electricity in 1970.

Not since Congress had approved funds for construction of its first peace time coal-fired steam plant in 1949 had TVA adopted a new technology. The autonomy that had been granted the agency by the 1959 self-financing legislation made the Browns Ferry decision a simpler and speedier process than had occurred between 1946 and 1949. Although there is no reason to believe Congress would have disapproved of TVA's expanding its power program technology to include a nuclear plant, it might have been a time-consuming process for the agency to gain the necessary $122.7 million appropriation.

TVA, with the announcement concerning the Browns Ferry plant, issued a report explaining its decision. The report, an economic evaluation of the alternatives open to TVA, concluded that a BWR would save the agency approximately $8 million a year over a coal-fired steam plant.[24] The importance of this report and its findings to the future

---

[23]Tennessee Valley Authority, Comparison of Coal-Fired and Nuclear Power Plants for the TVA System (Chattanooga, Tennessee: Tennessee Valley Authority - Office of Power, 1966), p. 3.

[24]Ibid., p. 15.

of nuclear power was immediately apparent. Nuclear News, a trade journal for the nuclear industry, noted

> The 36-page explanation of TVA's decision to go nuclear has been called 'the most important economic analysis of comparative nuclear and coal-fired power-plant costs since the "Oyster Creek Report."'[25]

In the report, TVA directly addressed criticisms about the uncertainty of the cost of a nuclear facility:

> Although a nuclear plant is new to the TVA system, there are at least two important factors lending assurance to the adequacy of the cost estimates for the nuclear plants. Approximately two-thirds of the estimated total direct cost of the nuclear plants is for equipment being supplied by the manufacturer under a firm contract price (not subject to escalation), whereas only about 14 percent (the turbogenerator price) of the estimated direct cost of the conventional plant is firm. The other factor is the size of the contingency allowance included in the nuclear plant cost estimate. This allowance is about the same as the $12.4 million allowed for the conventional Cumberland City plant, but, since only about one-third of the nuclear plant direct costs are subject to change, the nuclear contingency allowance is quite generous compared to that for the coal-fired plant.[26]

An essential part of the contract between TVA and G.E. related to the fuel component. The contract required G.E. to handle all aspects of the fuel cycle during the first few years of the contract. Options were available to TVA in later years, however, both to take over parts of the fuel cycle operation and to purchase fuel from other

---

[25] Nuclear News, August 9, 1966, p. 8.

[26] Tennessee Valley Authority, Comparison of Coal-Fired and Nuclear Power Plants for the TVA System, p. 5.

suppliers. Because TVA predicted the price of uranium would drop in the 1970's, it wanted to be able to take advantage of such conditions.[27] Also, TVA officials believed agency personnel would develop expertise in fuel cycle matters, thus allowing the agency to operate some parts of the fuel cycle. If these events were to transpire, TVA would be better able to accomplish its mission. A drop in fuel prices would mean a drop in its electric rates, and if TVA could cut cost by entering the nuclear fuel cycle it would again be pioneering ways to lower the cost of electricity.

AFTERMATH

The first few years following TVA's decision to build the Browns Ferry nuclear power plant were uneventful, with 1967 through 1969 best characterized as an extension of the early and middle 1960's. TVA relations with its environment, including Congress and the coal industry, were very amiable. TVA officials had placated coal industry leaders by assuring them its consumption of coal would continue to increase. Also, the agency was successful in purchasing coal in the quantities it desired. The power program, during this period, experienced rapid/extensive growth in size.

TVA's 1967 annual review of power needs focused on generating capacity needed five years in the future. Projections indicated that

---

[27] G. O. Wessenauer, "Comprehensive Fuel Service for Browns Ferry," presented at the Conference on Nuclear Fuel Exploration to Power Reactors, Southern Interstate Nuclear Board, Skirvin Hotel, Oklahoma City, Oklahoma, May 24, 1968.

construction of new generating capacity was required to meet increases in electricity consumption of more than one million Kw. a year.

TVA's usual procedure was to let bids for the generating capacity necessary to meet future needs. The bids received would then be examined and the contracts awarded. This process requires several months to complete. The lead time for large-scale nuclear power plants, however, was increasing, and it was doubtful the agency could go through its usual bidding procedure and still meet its generating commitments in 1972. TVA responded by reverting to the bids it had received in 1966 when it awarded the Browns Ferry contract to G.E. The agency activated an option it had maintained with G.E. for a third nuclear unit at Browns Ferry. Simultaneously, it announced it would construct the Cumberland Steam Plant. This was the coal-fired plant on which the agency had received bids to compare with the Browns Ferry plant.

TVA then began anticipating needs further into the future. The next month, July 1967, the agency requested bids for two large scale nuclear units without making a specific commitment as to when or if these plants would be built. The bids were sought to gain more information on the state of the market for future generating capacity. Because the bids received were all labeled unsatisfactory, the agency entered into a series of negotiations with a number of bidders. In April, the agency announced the awarding of a $72 million contract to Westinghouse for two PWR nuclear units. Each unit was to be 1,175 Kw. in capacity, and the plant location, unannounced at the time, was to

be in the eastern portion of the TVA service area. Eventually, it would be named Sequoyah and located in southeast Tennessee.

As it had done with Browns Ferry, TVA included in the contract for the nuclear units a series of fuel options that could be activated at a later date. The option TVA chose was for $87 million and included both fuel and services. Westinghouse was to provide the bulk of the fuel for the plant from 1973 to 1984.

Shortly after activating the fuel option with Westinghouse, TVA let bids for large quantities of uranium to power its nuclear plants well into the future. The agency, after contacting every uranium supplier in the U. S., rejected all bids as too expensive and/or of insufficient amounts. The number of nuclear plants under construction in the late 1960's had created a strain on the nuclear fuel industry. In 1967, when TVA requested these bids, there was concern in the uranium market over "the ability of the uranium mining and milling industry to meet the long-term demands for uranium."[28] TVA made no other attempts to expand its uranium holdings or generating capacity during the rest of the 1960's.

During the 1960's, TVA seemed firmly in command of the development of its power program. However, several problems began to develop in the latter part of the decade that would eventually cause the agency a great deal of concern and expense in its nuclear efforts. Two things

---

[28] U. S. Atomic Energy Commission, The Nuclear Industry - 1968 (Washington, D.C.: U. S. Government Printing Office, 1969), p. 28.

especially can be distinguished as origins of future problems: increased lead time in constructing of nuclear power plants and thermal pollution at nuclear plants. Although these factors had no significance for program development in the 1960's, they are described here for two reasons. First, they depict the simple/static condition of TVA's environment during the late 1960's. Second, they are the causes from which that environment eventually would shift to a complex/dynamic state.

The increasing lead-time of nuclear power plants had two sources: construction delays and an increase in the time required for the process of AEC licensing. Construction delays were caused, in large part, by delays experienced by Babcock and Wilcox in delivering pressure vessels. The company, which had experienced labor problems, was as much as sixteen months behind in its deliveries. Concerning AEC licensing, the average time required by AEC to issue a license had increased to over thirteen months from an average of 8.3 months only four years previously. This was the result of a more elaborate and open licensing process instituted by AEC. These factors resulted in TVA's orders for new nuclear power units being lower in 1969 than at any time since the shift to nuclear power had begun in 1965.[29]

---

[29]This downward shift was attributed by the AEC to the increased lead time of nuclear plants. When the lead time for nuclear plants increased, utilities that required additional generating capacity before the new lead time would expire were forced to choose a fossil fuel plant with a shorter lead time. See. U. S. Atomic Energy Commission, The Nuclear Industry - 1969 (Washington, D.C.: U. S. Government Printing Office, 1970), pp. 10-2.

Thermal pollution first became widely recognized as a matter of concern and as an important problem with nuclear power plants in 1968. In the summer of that year, the first of a series of bills dealing with thermal pollution was introduced into the U. S. Senate by Senator Edmund Muskie (D. Maine). Eventually thermal pollution would prove to be a major point of conflict between TVA and its external environment. In 1968, however, the agency had no reason to anticipate this and ordered a diffuser system of pipes[30] for the Browns Ferry plant. The system would discharge daily an estimated 2.8 billion gallons of water back into its source.

The following year the thermal pollution problem intensified. Utilities faced tremendous difficulty in dealing with this problem because of two uncertainties that developed: how much thermal pollution was "too much" and who had jurisdiction over the problem.

TVA attempted to overcome the former uncertainty by entering into a series of joint studies with the Federal Water Pollution Control Administration (FWPCA), and by setting up procedures to study the effects of the Browns Ferry plant on the source body of its cooling water. This, however, would not alleviate the thermal pollution problem of Browns Ferry. The cooling system at Browns Ferry had been designed to meet Alabama water quality standards of 93°F maximum and a

---

[30] A diffuser system is a large network of pipes. It is spread over a large area of the body of water where the heated water discharge from the nuclear unit is pumped. The heated water is carried through the pipes and dispersed over a large area. Thus, its effects are spread out over a larger area and the maximum temperature of the source body is not as high.

10°F rise. The FWPCA, however, considered these to be too high, and questions were being raised over who had jurisdiction over the problem. This issue would not be settled for several years. Evenutally an agency not in existence at this time, the Environmental Protection Agency, would dominate the issue.

The only other existing dimension of TVA's environment that would later become a problem was TVA - Congressional relations. TVA interacted with Congress along three dimensions from 1966 to 1969. First, Senate approval was required for presidential nominees to the board of directors. In 1966, President Johnson nominated Don McBride to fill a vacancy on the board. McBride's confirmation hearing before the Senate Public Works Committee[31] was one hour and ten minutes long. It consisted, primarily, of assurances from senators and congressmen from McBride's home state of Oklahoma that he would make an outstanding board member.

In 1969, President Nixon renominated Aubrey Wagner for a second term as chairman. Wagner had been with TVA since 1934 and was its general manager from 1954 until President Kennedy appointed him to chair its board in 1961. Wagner's confirmation hearing[32] was thirty-eight minutes long. Nobody connected with the brief hearing had

---

[31] U. S. Congress, Senate, Committee on Public Works, Nomination of Don McBride to be a Member of the Board of Directors of the Tennessee Valley Authority, 89th Cong., 2d Sess., 1966.

[32] U. S. Congress, Senate, Committee on Public Works, Nomination of Aubrey J. Wagner to be a Member of the Board of Directors of the Tennessee Valley Authority, 91st Cong., 1st Sess., 1970.

anything but praise for Wagner. In neither case did the Senate attempt to exert any influence over the nominee as to his future behavior as a TVA board member. Thus, the Senate provided no reason for either the old chairman or the new director to believe that Congress was concerned about any TVA program.

The second dimension along which TVA and Congress interacted concerned TVA's attempt to have Congress raise its debt ceiling. In June of 1966, TVA officials appeared before Congress to request a debt ceiling increase from $750 million to $1.75 billion. Chairman Wagner presented TVA's case as follows:

> The $750 million borrowing authority is nearing exhaustion. In addition to the $345 million of bonds and notes outstanding, $155 million will have to be issued to finance completion of work already underway. This leaves only $250 million to finance future power facilities, all of which will be committed to finance two new units just ordered. Generating plants now require a lead time of 4 to 5 years until they are placed in service. One of the recently ordered units will be in service in 1970, the other in 1971.
>
> Looking to the near future, normal increase in power demands in the TVA area will require that TVA provide additional generating capacity of about 1½ million kilowatts a year. Over a 7 year period at current prices this would mean the investment of an additional $2 billion for generating and transmission facilities. Of this total we estimate that power reserves will provide some $0.8 billion, leaving about $1.2 billion to be supplied through borrowings.
>
> If the region TVA supplies with power is to continue to grow and to prosper it must have assurance that TVA can build the necessary generating and transmission facilities in time to meet its expanding requirements. Passage of the pending legislation increasing by $1 billion the amount of bonds which can be outstanding will provide this assurance for an additional 6 or 7 years.[33]

---

[33]U. S. Congress, Senate, Subcommittee on Flood Control-Rivers and Harbors of the Committee on Public Works, Revenue Bond Financing by the TVA, 89th Cong., 2d Sess., 1966, pp. 21-2.

Throughout the brief hearing, no one spoke in opposition to the increase and it was quickly approved.

The third dimension along which TVA and Congress interacted was the appropriations process. Because the self-financing amendment of 1959 made the power program self-financing, TVA is not required to receive congressional approval for power program related expenditures. However, the agency always submits its power program budget to Congress along with its request for funds for its non-power programs. From 1966 to 1969, committee hearings on TVA's budget focused predominantly on non-power program expenditures. Further, TVA's dramatic expansion into nuclear power was little more than acknowledged. The following exchange in 1966 between Congressman Joe L. Evins (D., Tenn.) and Chairman Wagner is typical of that part of committee hearings that addressed TVA's growing nuclear contingent:

> Mr. Evins. What are your plans with respect to the use of nuclear power reactors?
>
> Mr. Wagner. Mr. Chairman, as you know, we are completely dedicated to providing power for the Tennessee Valley area at the lowest possible cost consistent with sound management. Technology in the nuclear reactor field has developed to a point where we believe that power from nuclear reactors may be competitive with power from conventional coal-fired plants in our area. For this reason, we have taken bids on a unit of about a million kilowatts. In taking those bids, we asked for bids on a conventional coal-fired plant and its fuel supply and, alternatively, on a nuclear-fired plant and its fuel supply. We are analyzing those bids at the present time.
>
> This is an extremely complex matter because of the many, many factors involved, but we are analyzing those bids and, if it develops that a nuclear-

> fired plant would provide us with lower cost power than the conventional plant, we would make the award that way. Our objective is always to get power for the region at the lowest cost.[34]

Neither Evins nor any member of the subcommittee made an attempt to follow up this line of questioning. Evins' next question related to TVA expenditures for transmission facilities. The topic of nuclear power was not reopened.

CONCLUSION

The year 1969 ended a decade of dramatic growth and development for both nuclear power and TVA. During the decade nuclear generating of electricity had gone from a number of small experimental plants to a large-scale alternative to fossil-fuel plants. The end of the 1960's marked the end of an era for the nuclear power industry. During this decade, the decisions to build nuclear or fossil-fuel plants were based primarily on economics. The 1970's, however, would bring a dramatic change in this situation as the externalities of nuclear generating of electricity would become a focus of concern for an enlarging sector of society.

The change in TVA's power program was no less dramatic than the change that had occurred in the nuclear power industry. Important changes occurred in the power program's size, scope and technology. Changes in size and technology were rapid in pace and extensive in

---

[34] U. S. Congress, House, Subcommittee of the Committee on Appropriations, Public Works Appropriations for 1967, Part 2, 89th Cong., 2d Sess., 1966, p. 744.

magnitude while the change in scope was rapid in pace but limited in magnitude. The size of the power program increased from 17.2 million Kw. in 1966 to 19.4 in early 1970. However, more importantly, during this period TVA committed itself to 8.3 million Kw. in additional generating capacity, of which 5.7 million Kw. would be nuclear powered. This commitment was almost one half the size of TVA's total generating capacity in 1966.

TVA's decision to expand into the coal market, at the cost of $7.4 million, provided the agency with 225 million tons of retrievable coal. This rapid expansion of scope to help protect the agency from the vagaries of the coal market was limited in that this one source could only supply a small part of total agency needs. Further, the expansion of scope was also limited in that the agency only purchased rights to the coal. When TVA decided, in 1969, to use the coal the mining aspect of the operation was contracted out.

TVA's decision to adopt this new technology, although foreshadowed by twenty years of active interest in the area, occurred very rapidly. The move was unparalled in any area where fossil fuels were not extremely expensive. Also, the magnitude of the change both at the instance of adoption and over the following four years was extensive. The Browns Ferry plant's individual units were larger than any other unit operating or under construction in the world, and the extent of TVA's commitment between 1966 and 1969 far exceeded that made by any other utility in the country.

Despite these important program changes, the place of the power program within TVA and its mission did not experience any change. The

power program maintained its dominance over other programs within TVA. The agency was still firmly committed to providing low-cost electrical energy to the Tennessee Valley and, in so doing, provided leadership in this area to other utilities.

CHAPTER IV

PROGRAM DEVELOPMENT IN AN UNCERTAIN ENVIRONMENT

TVA's annual report for the first full fiscal year of the new decade, 1970 to 1971, contained the following statement:

> TVA is looking to its nuclear plants to provide a major part of power supply during this and succeeding decades. Not only will they produce relatively low-cost power, but they will do so cleanly, an instrumental factor in helping protect the environment.[1]

This statement is indicative of TVA's continued optimism toward nuclear power. However, as noted in the last chapter, forces were gathering which would belie optimism and alter significantly the context of TVA's nuclear power efforts. The forces and their effects are the major focus of this chapter. Discussion will be aided by summarizing at this point key decisions and events concerning nuclear power in TVA (see Table 3).

ENVIRONMENTAL CHANGES

Even by 1970, TVA's environment was rapidly changing from a simple/static state to a complex/dynamic one. Three specific events can be distinguished as occurring around the turn of the decade that would have long-range consequences for the development of TVA's power program. First, thermal pollution, which had first developed as a

---

[1] Tennessee Valley Authority, Annual Report of the Tennessee Valley Authority: 1970 - 1971 (Knoxville: Tennessee Valley Authority, 1971), p. 33.

TABLE 3

DEVELOPMENT OF TVA'S POWER PROGRAM, BY YEAR
FROM 1970 THROUGH 1977

1970 - NEPA is signed into law.

TVA awards Babcox and Wilcox and Westinghouse contracts for two 1,100 Mw. nuclear units each. The units will make up the Watts Bar Nuclear Power Plant and the Bellefonte Nuclear Power Plant.

TVA's debt ceiling is raised from $1.75 billion to $3.5 billion.

1971 - The Alabama Water Improvement Commission establishes thermal pollution standards of 93°F maximum and 5°F maximum change. These levels are below what the Browns Ferry diffuser system was designed to accomplish.

The U. S. Court of Appeals in the District of Columbia rules in the Calvert Cliffs case, requiring the AEC to certify utilities' compliance with NEPA. The order is made retroactive to January 1, 1970.

1972 - TVA requests bids for four 1,200 Mw. nuclear generating units. The plant, to be built in Hartsville, Tennessee, will be the world's largest.

TVA spends $2 million for mineral rights and options on mineral right for uranium.

TVA announces it will, as a last resort, install cooling towers at Browns Ferry.

TVA enacts a more stringent policy concerning reclamation toward suppliers of strip-mined coal.

1973 - TVA invites 53 companies to bid to supply the agency with 86 million pounds of uranium. No acceptable bids were received.

TVA capitulates to EPA and agrees to construct cooling towers at all of its nuclear plants.

1974 - The price of coal in new contracts rises from $11.30 a ton to $30 a ton over the year.

TVA makes a conditional offer to buy Peabody Coal Company.

TVA requests bids for nuclear power units for two new nuclear power plants: Phipps Bend and Yellow Creek.

TVA adds a mitigation program to expand its power program scope.

TABLE 3 (Continued)

1975 -	A large fire breaks out at the Browns Ferry nuclear power plant.
	U. S. Senate Committee on Public Works holds oversight hearings on TVA.
	President Ford nominates James F. Hooper to fill a vacancy on the TVA Board of Directors.
	TVA rescinds its offer to buy Peabody Coal Company.
1976 -	The Senate Committee on Public Works rejects the Hooper nomination.
	President Ford nominates Thomas L. Longshore to fill the year-old vacancy on the TVA Board of Directors.
	The Senate Committee on Public Works rejects the Longshore nomination.
	TVA expands its holding of uranium deposits to a total of 900,000 acres of both developed and undeveloped uranium lands.

minor problem for TVA in the late 1960's, would become a major problem for the agency as a result of the National Environmental Policy Act (NEPA).[2] Second, the use of coal was creating both pollution and cost problems for TVA. How to overcome the effects of SO_2 emissions and achieve clean air became a source of conflict between TVA and EPA. Further, the rapid upward spiral in the cost of coal was significant in the future development of the power program because TVA officials consider coal to be the only alternative to nuclear energy. Third, the rates charged by TVA for its electricity began to rise sharply. Although TVA had instituted two relatively small rate increases in the late 1960's, the increases in the early and middle 1970's were far more dramatic. Largely in response to these rate increases, TVA's relations with Congress, although amiable during the first part of the decade, would begin to change in 1973.

The first opposition to TVA's use of nuclear power arose in 1970 because of thermal pollution. In April the AEC held hearings concerning a construction permit for TVA's Sequoyah plant. Two faculty members from the Biology Department at the University of Tennessee at Chattanooga, Dr. R. J. Litchford and Mr. Eric Morgan, criticized the high level of thermal pollution the proposed diffuser system would allow.[3]

---

[2] The National Environmental Policy Act of 1969, Pub.L. No. 91-190, January 1, 1970, 83 Stat. 852, 452 U.S.C. Sections 4321-4347 (1970).

[3] Chattanooga Times, April 24, 1970.

In 1970, the level of allowable thermal pollution was still a point of conflict. TVA was making decisions on the criterion of a maximum change of 10°F and a maximum temperature of 93°F established by the state of Alabama. However, the federal government was challenging the states' jurisdiction in this area. The Interior Department, through the Justice Department, brought its first suit against a utility for thermal pollution from a nuclear power plant. The Florida Power and Light Company, which had not violated state law, was charged with excessive thermal pollution of Biscayne Bay. This conflict was important to TVA because several federal agencies, the Federal Water Pollution Control Administration especially, had stated displeasure with TVA's standards even though they complied with state law.

The most important event of this time period, in respect to the future development of TVA's power program and the thermal pollution issue, was the enactment of NEPA. President Nixon, to dramatize his support for a clean environment, had signed NEPA as his first official act of the new decade. The law, labeled by one observer as "the most sweeping environmental law ever enacted by a United States Congress,"[4] was an attempt to force federal agencies to include environmental considerations in their decision-making processes. The Act's main instrument for accomplishing this is the environmental impact statement (EIS).

---

[4]Richard A. Liroff, A National Policy for the Environment (Bloomington: Indiana University Press, 1976), p. 3.

The most critical dimension of NEPA has proven to be its vagueness. This has resulted in a long process of judicial interpretation and allowed environmental groups a means by which to intervene in the decision-making process of federal agencies.[5]

SO_2 emissions at this time were not a source of contention for TVA. The coal marketplace, however, was posing serious problems. In 1969 the agency had rejected as too high a number of bids by coal companies to provide its steam plants with coal. In addition, several companies were refusing to honor long term contracts to supply coal. In mid-1970, TVA, with its stockpiles at very low levels, was forced to pay $9 a ton for coal. This was twice what the agency had paid the previous year.

In 1967, TVA had raised its rates for residential customers for the first time since its inception in 1933. Over these 34 years, the agency had continually decreased rates by taking advantage of the economies of scale. The agency continuously built larger coal-fired steam plants to meet the increasing demand for electricity. Inflation, however, was wearing away at this down-sloping price curve, and the small increase instituted in 1967 was only a prelude to things to come.

---

[5]For a discussion of the development of NEPA and the role of the courts and environmental groups in this process, see Liroff, A National Policy for the Environment: NEPA and Its Aftermath. Also, an interesting discussion of the development of the Act, with specific reference to judicial interpretation, is Frederick R. Anderson, NEPA in the Courts (published by Resources for the Future, Inc., distributed by the Johns Hopkins University Press: Baltimore, 1973).

In August, 1969, rates for residential customers were raised again. The frustration high-level TVA officials experienced is evident in the following statement taken from the agency's 1970 annual power report:

> TVA's policy is to have electric rates as low as possible so that electricity will be as useful as possible. But the agency also is required, under the TVA Act, to charge rates which will produce gross power revenue sufficient to cover operation and maintenance expense, payments in lieu of taxes, payments to the U.S. Treasury, debt service on bonds, and a reasonable margin.
>
> TVA's costs have been climbing rapidly, as have those of other power systems. And in spite of the previous rate increases, persisting increases in TVA's costs continue to erode the margin of revenues above expenses.
>
> In the 4-year period 1965 to 1969, the cost of money increased 60 percent and the rate for the dividend to the Treasury rose 38 percent; the average labor cost per employee increased 28 percent; the cost of coal increased 11 percent. Late in fiscal 1970 much sharper price increases appeared in new coal bids - some of them nearly double the prices TVA had been paying two years earlier.[6]

At first glance, the rate increases that TVA had instituted would not seem to be very dramatic. Since TVA's 1970 rates were about 50 percent of the national average,[7] a 10 percent rate increase would equal only half the dollar amount a similar rate increase would produce in most places outside the TVA service area. However, rate is only one-half the equation for electric bills. The other half is amount of electricity consumed, and, in 1970, the average home in the TVA service area consumed over twice the national average.[8]

---

[6]Tennessee Valley Authority, Power Annual Report - 1970 (Tennessee Valley Authority: Knoxville, Tennessee, 1971), p. 14.

[7]Ibid.

[8]Ibid., p. 10.

The rate increases resulted in increasing attention being focused on the agency by Valley congressmen. Congressman Richard Fulton (D. Tenn.) requested a congressional investigation of TVA power rates,[9] and Congressman Joe Evins (D. Tenn.) criticized TVA officials saying that they "may be losing sight of the fact they are to serve the public in general and not just the TVA as some sort of isolated institution."[10]

Despite this increased interest in TVA by Valley congressmen, in 1970 TVA relations with Congress on the whole were amiable. During that year, agency officials appeared before Congress for two reasons: to present the agency's annual budget and to request another increase in the debt ceiling. In both instances, the hearings can be characterized as routine and uninquisitive. This is especially true concerning the agency's activities in the area of nuclear power. During the appropriations hearings both the House and Senate subcommittees displayed a low-level of critical interest in TVA's activities in power. The only interest shown was a few questions relating to delays in plant construction and cost increases.[11] In the House, Howard W. Robison (R. NY) expressed some

---

[9] Knoxville Journal, July 29, 1970.

[10] Ibid.

[11] U. S. Congress, Senate, Subcommittee of the Committee on Appropriations, Public Works for Water, Pollution Control and Power Development and Atomic Energy Commission Appropriations Bill, Part 3: Vol. 1, 91st Cong., 2d Sess., 1970.

concern over the general problem of thermal pollution. For the most part, however, subcommittee members can be described as both apathetic and uninformed about TVA activities in the area of nuclear power. The following exchange between TVA Board Chairman Wagner, Manager of Power Watson, and Congressman John N. Rhodes (R. Az.) is the only attention given to the agency's nuclear power program except for Robison's general questions.

> Mr. Rhodes. What about nuclear plants; do you have one under construction?
>
> Mr. Wagner. One under construction, and we have done some site preparation on the second one and hope to get our construction permit shortly from the AEC.
>
> Mr. Rhodes. When will they be on line?
>
> Mr. Watson. October of 1971 - I believe. . . .
>
> Mr. Rhodes. I notice that the Browns Ferry unit has a capacity of 1,152,000 Kw. This is a rather large plant.
>
> Mr. Watson. Yes, sir. . . .[12]

The hearings concerning TVA's request to have its debt ceiling increased from $1.75 billion to $3.5 billion[13] were of a similar nature. In both the Senate[14] and the House[15] the hearings consisted primarily

---

[12] Ibid.

[13] TVA originally requested an increase to $5 billion. However, the bill that finally passed the House and Senate allowed an increase to $3.5 billion.

[14] U. S. Congress, Senate, Subcommittee on Flood Control-Rivers and Harbors of the Committee on Public Works, Increase in Statutory Limitation of TVA to Issue Bonds, 89th Cong., 2d Sess., 1966.

[15] U. S. Congress, House, Committee on Public Works, TVA Act Amendment - Increase Borrowing Authority, 91st Cong., 2d Sess., 1970.

of statements by congressional representatives from the Tennessee Valley in support of the agency's request. The following statement by Congressman William E. Brock (R. Tenn.)[16] typifies the testimony given before both the House and the Senate:

> Mr. Brock. Mr. Chairman, my home of Chattanooga is the home of the Tennessee Valley Authority's Office of Power. This happy circumstance has given me the opportunity to become acquainted with the men who run TVA's power system and will have much of the responsibility for utilizing the increased borrowing authority provided for in H.R. 19104 and 16601.
>
> The reputation of these officials for dedication, experience, and knowledge is well known in Chattanooga. Backing up this reputation is an outstanding record of achievement. An idea of the magnitude of this record can be obtained by looking at the generating plants TVA started in the short time that I have been in Congress.
>
> I became a Member of Congress in January of 1965. In October of 1965, TVA started building a 1,150,000 kilowatt unit at Paradise steam plant in Kentucky. Browns Ferry, TVA's first nuclear plant having three units with a total capacity of 3,456,000 kilowatts was started in September of 1966. This was followed in March of 1968 by two-unit 2,600,000 kilowatt-capacity Cumberland steam plant. Finally, site preparation for TVA's second nuclear plant, Sequoyah near Chattanooga, was started in March of 1968. This plant will have a 2,441,150 kilowatt capacity.
>
> Thus in 5 short years TVA has started construction on 7 generating units which, when completed, will have a capacity of more than 9,600,000 kilowatts. The managerial ability shown in the undertaking of this vast construction program warrants the increase we are seeking in TVA's borrowing authority.
>
> The fact that so much generating capacity had to be started in this short period of time indicates

---

[16] Two years later Brock would be elected to the Senate from the state of Tennessee. Shortly after his election to the U. S. Senate, Brock would become one of the most vocal of TVA's critics.

> that the increase in borrowing authority to $5 billion provided in the proposed legislation is not only justified, but required. I ask that the committee give favorable consideration to this legislation.
>
> Thank you, Mr. Chairman.[17]

An understanding of the nature of these hearings is important in trying to understand the development of TVA's power program. The hearings indicate a lack of concern on the part of Congress over TVA activity in 1970. This lack of concern coupled with the agency's borrowing power provided TVA a tremendous amount of autonomy in developing its power program. This autonomy allowed the agency to pursue its mission without fear of congressional veto of its decisions or interference in its implementation of those decisions.

Throughout the years ahead, TVA's annual review of power needs would indicate a need for commitments to massive new generating capacity. This would be the result of a continued increase in demand, but more importantly, it would reflect the longer lead time required for building nuclear plants. In 1967, TVA was concerned with generating capacity needed to meet demand five years in the future. By 1977, however, the lead time for a nuclear power plant would be 12 years, requiring commitments be made for generating capacity 12 years in the future. This would require the power program's size and scope to expand at a rapid pace and over an extensive magnitude. However, the high levels of complexity and change in its environment would act as constraints on agency decision-making. Potentially, the most powerful

---

[17] House Hearing, TVA Act Amendment - Increase Borrowing Authority, p. 23.

constraint on TVA was Congress. If Congress decided to take away from TVA the autonomy it had provided the agency with passage of the self-financing amendment in 1959, TVA's ability to respond to projections for increased demands in the future would be greatly inhibited. The time necessary to gain congressional approval for changes in the size and scope of its power program, especially given the high level of controversy such hearings would be sure to generate, could destroy totally the viability of nuclear power plants in the TVA system. For this reason, TVA relations with Congress will be a main point of focus throughout this chapter.

NUCLEAR EXPANSION

Throughout this time period, 1970 to 1977, TVA committed itself to adding to its capacity twelve large generating units at five plants. All twelve units were to be nuclear powered. This rapid and extensive increase in size marked TVA as having the nation's largest commitment to nuclear power. In addition, program scope also experienced important change during this time period as TVA entered the nuclear fuel cycle and established a mitigation program to help ease the social and economic impact of its nuclear plants on the communities in which they were being constructed. Although no new technologies were added to the program, the dramatic increase in the agency's commitment to nuclear units made it the dominant technology in the agency. The essential question of interest here is how and why the program developed at such a rapid rate and in such an extensive magnitude.

Environmental Change

Throughout the early and middle 1970's the environmental problems foreshadowed for TVA in 1970 came to fruition. Four situations in particular demanded a response from TVA: 1) the thermal pollution problem; 2) the increasingly bleak coal situation; 3) a rise in opposition to nuclear power within the Valley; and 4) changing relationships with Congress.

Thermal Pollution.--Although it had been a matter of some concern in the late 1960's, not until NEPA became law did thermal pollution pose a serious problem for TVA. The Environmental Protection Agency (EPA), which was established by NEPA, directed much of its early activity at lowering levels of thermal pollution. At the instigation of EPA, TVA officials met in April 1971 with officials from the Alabama Water Improvement Commission and EPA to discuss the heated water discharge from Browns Ferry. Under pressure from EPA, the water improvement commission decided that the maximum allowable temperature of the source body would be 90°F[18] and the maximum increase allowable would be 5°F. This meant the 93°F maximum and 10°F change the Browns Ferry plant had been engineered to produce was unacceptable. Further, EPA had asserted that an 86°F maximum temperature was more suitable. TVA's response, according to the first draft of the Browns Ferry Environmental Impact Statement (EIS) released in July, was to begin studying the possibility of installing cooling towers. The agency, however, made no commitment to install such structures.

---

[18]This maximum figure was eventually lowered to 86°F.

The situation was further complicated when, in July, the U. S. Court of Appeals in the District of Columbia ruled in the Calvert Cliffs decision.[19] The court ruled the AEC failed to fulfill its duties under NEPA when it allowed other agencies to certify utilities' compliance with thermal pollution standards. For TVA, this meant plans for dealing with heated water discharge would have to be approved by the AEC, in addition to the individual state in which the plant was being constructed. Also, the court had ruled that AEC's responsibility began not with the date of its ruling but with the effective date of NEPA, which was January 1, 1970. Thus, TVA had to clear its cooling plans for the Browns Ferry plant with the AEC.

During interviews, several TVA officials expressed bewilderment over the events surrounding the thermal pollution problem in the early 1970's. One official noted, "We were caught with our pants down. We had acted in good faith and naturally figured everything would work out our way." The agency had gone to great expense to tailor each nuclear plant with what it perceived to be adequate cooling facilities. The Watts Bar plant, because of the small size of the water's source body, was even to be fitted with cooling towers. Further, all three of the nuclear plants then under construction complied with all state regulations. Also, the agency was setting up a

---

[19] Calvert Cliffs Coordinating Committee v. Atomic Energy Commission, 449F.2d 1109, 1 ELR 20346 (D.C. Cir. 1971), denied, 404 U.S. 942 (1972).

multi-million dollar testing facility at Browns Ferry both to study the impact of hot water discharge and to develop alternate uses for the waste heat in the discharged water. TVA officials believed their actions had exceeded any reasonable demands that might be placed on the agency.

The thermal pollution issue, for TVA, climaxed in 1972. Early in the year the agency announced that in order to comply with Alabama water quality standards, as enforced by EPA, it would install cooling towers at Browns Ferry. The cooling towers were installed only as a last resort, and their necessity was still a matter of debate both within and outside of TVA. The following statement reflects TVA's attitude toward the situation.

> In complying with these standards, the temperature of the water in the river at the plant can be raised no more than five degrees, nor exceed a maximum temperature of 86 degrees from the addition of heat by the plant. (Water in the river at this location, however, naturally exceeds 86 degrees in some periods during summer months.) Although, in TVA's opinion these restrictive standards are not environmentally necessary, TVA must spend approximately $43 million for cooling towers that will only need to be operated about 28 percent of the time to comply with the standards.
>
> . . . As a result large expenditures are being incurred with no appreciable improvement to the environment.[20]

The conflict between TVA and EPA over thermal pollution at Browns Ferry was not yet over. The decision to install cooling towers

---

[20]Tennessee Valley Authority, Annual Report of the Tennessee Valley Authority: 1973 (Knoxville: Tennessee Valley Authority, 1973), pp. 43-4.

came very late in the construction phase of the plant. The first two units of the plant were scheduled for start-up several months before the cooling towers were to be completed. At a meeting in March, and again by letter in May,[21] the EPA requested TVA to refrain from exceeding the 86°F maximum and 5°F change limitations during the "interim period." TVA refused, noting the standards would be exceeded only 20 percent of the time. Its justification for not complying with EPA's desires between completion of the plant and completion of the cooling towers was articulated as follows:

> Meeting the proposed thermal standards of a 5° rise and 86°F maximum would involve the regulation of upstream reservoirs to provide additional steam-flow at Browns Ferry, the reduction of generation by the Browns Ferry units, or a combination of the two.
>
> Although it is feasible to use limited regulation by the TVA reservoir system to meet the 10°F rise and 93°F maximum criteria, the greater regulation which would be required to meet the more stringent criteria would result in drawdowns of upstream reservoirs so large that TVA does not consider this approach to be practicable. Furthermore, the natural temperature of Wheeler Reservoir exceeds the 86°F on many occasions, in which case the proposed standards could not be realized even with upstream regulation.
>
> TVA considers that the adverse impacts to the environment from increased generation by fossil-fueled plants as a result of reducing generation at Browns Ferry would exceed the questionable environmental benefit to aquatic life, particularly in view of the small percentage of time the proposed 5°F rise and 86°F maximum temperature standard would be exceeded

---

[21] Jack E. Raven, U. S. Environmental Protection Agency, Letter to Dr. F. E. Gartrell, Tennessee Valley Authority, May 22, 1972, Tennessee Valley Authority Office of Health and Environmental Science, Final Environmental Statement - Browns Ferry Nuclear Plant - Units 1, 2, and 3, Vol. 1 (Chattanooga: Tennessee Authority, 1972), pp. 3.12-1-3.12-2.

during the interim period due to plant generation. TVA does not consider the interruption of service to power consumers to be an acceptable alternative in this case.

After taking the overall system requirements and environmental impacts into account, it is judged that the operation of the Browns Ferry plant to meet the 10°F rise and 93°F maximum temperature criteria during the interim period represents the best method of operation.[22]

In September of 1973, TVA resolved the thermal pollution controversy. The agency capitulated to EPA and announced it would spend $42 million to construct cooling towers at its Sequoyah nuclear plant. The cooling towers would allow the agency to maintain the source body for Sequoyah's heated water discharge within the 86.9°F maximum and 5°F change limits set by the state of Tennessee. Along with the announcement, TVA noted the reason for constructing the towers was to prevent the delays in the licensing process that would have ensued. TVA viewed the power brownouts that could have resulted from further delays in the Sequoyah plant as more significant than the dollar expenditure for cooling towers.[23]

This decision meant that all TVA nuclear plants then under construction were to be fitted with cooling towers. Thus, all the plants would be capable of meeting the most stringent thermal pollution standards.[24] Although questions concerning thermal pollution at

---

[22] Ibid., pp. 3.12-3 - 3.12-4.

[23] Chattanooga Times, September 18, 1973.

[24] Tennessee Valley Authority, Annual Report of the Tennessee Valley Authority: 1975 (Knoxville: Tennessee Valley Authority, 1975), pp. 47-8.

these plant sites would still be raised by individuals and community groups, the problem for TVA became one of simply informing the public as to the measures being taken to protect the environment. More importantly, however, this decision removed the spectre of EPA or the NRC delaying the operation of one or more nuclear power plants for environmental reasons.

The thermal pollution controversy can be perceived as a cost-benefit situation. TVA agreed to construct cooling towers at all its nuclear plants only after EPA and the NRC made benefits for so doing exceed the costs. The potential danger to TVA of not being able to supply adequate quantities of electricity to the Tennessee Valley, because of EPA- and NRC-imposed shut-downs of its nuclear contingent, exceeded in cost the several hundred million dollars expended on cooling towers.

The Coal Situation: Air Pollution.--In mid-1972, EPA directed TVA to reduce the level of SO_2 emissions at their eight largest coal-fired steam plants. The date of compliance was set by EPA as July 1975 for two of the plants and July 1977 for the other six. Agency officials asserted the technological means to meet the imposed standards were not available.[25] The source of the problem was not so much the standards EPA had established as it was how those standards would be achieved. TVA officials wanted to install extremely high smoke stacks that would disperse the pollutants over a large area, stating

---

[25] Huntsville Times, June 2, 1972.

that at no point on the ground would EPA clean air standards be violated. EPA countered that such supplementary controls were acceptable only when no other techniques could meet the relevant standards. EPA requested the installation of scrubbers, a technology TVA considered both unproven and too costly. The $1 billion TVA estimated it would have to expend to install scrubbers was ten times the cost it estimated for tall stacks. By November 1973, the two parties were deadlocked, and the dispute seemed certain to end up in court.

The conflict between TVA and EPA continued into 1974. Early in January TVA announced it would install "tall stacks" at one of its coal-fired steam plants. Scrubbers were rejected as being too expensive and too inefficient. A series of negotiating sessions was held with EPA, but the discussions ended without a solution. The following year, EPA became adamant in its insistence that TVA use scrubbers at its coal-fired plants. TVA responded that the authority to require the use of a specific method in the meeting of clean air standards was vested in the states.

The states of Alabama and Kentucky, however, were also dissatisfied with TVA's performance. In Alabama, the Attorney General, at the request of the Alabama Air Pollution Control Commission, filed suit against TVA, contending TVA was not acting in "good faith" in its attempts to reduce air pollution resulting from one of its coal-fired steam plants. In Kentucky, new air quality standards went into effect during 1975. The Kentucky standards related to plant emissions as opposed to resulting ground level pollution, a defeat for TVA, since tall stacks do not affect emissions.

Throughout 1976 and the first half of 1977, the conflict between TVA and EPA continued to intensify. At this time, TVA's strategy for dealing with SO_2 emissions was to use a low to medium sulfur coal combined with tall stacks as a temporary solution. The agency continued to assert scrubbers were unreliable and too expensive to operate. The EPA, however, insisted on installation of scrubbers. By December 1976, compromises had been worked out on some of TVA's smaller coal-fired plants allowing for tall stacks on some units and scrubbers at others. However, EPA insisted TVA install scrubbers at four of their larger plants. TVA estimated the cost at $900 million, roughly equal to the original cost of the plants.

TVA, after exhausting its appeals in the courts, took the issue to the U. S. Congress. As EPA increased pressure on TVA for compliance, Senator Howard Baker introduced legislation, in early 1977, to exempt older plants from certain aspects of EPA standards. Because the legislation covered only those plants that had tall stacks in place by 1974, only one of TVA's plants would have been affected. Although the act was passed in the Senate, it did not pass in the House.

The Coal Situation: Market.--From the point of view of consumers, the market for coal had gone from bad to worse during the late 1960's and early 1970's. When TVA rejected bids in 1969, the reason was as much the small quantities the bidders were willing to guarantee as the high price bidders requested. Although the exact reason for this situation is not readily apparent, TVA Board Member, Don McBride,

concluded that oil companies expanding into the coal and uranium marketplaces had reduced competition.[26]

The Coal Situation: Strip-Mining.--The use of strip-mining as a technique to remove coal from the earth had increased dramatically during the late 1960's. By 1971, the quantity of coal acquired by strip-mining in the United States exceeded all other methods.[27] Also, the amount of strip-mined land that remained "unreclaimed . . . would represent a barren swath one mile wide from New York to San Francisco."[28] This resulted in what the staff of Congressional Quarterly Weekly Report called "One of the fiercest continuing controversies in the environmental field."[29]

At least one member of Congress, Senator Fred R. Harris (D., Okla.), attributed much of the blame for this environmental degradation to TVA. Harris, while touring Appalachia in April of 1972, threatened to "submit a bill forbidding the Tennessee Valley Authority to purchase coal from strip miners." He labeled it a "disgrace" that the agency had "become the largest single consumer of strip-mined coal to supply electric power."[30]

The process of strip-mining has both advantages and disadvantages

---

[26] Memphis Press Semitar, August 13, 1970.

[27] Congressional Quarterly Weekly Report, September 2, 1972, p. 2227.

[28] Ibid.

[29] Ibid.

[30] New York Times, April 7, 1972, p. 15.

relative to deep-mining. In 1973, TVA stated its perception of the situation as follows:

> Coal is still 'kingfuel' for the TVA power system - which has 75 percent of its installed capacity in coal-fired generating units. About half of the coal delivered to TVA to feed the units is produced by strip mining, a method that uses earthmoving equipment to strip overlying earth and rock from shallow coal seams so the coal can be dug from open pits.
>
> This method of coal recovery has many advantages: where seams lie close to the surface, it usually makes more complete use of the coal resource; it is more economical than others (sic) means; in some cases, it makes available a resource which would otherwise be unavailable; and in terms of the miner's safety, it is highly preferred over deep mining.
>
> Such advantages, however, can be offset by severe disadvantages if strip-mined lands are abandoned. Stripped scars on the landscape are long in healing naturally, and meanwhile, the bare earth and exposed coal wastes can open the way to erosion and acid pollution of streams.[31]

TVA's response to the increased criticism was to step up its activity in the area of reclamation. Although the agency had required reclamation provisions in its coal contracts as early as 1965, these provisions became more stringent in the early 1970's.

> Contracts for strip-mined coal now involve a two-step bidding procedure, requiring the producer to submit a detailed mining and reclamation plan that must be approved by specialists in these fields before the producer can qualify as an approved bidder. To provide a more workable enforcement procedure, a portion of the contract payments is withheld by TVA in a reserve account, to be paid with interest when the required reclamation is satisfactorily completed.

---

[31] Tennessee Valley Authority, Power Annual Report: 1973 (Knoxville: Tennessee Valley Authority, 1973), p. 8.

> If it is not, this money is then available for TVA's use in completing any needed work.[32]

This activity in the reclamation area would appear to be an expansion of program scope. However, the process of reclamation proved to be more complicated and expensive than anticipated and TVA's efforts to enforce long-range standards were minimal. The General Accounting Office in a 1972 study labeled unsuccessful these early attempts to control the effects of strip-mining.[33]

Opposition to Use of Nuclear Energy.--Citizens groups' opposition to TVA's use of nuclear energy did not become a problem for the agency until 1974. Prior to that time, the only citizen opposition was an organization formed in Corinth, Mississippi to question a possible nuclear plant in that area. However, in 1974, the issue of the safety of nuclear power plants became a rallying point for several groups of citizens in the TVA service area. This issue, the dominant concern about nuclear power plants being built outside the Tennessee Valley, had not been a major concern within the Valley. TVA officials attribute this to residents of the area "being used to nuclear technology" and willing to "trust in TVA." The Oak Ridge facilities that produced the first atomic bomb, and which remain the center of much defense work in the nuclear field, are in the heart of the TVA service

---

[32]Tennessee Valley Authority, Power Annual Report: 1972 (Knoxville: Tennessee Valley Authority, 1972), p. 5.

[33]General Accounting Office Report, Opportunities for Improvements in Reclaiming Strip-Mined Lands under Coal Purchase Contracts - Tennessee Valley Authority. GAO Report No. B-114850, August 9, 1972.

area. Thus, residents of the Valley have had over three decades to become acclimated to the presence of nuclear power.

The most vocal and persistent of the groups that formed during 1974 was Concerned Citizens of Tennessee (CCT). CCT, located in the Hartsville - Nashville area, was formed in response to TVA's choice of Hartsville for its largest nuclear plant. Operating on a small budget, CCT relied primarily on free publicity to draw attention to what it considered the inadequate safety dimensions of nuclear power plants.

These groups persisted in their opposition to TVA nuclear contingent throughout the mid-1970's, and have relied for the validity of their arguments on a fire that occurred at the Browns Ferry plant. On March 22, 1976, a workman using a candle to check for air leaks in electrical cables set the cable insulation on fire. This resulted in the plant being shut down for several months, a congressional investigation, and an increase in local and national attention to the safety of nuclear power.

Although these citizen groups are small, TVA officials are cognizant of their members' complaints and fears. Several officials mentioned during interviews that these groups were often a focal point of discussion among high level TVA personnel. Virtually every official who discussed the problem, however, attributed a narrowness of outlook to the members of these groups. In the words of one official, "They aren't the ones responsbile when the lights go out; they won't ever have to account for increased unemployment when industry has to shut down because there isn't enough electrical energy."

Relationships with Congress.--The aspect of TVA's environment that may yet prove to be the most important is the change in the level of attention focused on TVA by Congress. Congress had virtually ignored TVA since the passage of the self-financing legislation in 1959, and paid little attention to the agency through the early 1970's. The mechanism for congressional attention was available through three procedures, and the expanding congressional involvement can be related in terms of those congressional powers: 1) advise and consent hearings for people nominated to serve on the TVA board, 2) approval of annual budget appropriations, 3) oversight hearings.

Relationships with Congress: Advise and Consent Hearings.--In 1972, President Nixon nominated William L. Jenkins to replace Frank E. Smith as a member of the TVA Board of Directors. Jenkins, then Commissioner of the Department of Conservation in Tennessee, had received strong endorsements from both of the Republican Senators from Tennessee, Howard Baker and William Brock. Jenkins had strong ties to the state Republican Party, having served in the state legislature and having been an unsuccessful cnadidate for the Republican nomination for Governor.

During the hearings on Jenkins' confirmation, questions concerning his attitude toward TVA's power program are noteworthy for their absence. The brief hearings focused on his stand on the reclamation of strip-mined land and possible conflict of interest. No member of Congress, however, expressed any concern over the nomination.[34]

---

[34]U. S. Congress, Senate, Committee on Public Works, Nomination of William L. Jenkins to be a Member of the Board of Directors of the Tennessee Valley Authority, 92nd Cong., 2d Sess., 1972.

Considerably different is the amount of attention given to the next appointment to the Board. The choice of a successor to the retiring Don McBride, who had been appointed by President Johnson in 1966, became a matter of great concern to TVA's critics. Since Jenkins' appointment in 1972, this director had expressed some dissatisfaction with the increasing cost of TVA's nuclear power program. Further, in April of 1975, Jenkins had voted against authorizing the design of two new nuclear power plants. This became a matter of concern for pro- and anti-nuclear forces as they came to perceive the new appointee as a "swing vote."[35] However, during an interview, Jenkins noted that his opposition votes were "entirely over matters of financing." TVA's debt was rapidly approaching the legal ceiling established by Congress. Jenkins did not want work begun on these new plants until that ceiling was raised to cover the expenditures the new plants would necessitate.[36]

On June 12, 1975, President Ford nominated Mississippi farmer and businessman, James F. Hooper, III, to fill the vacant position. The Senate Public Works Committee scheduled hearings on the Hooper nomination for the next month. However, criticism of Hooper's nomination became so widespread that the hearings were postponed until the following February to allow the Committee's staff time to investigate the nominee's background.

---

[35] New York Times, March 31, 1975, p. 37.

[36] Interview with William Jenkins, Knoxville, July 18, 1977.

Hooper was accused by his critics of financial impropriety in his business dealings.[37] The situation became so controversial that by the time the hearings were held in February 1976, Hooper felt compelled to be accompanied by his lawyer. Shortly after the hearings, the Senate Public Works Committee voted 11 to 1 to "postpone 'indefinitely'" further hearings.[38] This was the committee's way of rejecting Hooper without actually voting against him. On February 26th, President Ford announced he would withdraw the nomination.

Shortly after, President Ford nominated to fill the year old vacancy Thomas L. Longshore, who had worked for the Alabama Power Company since 1961 in various administrative positions. The nomination was immediately attacked by several environmental groups as well as supporters of TVA. Environmentalists criticized Longshore as being something other than a "Conservationist."[39] Many supporters of TVA were leery of Longshore's "private-power background." The Board of Directors of the Tennessee Valley Public Power Association, an organization representing distributors of TVA electricity, was probably the

---

[37] A summary of Hooper's financial dealings may be found in the report of the committee itself. "An Analysis of the Background of James F. Hooper, III," together with Mr. Hooper's response, in U. S. Congress, Senate, Committee on Public Works, Nomination of James F. Hooper, III, 94th Cong., 2d Sess., 1976, pp. 245-329.

[38] New York Times, February 24, 1976, p. 53.

[39] For example, see the letter from William H. Skelton, Chairman, Sierra Club, Tennessee Chapter to the Senate Committee on Public Works concerning Longshore's nomination. U. S. Congress, Senate, Committee on Public Works, Nomination of Thomas L. Longshore, 94th Cong., 2d Sess., 1976, pp. 249-55.

most vocal of these critics. J. Wiley Bowers, the association's executive director, stated the case as follows:

> Our position can be summarized in two points.
> One: Mr. Longshore does not meet the qualifications required for the highly important position of TVA Director. Without experience in a decision-making executive position in Alabama Power Co., he seems to fall considerably short of the high expectations our association has for a Director of the multibillion dollar Federal Corporation.
> Two: His appointment raises the possibility of a conflict of interest, because of his long years of service with a private power company that has continual dealings with TVA.[40]

In August, the Senate Public Works Committee voted 8 to 6 to reject the Longshore nomination.[41]

Relationships with Congress: Budget Hearings.--In 1973, as congressional concern over TVA's power program began to intensify, the annual budget hearing before the House became the occasion for close questioning about rate increases for TVA power. Between 1967 and 1973, TVA had raised its rates 68.8 percent. Although rates for residential customers were still only 60 percent of the national average, the size of the percentage increases became a matter of concern for many congressmen.[42]

---

[40]U. S. Congress, Senate, Committee on Public Works, Nomination of Thomas L. Longshore, 94th Cong., 2d Sess., 1976, p. 98.

[41]New York Times, August 25, 1976, p. 15.

[42]U. S. Congress, Subcommittee of the Committee on Appropriations, Public Works for Water and Power Development and Energy Research Appropriation Bill, 1974, Part 6: 93rd Cong., 1st Sess., 1973, pp. 217-23.

In the House, the rate increases became the main focus of attention during the annual budget hearing. The hearing consisted primarily of TVA officials explaining the reasons for the rate increases in response to questions from subcommittee members. Although the increasing cost of coal received the bulk of the blame,[43] cost overruns for under-construction nuclear power plants were also mentioned.[44] Despite this, however, concern over TVA's growing commitment to nuclear power was virtually ignored by the House subcommittee. The importance of these hearings is in their signaling a marked shift in TVA-congressional relations concerning TVA's overall power program. The autonomy the agency had experienced in this area since 1959 showed signs of diminishing.

After 1973, TVA's annual budget hearing continued to increase in intensity. This was especially true in the House, where the appropriations subcommittee was chaired by Congressman Joe L. Evins (D. Tenn.). The consistent focus came to be TVA imposed power rate increases. TVA, between 1973 and 1976, had increased the cost of electricity to residential customers by more than 40 percent. However, the 2.26 cents per kilowatt hour these consumers were paying was still well below the national average of 3.3 cents.[45] Although the increasing

---

[43]Ibid., pp. 224-6.

[44]Ibid., pp. 317-28.

[45]These figures are taken from Tennessee Valley Authority, Power Annual Report (Knoxville: Tennessee Valley Authority, 1975 and 1976).

cost of coal was given blame for the bulk of the increases, reference was consistently made to TVA's nuclear plants.

The following exchange between Congressman Evins, Mr. Kimmons, Manager of Engineering Design and Construction, and Aubrey Wagner, Chairman of the TVA Board of Directors is indicative of the types of questions subcommittee members directed at TVA officials during this time period. The exchange indicates the sharp increase in concern, among the subcommittee members, over TVA activities.

> Mr. Evins. . . . Browns Ferry Nuclear Power plant, is estimated to cost $815 million, a $65 million overrun in 1 year. Why do you have $65 million more in 1 year?
>
> Mr. Kimmons. Primarily a change of scope, a continuous dragging out of the program, higher interest rates and higher escalation than we had expected.
>
> Mr. Evins. What do you mean, dragging out of the program?
>
> Mr. Kimmons. We had taken longer to build the project than we thought we had when we made our last estimates.
>
> Mr. Evins. You made a little miscue on your estimates then?
>
> Mr. Kimmons. Yes.
>
> Mr. Evins. You make them on every one of them, every one of them has a cost overrun. Anyway, you can recommend to the Board to hold down these cost overruns.
>
> Mr. Kimmons. Sir, we are trying to get our estimates right.
>
> Mr. Wagner. Also, we are trying to use standardized plants which would give us a better estimating possibility. I would point out that on the basis of the chart we showed you yesterday, our cost overruns have been generally less than by others who build nuclear plants. . . .
>
> Mr. Evins. The Browns Ferry nuclear plant is now estimated to cost $815 million, which is a $65 million overrun over the estimated cost of $750 million a year ago. What was the original estimated cost of the Browns Ferry plant?

> Mr. Kimmons. The original estimated cost of the Browns Ferry three-unit plant was $392 million; this estimate anticipated commercial operation of the units some 40 months earlier than the current schedule and much lower rates of price excalation.
>
> Mr. Evins. Why has the completion date of the project slipped from March 1976 to December 1976?
>
> Mr. Kimmons. The completion date of the project and operation of the generating units have been delayed because of problems arising during the test and startup period for unit 1 and a scarcity of skilled craft workers which required that effort of available workers be concentrated on unit 1 with resultant delays in units 2 and 3.
>
> Mr. Evins. The Browns Ferry plant has been ordered closed down twice by NRC for inspection. Explain the nature of these inspections and the results.[46]

A similar line of questioning would then occur for each of TVA's other under-construction or planned nuclear power plants.

It would require little effort on the part of Congress to reduce the relative autonomy exercised by TVA. By revoking the self-financing amendment, Congress could easily constrain or even dictate future choices of new generating capacity. If the interest expressed by Congress in TVA's power program during the 1973 budget hearing continued to intensify such constraint would be a real possibility.

Relationships with Congress: Oversight Hearings.--The oversight hearings resulted, in part, from an attempt by TVA to expand its power program scope by buying a coal company. (This attempted expansion of program scope will be discussed below.) The bid was viewed,

---

[46]U. S. Congress, House, Subcommittee of the Committee on Appropriations, Public Works for Water and Power Development and Energy Research Appropriation Bill, 1976, Part 7: 94th Cong., 1st Sess., 1975, pp. 446-8.

by many, as an illegitimate encroachment by a government agency on the free enterprise system. When Senator Howard Baker (R. Tenn.) requested an investigation of the offer, the groups formed in opposition to TVA nuclear plants together with many consumers of the agency's increasingly expensive electricity pleaded for a broader investigation. In February of 1975, the Senate Public Works Committee announced it would hold oversight hearings on the full scope of TVA.

Senator Baker, who presided over much of the hearings, described their focus as follows:

> Senator Baker. . . . These hearings will explore several facets of TVA's operations and will provide an insight in the effectiveness of the agency and an indication of its role in the future of the Nation and valley it serves.[47]

During the hearings, TVA received a great deal of criticism from environmental groups objecting to strip-mining, emissions from coal-fired steam plants, and the construction of what they perceived to be unnecessary dams. Also, several anti-nuclear power groups from both inside and outside the TVA service area criticized the agency's expanding use of nuclear power. Overall, however, little attention was given by the oversight committee to TVA's rapidly expanding contingent of nuclear power plants.

Environment: Summary.--These dramatic changes in TVA's environment altered its state from a simple/static one characterized by a

---

[47]U. S. Congress, Senate, Committee on Public Works, Tennessee Valley Authority Oversight Hearings Before the Senate Public Works Committee, Part 1: 94th Cong., 1st Sess., 1975, p. 2.

high level of certainty to a complex/dynamic one characterized by a high level of uncertainty. The increase in environmental complexity was caused by the large number of new groups in TVA's environment with whom the agency was forced to cope. EPA and NRC, with the backing of NEPA, exerted pressure on TVA over the issue of thermal pollution. EPA, again with the backing of NEPA, attempted to force its will on TVA concerning the manner in which the agency should control the SO_2 flowing from its coal-fired steam plants. Also, several citizens' groups have organized for the sole purpose of opposing TVA's nuclear contingent. These organizations, especially EPA and NRC, have greatly increased the level of uncertainty in TVA's environment by establishing control over certain aspects of the power program. EPA, which is concerned with pollution externalities of the power program, exerts a great deal of influence over pollution matters. Although only partly successful in forcing TVA to comply with its standards relative to SO_2 emissions, EPA was totally successful in the thermal pollution controversy. There is a great deal of uncertainty in TVA now over the ability of EPA to enforce its SO_2 standards on the agency. The NRC has far more authority over matters concerning the nuclear generation of electricity than EPA has over environmental matters. The NRC, on numerous occasions, has delayed construction of TVA's nuclear plants. TVA has little recourse in such matters. This tremendous amount of control NRC exercies over the construction of TVA's nuclear plants removes from TVA any certainty over the completion date of these plants and, thus, over their cost.

The increase in environmental change has been just as dramatic as in the increase in environmental complexity. The change experienced by the coal market during this period greatly affected the price and availability of coal. The decrease in the number of bidders for TVA coal contracts, regardless of the reason, and the unwillingness of these few bidders to supply coal in the quantity TVA required created tremendous uncertainties for the agency. Also, the change in TVA's relationship with Congress has caused a great deal of uncertainty within TVA concerning the direction of that relationship. If Congress decided to take away from TVA the autonomy it had provided the agency with passage of the self-financing legislation in 1959, TVA's ability to respond to projections for increased demands for its electricity would be greatly inhibited.

Program Change

The open-system perspective asserts that the environment is the principal source of stimuli for program change. This section, by focusing on the change that occurred in TVA's power program during this time period, attempts to delineate how the program changed in response to environmental change. Important change occurred in the power program's size and scope between 1970 and 1977. Although no new technologies were adopted, TVA's nuclear contingent became the dominant program technology with constructed and committed generating capacity accounting for 46.4 percent of total generating capacity in relation to 38.1 percent for coal, 10.2 percent for hydro and 5.3 percent for combustion turbine.

The change in size of TVA's nuclear contingent during this period exceeded 14,000 Mw. of generating capacity. This was of a magnitude equal to the total generating capacity of the entire TVA system just prior to the Browns Ferry decision in 1966. This rapid and extensive change in program size was the result of three different decisions made in 1970, 1972 and 1974.

Changes in program scope occurred in 1972, when TVA expanded into the nuclear fuel cycle, and in 1974, when the first mitigation program was established to help ensure acceptance of nuclear power plants by the communities in which they were to be constructed. Also in 1974, TVA made a conditional bid to buy Peabody Coal Company. Although the offer was rescinded the following year, if the deal had been completed it would have represented a major expansion of program scope. Thus, during this period TVA's power program experienced six distinct attempts at program change.

TVA's environment in 1970 could be characterized as at the simple end of the complexity continuum and the static end of the change continuum. These conditions resulted in a relatively high level of certainty in the environment. Relations with Congress were amiable and there was only token opposition to the nuclear contingent. The cost of coal had doubled from $4.50 a ton the year before to $9.00 a ton but then stabilized at that point. The only uncertainties were the supply of coal and the ambiguities about regulation of thermal pollution. Although TVA was having some difficulty getting long-term commitments from bidders on coal contracts, the fuel was by no means in short supply. Although thermal pollution was not a serious problem,

there was some uncertainty about what the definition of "pollution" should be. NEPA had just been signed into law but there was no reason to believe it would present major difficulties for the power program.

In this simple, static, and relatively certain environment, TVA invited bids for 4,400 Mw. of new generating capacity to be supplied by either coal-fired or nuclear generating units. The question of whether the units would be coal or nuclear was answered when no bids to supply coal were offered. When TVA announced in August they were awarding contracts for two 1,100 Mw. units each to both Babcock and Wilcox and Westinghouse, they had achieved a larger nuclear Mw. commitment than any other utility in the country.

The four units were to be constructed at two different plant sites. The Westinghouse plant was to be constructed in east Tennessee at Watts Bar. The contract was for $79.9 million for the plant and $104 million for the fuel. The Babcock and Wilcox contract was for $77 million for the plant and $97 million for the fuel. A location for the plant had not been finalized but eventually a site in northern Alabama would be chosen. The plant would be named Bellefonte.

The failure of any coal company to bid to supply the agency with coal was somewhat surprising to TVA officials. Although change in the coal market had been evident, coal prices had stabilized and the agency had recently negotiated several coal contracts. The lack of bids, according to TVA officials, resulted from uncertainty in the coal market especially as concerned strip-mining and future requirements for reclamation. Under this aura of uncertainty, coal companies were not willing to make the long-term commitments TVA officials had requested.

Before 1972, when the second decision to change program size would be made, developments in the thermal pollution and SO_2 areas increased the level of complexity and uncertainty in TVA's environment. The level of complexity increased as EPA and the NRC became important actors in TVA's environment. EPA, under the authority of NEPA, began pressuring TVA, through the Alabama Water Improvement Commission, to install cooling towers at Browns Ferry. The NRC, because of the Calvert Cliffs ruling in 1971, was also required to examine the environmental impact of all of TVA's nuclear plants. Thus, in addition to being accountable to the states of Alabama and Tennessee for its thermal pollution, TVA was also responsible to EPA and NRC. EPA, again with the authority of NEPA, established standards for SO_2 emissions that TVA asserted were unattainable with present technological capabilities. Thus, TVA was presented with two serious uncertainties: uncertainty concerning who would establish thermal pollution standards and uncertainty over how to attain SO_2 standards. The major difference between these two pollution difficulties was that the former could be solved, at a high cost, while the latter, according to TVA officials, was probably unsolvable.

The former uncertainty, coupled with the continued high price of coal, greatly detracted from the viability of coal for new generating capacity. When, in May, the agency requested bids be submitted for four 1,200 Mw. generating units, it requested only bids for nuclear units. The plant's location, undecided at the time, would be Hartsville, Tennessee, a small community northeast of Nashville. The

Hartsville plant, when all four units are complete, will be the world's largest nuclear power plant.

The dramatic importance of the environment in the change in program size is made obvious by TVA's decision not to accept bids from coal companies. Between 1946 and 1966 virtually all of TVA's new generating capacity had been coal-fired. Yet, just six years later, the coal situation was so different that TVA would not even accept bids for new coal-fired generating capacity. Although the cost of coal in TVA coal contracts had risen to almost $11 a ton, two aspects of the coal situation were even more important: the uncertainty of the coal market concerning future price and supply, and the increasing role of EPA in TVA's environment concerning SO_2 emissions. TVA was still experiencing difficulty getting commitments for long term coal contracts from the coal industry. The SO_2 controversy was affecting coal use in all parts of the country and was having important effects on the coal industry. More important, however, was the reductions in TVA's autonomy caused by EPA and, to a lesser degree, NRC. Since 1959, when the self-financing legislation was passed, TVA's choice of new generating capacity had always been related to the agency's mission. The very elaborate decision-making process the agency goes through in comparing various alternatives focused on two major considerations: costs, so that electricity could be provided at the lowest possible cost, and the potential for TVA to provide leadership in this area. The aggressiveness of the agency in nurturing nuclear power plants as a viable economic alternative to coal is an excellent example of this.

By 1977, however, EPA was such a prominent factor in the SO_2 controversy that they had effectively limited the choices available to TVA by greatly reducing the viability of coal as an alternative relative to nuclear plants. This inhibition upon TVA's autonomy greatly impaired its ability to accomplish its mission.

In the same month that bids were let for the Hartsville plant, TVA expanded its program scope to include a part of the nuclear fuel cycle. The agency paid American Nuclear Corporation $2 million for mineral rights and options to mineral rights on land in Wyoming. Although this was a small investment relative to future needs for generating capacity, it represented an important expansion in program scope. The expansion, however, was limited in that it included only ownership rights to minerals in the ground. No attempt was made to obtain mining or milling operations.

The nuclear contingent suffered a serious setback in 1972, when all three of the projected plants experienced some type of delay. The most expensive of these was a one year delay suffered by the Watts Bar plant. The AEC, in response to the Calvert Cliffs decision, refused to issue a construction permit for the plant until the commission had completed its own environmental impact study. TVA asserted the commission's study would be redundant because of its already completed environmental studies, but to no avail.

Despite the problems encountered with construction delays and thermal pollution, TVA maintained its optimism toward nuclear power. One indication of this was its attempts to reduce lead time for future plants. TVA announced, in September of 1972, that it would work in

conjunction with G. E. to develop a standard nuclear power unit. TVA, G. E. and the AEC asserted that a standard unit would simplify the regulatory process because many of the unit's components could be approved before, rather than during, construction. This would shorten the time necessary for licensing.

No program changes occurred in 1973. TVA did, however, make one attempt to increase the size of its uranium holdings. In October, invitations were sent to fifty-three suppliers inviting bids to supply TVA with eighty-six million pounds of uranium. Only three suppliers responded, and their offerings amounted to little more than one-third of what TVA had requested.

The next program change was the increase in generating capacity in 1974. The environment by this time had reached a complex, dynamic, and uncertain state. Congress was showing an increased amount of concern over TVA activities especially as they might lead to increased rates. Also, Concerned Citizens of Tennessee had formed in the Hartsville community, and was receiving a lot of state wide attention for its criticisms of TVA's nuclear contingent. The most apparent environmental changes during this time, however, related to the thermal pollution issue and the SO_2 issue. By this time, the thermal pollution issue had been solved by TVA's capitulation to EPA. The coal situation, however, had grown dramatically worse in two respects. During 1974, the cost of coal in TVA contracts rose from $11.30 a ton to $30 a ton.[48] Even more important than this cost factor was the

[48] TVA, with the opportunity to provide some good publicity for its nuclear program, emphasized Browns Ferry was consuming uranium at a cost equivalent to $3 a ton for coal.

high level of uncertainty involved in TVA's conflict with EPA over SO_2 emissions. The dramatic effect that this dispute was having on the relative balance of fuel alternatives is reflected in the following exchange between Aubrey Wagner, Chairman of TVA's Board of Directors, and Congressman Rhodes (R., Az.). The setting is a 1973 appropriations hearing that occurred while the TVA - EPA SO_2 dispute was at its zenith.

> Mr. Wagner. In making those comparisons (between coal-fired and nuclear power plants), you have to look at what it costs to build coal-burning plants with the environmental requirements that are now placed on them.
>
> Mr. Rhodes. Absolutely.
>
> Mr. Wagner. I don't know that any of the existing plants that we have fully comply. We are almost driven to nuclear by the environmental requirements.[49]

Chairman Wagner's awareness of the reduction in agency autonomy shows the tremendous influence of EPA over TVA's choice of generating capacity. If TVA was to continue to provide electricity to the Tennessee Valley, at any price, it would have to expand the size of its nuclear contingent.

When, in 1974, the agency let bids for new generating capacity it requested bids to supply nuclear units only. In September, contracts were awarded for four nuclear units, with a total generating capacity in excess of 5,000 Mw., to be brought on line between 1982 and 1984. The four units would be installed at two plants, to be located on the eastern and western edges of the TVA service area. The

---

[49] U. S., Congress, House, Subcommittee on Public Works of the Committee on Appropriations, Public Works for Water and Power Development and Atomic Energy Commission Appropriations Bill, 1974: TVA, 93rd Cong., 2d Sess., 1973, p. 323.

first, named Phipps Bend, was to be constructed on the Holston River about fifteen miles southwest of Kingsport in upper-eastern Tennessee. The second, named Yellow Creek, was to be located east of Corinth, Mississippi.

The coal situation presented TVA with a tremendous amount of uncertainty in 1974. The dramatic increase in coal cost did not alleviate supply problems. An anticipated strike by miners in the fall and an already dwindling stockpile forced the TVA board to deviate from normal coal-purchasing policy. Early in the year, the board announced it would begin negotiating the purchase of coal from coal firms. The agency had, in the past, awarded all coal contracts through competitive bidding. The situation had deteriorated by August when the United Mine Workers leadership called for a week-long stoppage as a memorial to those who had died in mining accidents or from black lung disease. When miners walked out on strike in November, the agency announced that if the strike continued,"rotating blackouts" would become a necessity.

TVA, powerless to affect the miners' strike and in need of a reliable source of coal, attempted a rapid and extensive change in its program's scope. The agency submitted a conditional bid of $2.1 billion to purchase Peabody Coal Company, at that time owned by Kennecott Copper Corporation, which had been ordered by the Federal Trade Commission to divest itself of the coal holdings. The company was the nation's largest supplier of coal, being responsible for 10 percent of the national coal production. TVA consumed 35 percent of Peabody's

total output.[50] Several senators expressed concern over TVA's control of these vast coal resources, especially the 65 percent of Peabody's production TVA would not themselves consume. Lynn Seeber, TVA's General Manager, addressed this matter as follows:

> In a letter to Kennecott in October 1974, TVA made a carefully qualified and conditional purchase offer as a basis for negotiation. The intention here was not for TVA to go into the coal business as such, but to safeguard an essential part of our present coal suppliers and particularly to gain additional reserves as a safeguard for the future.
>
> I can't emphasize that enough. TVA has absolutely no intention of going into the business of digging coal and selling it to others. Our interest here is merely trying to get reserves of coal to be used for the TVA power system.
>
> If TVA were the successful purchaser of Peabody Coal Co. its plans would be to sell off or to arrange for partners to take Peabody assets other than the reserves found to be needed for the TVA power system.[51]

TVA's offer to buy Peabody created extensive controversy. The agency's critics perceived it as a move by an unresponsive organization to further isolate itself from its environment. Many people perceived it as further encroachment by the government on the free enterprise system. The United Mine Workers expressed concern over union members employed at Peabody mines becoming government employees.

The high level of attention the bid received eventually served as a catalyst for the 1975 oversight hearings by the Senate Public

---

[50] Senate Committee on Public Works, Tennessee Valley Authority Oversight Hearings before the Senate Public Works Committee, Part 1: p. 417.

[51] Ibid., p. 408.

Works Committee (see "Relationships with Congress: Oversight Hearings," page 135). The purchase offer was eventually rescinded when TVA officials discovered Peabody's coal reserves to be less desirable than they had first perceived them to be.

Also in 1974, TVA expanded its program scope to include mitigation programs. These programs within the power program were designed to help ease the burden of large-scale construction projects on local communities. The mitigation programs, which started in Hartsville, consisted of two principal aspects: funding and information. Funds would be provided to communities to help offset the expenses incurred as a result of TVA construction projects. For example, any expenses incurred as a result of increases in school enrollments in community schools due to the influx of families of construction workers would be compensated by TVA. The information aspect consisted of providing a source of information for community residents on the effects of nuclear power plants on surrounding communities. CCT, according to agency officials, was providing people in the Hartsville area a lot of information that did not "tell the whole story." The mitigation program would allow the people of the Hartsville community to hear "the whole story."

TVA has not expanded the size of its generating capacity since 1974. The volume of nuclear generating capacity under construction is considered adequate to fill consumer needs through the mid-1980's. The main concern of the agency has been in obtaining fuel for the nuclear units. Efforts in this area were intensified when Westinghouse

refused to honor contracts to supply TVA with nuclear fuel. Because of the intricate nature of nuclear fuel and nuclear power plants, most early contracts for nuclear power plants included a large quantity of fuel. Westinghouse had contracted to supply about 80 million pounds of yellowcake at about $8 a pound. When the cost of the concentrate increased to $30 to $40 a pound, Westinghouse reneged on its obligations. In 1975, TVA filed suit to force Westinghouse to supply the 3.4 million pounds of yellowcake for which they had contracted. The case, however, was still in court at the end of 1977. Although Westinghouse has settled with several utilities, TVA still asserts the contracts should be fulfilled.

On several occasions TVA has expanded its uranium holdings. By the end of 1976, the agency had spent approximately $33 million in acquiring mineral rights to 900,000 acres of land. While touring TVA uranium properties in Wyoming in 1976, Aubrey Wagner was so impressed with the magnitude of the operation he referred to it as "TVA West."[52]

TVA has not expanded its power program's scope to include the mining phase of the uranium operation. The agency has contracted with private mining firms to remove the ore from the ground. This has proven successful for the agency, and the first of its own ore is expected to be available sometime in 1978.

TVA is expected to expand its generating capacity late in 1978. Since the 1974 decision to let bids only for nuclear units,

---

[52]Nashville Tennessean, November 21, 1976.

several events have transpired that will affect the decision. Two changes relevant to TVA's use of nuclear power have greatly affected its viability. First, TVA's nuclear plants presently under construction have experienced delays in construction and dramatic cost overruns. Table 4 presents the original cost estimates and the 1977 cost estimates for each of the agency's nuclear plants.

TABLE 4

COST OVERRUNS AT TVA NUCLEAR PLANTS
(In Millions of Dollars)*

Plant	Original Cost Estimate	1977 Cost Estimate
Browns Ferry	392	920
Sequoyah	336	980
Watts Bar	500	985
Bellefonte	650	1,200
Hartsville	1,425	2,500
Phipps Bend	1,600	1,600
Yellow Creek	1,900	1,900

*Source: U. S. Congress, House, Subcommittee of the Committee Appropriations, Public Works for Water and Power Development and Energy Research Appropriation Bill, 1978, Part 4: 95th Cong., 1st Sess., 1977, p. 283.

Although part of the cost overruns can be attributed to delays in delivery of plant components, TVA attributes the bulk of the problem to the NRC licensing procedure. At the request of the House subcommittee that hears TVA's requests for appropriations, the agency provided the

following written statement relating to NRC caused construction delays at the Hartsville plant.

> Delays in the licensing process at Hartsville have occurred from the start. We estimate that, as of today, these delays total some 13½ months and will result in additional expenses of some $800 million. . . .
>
> The Nuclear Regulatory Commission initially established a licensing schedule for the Hartsville plant which called for the issuance of a limited work authorization on July 1, 1975. We filed our license application on time and were prepared to begin the work which would be permitted under the limited work authorization on July 1, 1975, as scheduled. However, the limited work authorization was not actually issued until April 1976--some 9½ months behind NRC's own schedule. One and a half months of the delay was caused by NRC's not completing its preliminary review of our application on schedule. Six months' delay was caused by the NRC licensing board's taking extra time processing the petitions which were filed by intervenors opposing the plant. Still another delay for 2 months was caused by the licensing board's failure to issue a partial initial decision in a timely manner. These three events combined to create a 9½-month delay in beginning work on the plant and, consequently, a 9½-month delay in its eventual completion.
>
> As bad as this was, it was not the only delay we have had at Hartsville. On August 16 last year, NRC, following the decisions of the two court cases involving non-TVA nuclear plants, suspended the issuance of any further operating licenses, construction permits, or limited work authorizations. In September TVA was ready to commence critical path work at Hartsville but was unable to do so because of the suspension of licensing. On November 5, 1976, the NRC modified the suspension order so that licensing could continue. The Hartsville licensing board finally authorized the critical path work in December. This resulted in a 4-month delay.
>
> Quite frankly, Mr. Chairman, the cost of these delays is extraordinary. Assuming that for every month of delay now, the final completion of the plant will be delayed 1 month--and we think this is a valid assumption--it will cost TVA power consumers $60 million for every month construction on the Hartsville plant is delayed. Forty million dollars a month is what we estimate it will cost just to replace the electric power

> which Hartsville would produce. The other $20 million is the amount by which every month of delay would increase the cost of constructing the plant.[53]

Thus, NRC has also reduced the autonomy exercised by TVA. Prior to its extensive expansion into nuclear power, TVA exercised control over construction of its power plants. It set work schedules and increased work loads as necessary to complete plants at their scheduled time. Control over this aspect of the power program, however, has been transferred to NRC. The construction delays that have resulted from this loss of autonomy have forced TVA to order combustion turbines powered by oil and natural gas to prevent power cutbacks. These combustion turbines can be placed on line in a very short period of time, but they are very expensive to operate because of their high fuel cost. By 1985, these units will account for just over five percent of total generating capacity.

SUMMARY

Figure IV.1 depicts changes in the size of TVA's total generating capacity from 1970 through 1985. The large size of the increments of change, relative to the base, indicates a continuous pattern of non-incremental change. In addition to these very dramatic changes in the size of TVA's power program, several other important changes in the power program occurred during the 1970 to 1977 period. Figure

---

[53] U. S. Congress, House, Subcommittee of the Committee on Appropriations, Public Works for Water and Power Development and Energy Research Appropriation Bill, 1976, Part 4: 95th Cong., 1st Sess., pp. 273-5.

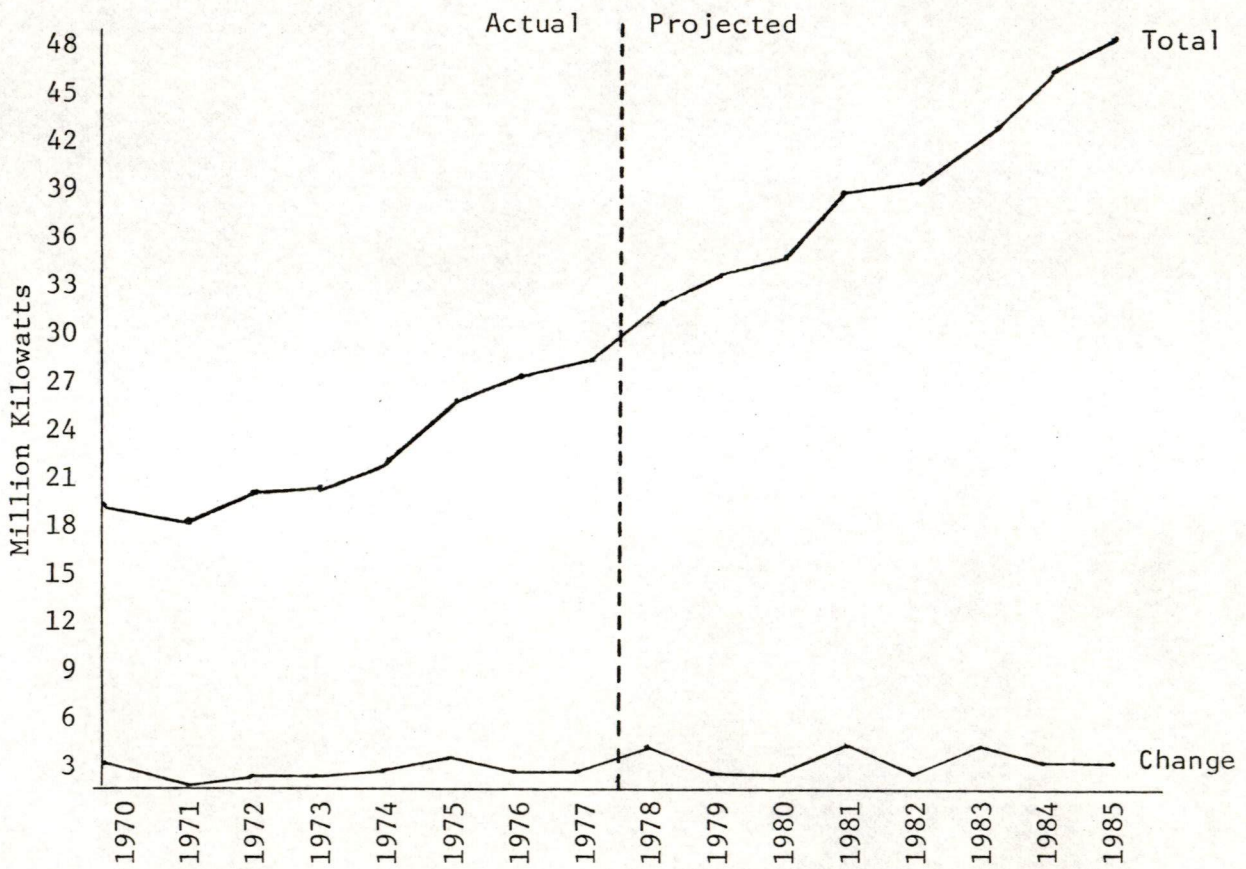


Figure IV.1

TVA's Total Generating Capacity and Change in Generating Capacity from 1970 Through 1985

Source: Tennessee Valley Authority, Tennessee Valley Authority Power Annual Report (Knoxville: Tennessee Valley Authority, 1970 - 1977).

IV.2, for example, shows the change in prominence of nuclear technology within TVA. The pace at which this change has occurred is even more phenomenal when one considers that TVA committed itself to this pattern of growth in just eight years.

Change in size is not the only program change that occurred during this period, however. TVA expanded its program scope to include a major aspect of the nuclear fuel cycle and mitigation programs to help ease the impact and acceptance of its nuclear power plants in local communities. Also, the attempted expansion of scope to include all the phases of coal supply, although it failed, reveals much about the determination of TVA to accomplish its mission. Although the agency expanded its scope to include large coal reserves in 1966, except for the conditional offer to buy Peabody, it has not attempted to expand beyond this aspect of coal supply.

TVA's power program, throughout this period, has obviously maintained its dominance within TVA. The complex, dynamic, and uncertain environment within which TVA finds itself makes it difficult to say anything else about the program. TVA, at the end of 1978 or beginning of 1979, is scheduled to further commit itself to new generating capacity. Forces in the environment, especially Congress, EPA, and NRC, are of obvious importance in this decision. Probably even more important, however, are the dramatic changes taking place inside of TVA. Although a replacement for McBride acceptable to Congress was finally found, Chairman Wagner has retired and the only other established board member, William Jenkins, has resigned. Further, the

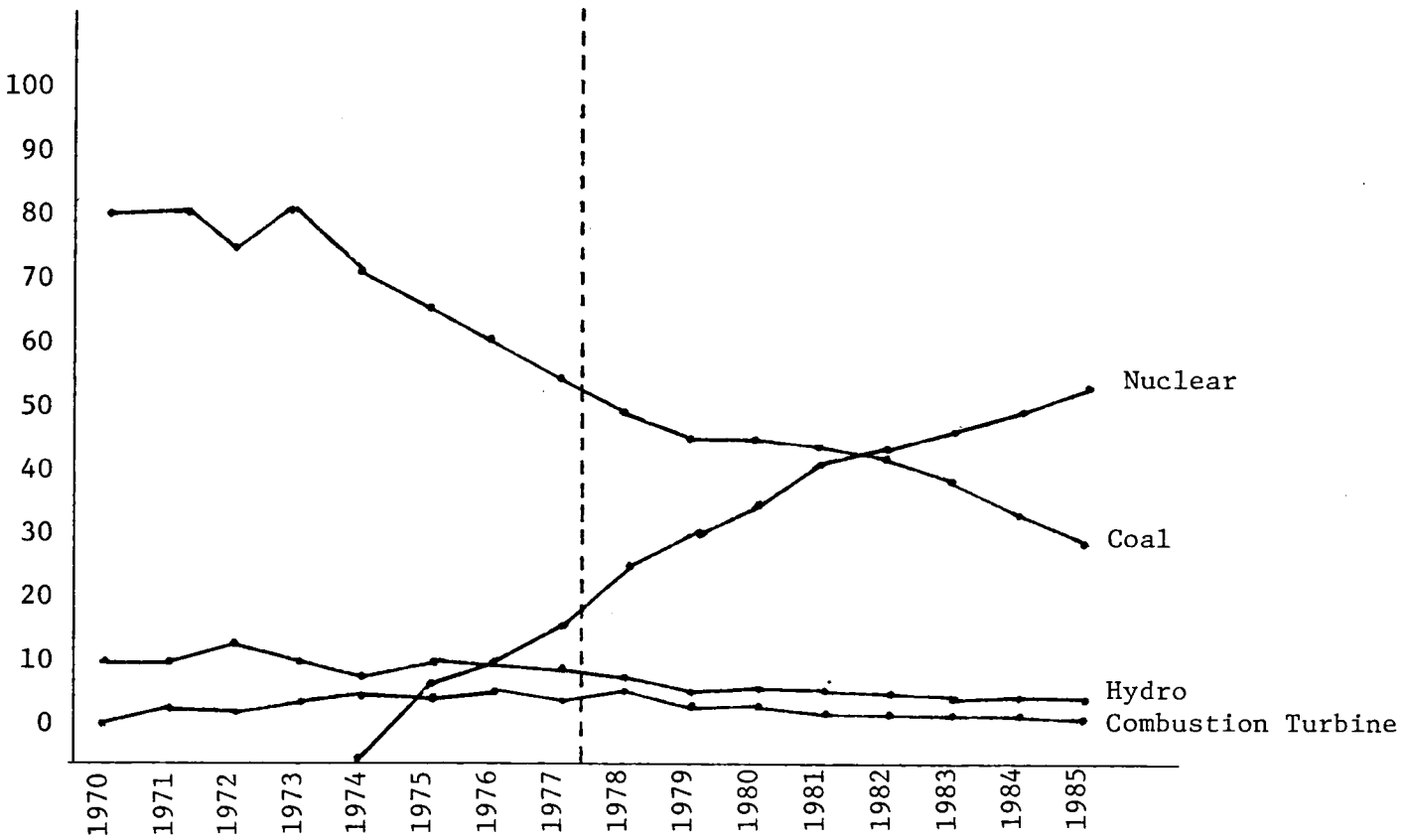


Figure IV.2

Percent of TVA's Generating Capacity by Year and Source

Source: Tennessee Valley Authority, Tennessee Valley Authority Power Annual Report (Knoxville: Tennessee Valley Authority, 1970 - 1971).

General Manager has resigned. Filling these vacancies provides to President Carter the opportunity to shape for years to come both TVA as a whole and its power program in particular.

The rapid/expansive development in TVA's power program has been the result of many factors. The next chapter systematically analyzes the development of this program for the purpose of explaining the rate and magnitude of change in its size, scope, and technology.

CHAPTER V

CASE ANALYSIS

The purpose of this chapter is to analyze the development of TVA's power program in light of the theoretical perspectives set forth in Chapter I. This will require, first, a brief recapitulation of the case emphasizing the pace and magnitude of change in program size, scope and technology; second, isolation of the major forces affecting program development; and third, application of the alternative theoretical perspectives presented in Chapter I to explain program development.

RECAPITULATION

TVA, when it was established, took control of an already constructed dam with a generating capacity of 184,000 Kw. By the end of World War II, TVA's power program had experienced rapid and extensive change in its size and scope. Generating capacity between 1933 and 1945 increased by a factor of 14 to 2,503,900 Kw.

During the period 1933 through 1945, TVA instituted two important changes in the scope of its power program. First was the decision to establish the power program as an entity separate from the private power program that existed in the Tennessee Valley in the 1930's. This decision, made over the objections of Arthur Morgan, changed the scope of the power program from an adjunct addition to processes of navigation and flood control to the sole source of electricity within the Tennessee Valley. This rapid/extensive change in

program scope was followed by a rapid/limited change in scope with the establishment of a distribution system to ensure that electrical energy produced at TVA's dams would reach consumers. Although there were distribution systems present in the Valley, they were inadequate to distribute the amount of electrical energy TVA could product. The system was established rapidly, however; the fact that the agency maintained control over only one of the three separate distribution systems it set up distinguished the magnitude of change as limited.

These changes in power program scope were directly related to another change that began occurring at this time: the rise in prominence of the power program relative to other programs within TVA. Although the decision to establish power as a major program was the first step in this rise in importance, the power program slowly came to dominate not only "program activity," as noted by Roscoe Martin, but "program thinking" as well. The power program aim of providing electrical energy at the lowest possible cost would slowly evolve as TVA's mission.

Throughout the period 1933 through 1945, TVA's power program experienced no changes in technology. The several dams the agency completed, coupled with the few coal-fired steam plants acquired from private power companies and the Watts Bar coal-fired steam plant constructed under war time conditions, were adequate to meet demand.

Between the end of World War II and the passage of self-financing legislation in 1959, TVA's power program continued to increase in size at a rapid pace and an extensive magnitude. Total generating

capacity more than quadrupled from 2,504 Mw. to 11,387 Mw. The power program's scope, however, remained constant during this period. Thus it can be distinguished as positioned at the slow extreme of the pace continuum and limited extreme of the magnitude continuum.

The power program's technology experienced a very important change during this period. The demand for electricity following World War II required an increase in generating capacity of a magnitude the Tennessee River could not accommodate. Because of TVA's location in the midst of large coal deposits, coal was the logical choice as a source of energy. But this would represent a change in program technology the agency did not have the autonomy to effect. After a long and bitter battle between TVA and several private power companies, congressional approval of the further reliance on coal for the production of power was given in 1949.

This approval by Congress of TVA's use of a means of generating electricity beyond hydro-electric generators at its dams established the legitimacy of TVA as a public utility. Until this time, all of its generating capacity either was incidental to its flood control and navigation projects, or was purchased from a private power producer when TVA had established its service area, or was constructed to meet a war-time emergency. Thus, in granting to TVA the power to meet increased demand for electricity, Congress recognized the agency's position as sole source and major distributor of electricity in the Tennessee Valley.

Although Congress recognized TVA's position as a public utility

in 1949, under increasing pressure from private power companies it became less willing to finance new generating capacity. In 1955, TVA responded by requesting an amendment to the TVA Act that would allow for self-financing of the power program through the sale of bonds. The amendment was approved in 1959, after a compromise was reached between TVA and the private power companies which had opposed the amendment. The compromise allowed TVA control over the financing of its power program, but fixed the geographical boundaries of its service area. This compromise was of great importance to the development of TVA's power program because it removed from the political arena in which TVA operated the private power companies that had opposed it since 1933. Also, self-financing power greatly enhanced TVA's autonomy from Congress by relieving it of having to gain congressional approval for changes in program size, scope and technology.

From 1960 through 1977 TVA's power program experienced the most rapid and extensive changes in size in its history. On-line generating capacity increased from 11.4 Mw. in 1960 to 28.1 Mw. in 1977. Further, the agency committed itself to another 16.5 Mw. to be brought on line by 1985.

Power program scope changed several times during this time period. First, in 1966 the agency expended $7.4 million for rights to an estimated 225 million tons of recoverable coal underlying Fort Breckenridge in Kentucky. This was TVA's first major purchase of coal lands. Although the change in program scope occurred at a rapid pace, the fact that TVA entered only the ownership aspect of coal supply made the change of limited magnitude.

In 1972, TVA again expanded its program scope to include an aspect of a fuel cycle. The agency, at a rapid pace, entered the nuclear fuel cycle by buying rights to uranium land in the western part of the United States. Again the magnitude of change was limited because the expansion included only ownership of the mineral rights. The mining and milling aspects were contracted out to private companies.

In 1974 TVA made one change in the scope of the power program and attempted to make a second. A mitigation program, started in communities surrounding the site of the proposed Hartsville nuclear power plant, was designed to provide financial assistance and information to the communities to help ease the impact of, and gain acceptance for the plant. TVA implemented this program at a slow pace by adopting it first as a small scale experiment and examining its results. The adoption was of limited magnitude because after the experiment it included only projects begun after the experiment and did not include large scale projects begun but not completed at the conclusion of the experiment.

The attempted change in program scope was the conditional bid to buy Peabody Coal Company. Although TVA already owned coal properties, if this attempt to buy Peabody had been successful, TVA would have, at a rapid pace, extensively increased the magnitude of its scope by becoming the nation's largest coal company.

The 1966 decision to adopt nuclear technology was the only change in power program technology to occur during this period.

Within just eight years, however, TVA's commitment to this relatively new technology would exceed the size of any other power technology in the TVA system. This rapid-paced change of very extensive magnitude would occur as the environment entered a higher level of uncertainty than TVA had experienced since the 1930's when its right to exist was in serious jeopardy.

MAJOR FORCES AFFECTING PROGRAM DEVELOPMENT

The previous section described the amazingly rapid and extensive development undergone by TVA's power program between 1933 and 1977. The central purpose of this study is to understand how a program could develop in such a manner. This section contributes to that end by examining the forces that acted upon the program causing it to change in the manner it did.

The changes that occurred in the power program's size and scope through World War II had several common factors. The most important of these was the decision by Congress and the President to allow the first board of directors to give substance to the TVA Act. Although several goals are explicitly stated in the Act, the priority to be given to each and the manner in which they were to be achieved were left to the board.

In relation to electrical energy, this high level of autonomy allowed the first board of directors to establish a power program that fit their interpretation of congressional and presidential intent. The principal intent, according to the board, was for TVA to be a yardstick by which the actual cost of generating and distributing

electricity could be determined. The most effective way in which this yardstick function could be accomplished would be for TVA to generate electricity as cheaply as possible and demonstrate this method for utilities across the country. The cheapest possible manner by which electricity could be generated, according to Lilienthal, was by the principle of "more, not less." Thus, in order to fulfill its yardstick function, TVA would have to generate as much electricity as possible.

There were present, however, three factors serving to prevent TVA from generating massive amounts of electricity: private power companies, an inadequate system for distributing the electricity once it was generated, and a lack of demand for the electricity. The major restraint was obviously the private power companies operating in the Valley who perceived as a threat to their existence a TVA that generated massive amounts of electricity. Thus, these companies worked through Congress and the courts to restrain TVA activities in this area. The absence of an adequate distribution system could be overcome only by establishing such a system. Concerning demand, although the agency did establish a few small programs to help generate demand for electricity, demand rose dramatically when TVA offered electricity at rates that could be afforded by many more people than the rates charged by the private power companies.

In sum, we can assert that the yardstick function of TVA, as interpreted by the board, <u>required</u> the power program's size to change at a rapid pace and extensive magnitude in order to be capable of

generating massive amounts of electricity. Further, the yardstick function, to be accomplished, required a rapid/extensive change in program scope to establish a power program independent of the hostile private power companies operating in the Valley, and a rapid/limited change in scope to include a distribution system to insure its electricity could reach potential consumers.

The other major factor in effecting this change was the agency's autonomy. The autonomy afforded the first board of directors allowed it to emphasize the power program to a degree probably unintended by Congress. The intense opposition of the private power companies created a complex, dynamic, and uncertain environment for TVA. This condition, however, could not prevent these dramatic changes from occurring.

These conditions affected two other changes that would be important for future development of the power program. First, the increase in the size and scope of the power program would raise it in prominence relative to the other programs in TVA. As the program continued to change, its importance in TVA would continue to increase until it would eventually become the agency's mission. Second, when TVA established its power program as the only source of electricity in the Valley, it became responsible to its consumers to supply them with the electricity they needed. Thus, TVA committed itself to increase the size of its power program's generating capacity to meet whatever demand arose. This locked the program into a pattern of rapid/extensive changes in size that is still evident in TVA today.

From the end of World War II through 1959, when the self-financing legislation was passed, TVA's power program continued to experience rapid/extensive changes in program size made necessary to meet the continuous increases in demand for TVA electricity. Moreover, as was noted above, this increase in size required the adoption of a new technology.

Three factors worked to restrain TVA from adopting coal technology and then using it to increase program size: private power companies, Congress, and its lack of sufficient autonomy. The private power companies vigorously lobbied Congress to prevent TVA from receiving the appropriation necessary to construct its first peace-time coal plant. Congress, itself, expressed severe reservations about appropriating the funds to TVA both to initially change its program technology and, even after it did so, to allow for increases in program size. Although TVA had been provided a great deal of autonomy in establishing the power program, it was still dependent on Congress for the capital necessary for large-scale construction projects.

The principal determinant of change was the rising mission within TVA of providing electricity at the lowest possible cost. The commitment that the agency had made to supply the Tennessee Valley with the electricity it needed had been incorporated into its mission. If TVA was to meet the rapidly rising demand for its electricity, its program size had to increase, and this increase demanded a change in technology.

In addition to these program changes, two important changes

occurring during this time related to changes in the power program and greatly affected future program development. First, the congressional appropriation to TVA to construct its first peace-time coal-fired steam plant legitimated the power program's existence. Except for emergency construction during World War II, this was the first time Congress had authorized an appropriation for TVA to construct a physical plant for the principal purpose of generating electricity. Although private power companies would still oppose increases in the size of TVA's generating capacity, they could do so only on the grounds that the increase was unnecessary and not that the increase was an illegitimate act by TVA. Second, TVA responded to the increasingly difficult process of gaining congressional appropriations for new generating capacity by requesting that its power program be made self-financing. The passage of the self-financing legislation in 1959 greatly increased the agency's autonomy.

During the period 1960 through 1977, TVA's power program size increased at a faster pace and more extensive magnitude than at any time in its history. The first six years, 1960 through 1965, was the first time since World War II the agency was not a center of controversy. The size of the power program increased rapidly and extensively as 3.4 million kilowatts of generating capacity was constructed. Although 87 percent was produced from new coal-fired plants, no one outside of TVA even seemed to notice. This increase in size was TVA's response to increased demand for its electricity, and it peacefully fulfilled its mission by providing this electricity at the lowest

possible cost. The autonomy it had gained from Congress in the self-financing legislation allowed this increase in size without the agency seeking outside approval. The environment was virtually devoid of anything that would restrain this increase and was characterized by low levels of complexity, change, and uncertainty.

This rapid/extensive change in program size was maintained from 1966 through 1977, and, in addition, the power program experienced one important change in technology and several important changes in scope. Change in the size of TVA's power program, was, by this time, a result of a fully developed mission and of demand factors arising outside the agency. TVA had committed itself to supplying the entire Tennessee Valley with the electricity necessary to ensure continued economic development and it would continue to do so throughout this period. The question for analysis is: Why did the program develop in the manner it did? The central thesis of this section is that, increasingly, factors external to the agency limited the choices available to TVA, not only in relation to new generating capacity, but to expansions of program scope as well. The remainder of this section will analyze, first, the factors affecting decisions related to coal and nuclear technologies by which program size was increased, and, second, the changes in program scope that accompanied these dramatic changes in technology and size.

TVA made large-scale commitments to new generating capacity in 1966, 1967, 1968, 1970, 1972, and 1974. The 1966 decision can be distinguished from the rest as providing an important change in

technology. Several factors can be delineated as affecting this important change: TVA's mission, autonomy, decision-making process, the coal situation, and the simple/static condition of the environment. The most important factor affecting the decision to adopt nuclear technology was TVA's mission. The mission, by this time, was fully developed and had incorporated the yardstick function of leadership. Nuclear technology had already been adopted by several utilities and one had even adopted it without financial assistance from the federal government. If TVA were to play a leadership role in pioneering production of low cost, nuclear-generated electricity, it would have to adopt the technology at the time it did. Further, the economic analysis of the bids the agency received for new generating capacity gave a several million dollar edge to nuclear technology over coal. To have chosen a coal-fired steam plant under these circumstances would have violated its mission.

The autonomy TVA possessed at this time, primarily as a result of the self-financing legislation passed in 1959, greatly facilitated this adoption of a new technology. If the agency had been required to gain congressional approval for this move, it could expect a delay of several months. The increasing lead-time required for nuclear plants might have ruled a nuclear plant out of consideration after such a delay.

TVA's decision-making process also greatly affected the choice. The comprehensive decision-making process that TVA has routinized allows it to analyze all technologically feasible alternatives for new

generating capacity. Because of the yardstick dimension of its mission, the agency has always been involved in new and developing technologies and incorporates into its decision-making process the necessary expertise to analyze the feasibility of new alternatives. Thus, when nuclear technology became a viable option, TVA's decision-makers had on hand all the necessary expertise to analyze its appropriateness for the TVA system.

The coal situation in 1966 served as a force driving TVA to adopt a technology with a different fuel source. Environmental degradation was rapidly becoming a national issue and TVA, as the nation's largest consumer of coal, was criticized for its use of large quantities of strip-mined coal. Further, because the coal market was undergoing important changes, the number of bidders for TVA coal contracts had dropped sharply. While the coal situation was undergoing these negative changes, the simple, static, and seemingly certain conditions associated at the time with nuclear technology greatly enhanced the viability of the nuclear alternative.

The 1967 decision added both coal and nuclear generating capacity to the TVA system. The lead time for nuclear and large-scale coal-fired steam plants had increased to such an extent that TVA did not have time to conduct its usual bidding process. Therefore, the agency referred back to the bids it received in 1966 when it decided to build Browns Ferry. The agency ordered a large-scale coal-fired steam plant and a third nuclear unit for Browns Ferry. This was the last time TVA ordered coal-fired generating capacity. The four

decisions made since this time have all added nuclear generating capacity.

The 1968 decision was made under much the same conditions as the 1966 decision except, of course, the 1968 decision did not represent a change in technology. The environment was in a simple/static condition characterized by a high level of certainty. Further, costs of the different plants and fuels were similar to what they had been in 1966. The choice was primarily dictated by the organizational mission.

After the 1968 decision, however, environmental factors began to increase in importance. The two most important factors affecting the 1970 decision grew out of the coal situation. The coal industry was suffering from a great deal of uncertainty relating to government regulation of strip-mining. More important for TVA, however, were the price and supply aspects. The agency was experiencing a great deal of difficulty in getting contractors to make long-term commitments for supplying coal. Also, since 1968, when the cost of generating electricity at coal-fired and nuclear plants were about equal, the cost of coal had doubled to $9 a ton. Despite this increase in price, when TVA let bids for 4,400 Mw. of new generating capacity in 1970, no bids were even offered to supply coal. Thus, for the first time, the environment effectively inhibited TVA's choice of new generating capacity by ruling out of consideration a previously viable alternative. If TVA were to ensure its ability to provide the Tennessee Valley with electricity, it would have to increase it nuclear generating capacity.

By 1972, factors in the environment became even more important. The thermal pollution problem was at its zenith with EPA applying pressure on TVA to install cooling towers at all of its nuclear plants. Even more important than the thermal pollution problem, however, were the growing problems with coal. The cost of coal had almost tripled since 1969, EPA was making demands relative to SO_2 emissions that TVA believed could not be met, and the agency was receiving increased criticism for its use of strip-mined coal. Although the cost of generating electricity at nuclear plants had risen because of the increased lead time for the plants, it was still cheaper than coal-generated electricity because of the high cost of coal. More important than cost, however, was the uncertainty that would be involved in any new coal-fired plant. TVA officials believed scrubbers, the only EPA approved SO_2 control device, were not adequate to allow a plant to meet EPA standards for SO_2 emissions. If TVA constructed a new coal-fired plant, either without scrubbers or with scrubbers that did not achieve EPA standards, operation of the plant could be limited for environmental reasons. Although thermal pollution presented a problem for TVA because the solution EPA demanded was extremely expensive, there was no uncertainty concerning the ability of cooling towers to meet EPA-imposed standards. Thus, the choice of a coal-fired steam plant would increase, for TVA, the already high level of uncertainty in its environment. When the agency let bids for four new large-scale generating units, it requested only bids for nuclear units be submitted. Once again, TVA's environment

had dictated the choice of new generating capacity by ruling out of consideration the only viable alternative.

The 1974 decision was also dictated to TVA by forces in its environment. The thermal pollution dispute between TVA and EPA had ended in 1973 when TVA agreed to construct cooling towers at all of its nuclear plants. Although this capitulation to EPA cost TVA $640 million, it provided the agency with a measure of certainty concerning the future operation of its nuclear contingent. Because most stringent of environmental standards could be met by the plants, operation could not be limited for environmental reasons.

The coal situation became even worse before the 1974 decision. The price of coal in TVA contracts in 1974 went from $11.30 a ton to $30 a ton. Further, the agency was experiencing difficulty in securing coal. TVA coal stock piles were dwindling when, in August, coal miners conducted a week-long work stoppage and then, in October, walked out on strike. Further, the dispute between EPA and TVA over how to control SO_2 emissions was even more intense. The worst part of the coal situation in 1974 was the fact that it gave no indication of improving.

When TVA let bids in 1974 for four new large-scale generating units, it again requested that only bids for nuclear units be submitted because the uncertainty involved in increasing its coal-fired generating capacity ruled coal plants out of consideration as a viable alternative. Again, the environment had dictated TVA's choice of new generating capacity by effectively limiting its alternatives to nuclear power.

The environmental change that occurred between 1966 and 1974 affected not only the choice of alternative technologies for increasing program size, but the scope of the power program as well. TVA, because of several factors, but most importantly the environmental change that was occurring, instituted several changes in program scope. The first occurred in 1966 when the agency purchased the coal reserves at Fort Breckenridge in Kentucky. This rapid expansion into the coal market was of limited magnitude in that it included only the ownership aspect of the coal supply process. This expansion of scope resulted from two of the same factors that influenced TVA to adopt nuclear technology at about the same time: the agency mission and the changing coal market. By expanding into the coal market, TVA was able to better determine the true cost of generating electricity. The ownership of a large coal operation allowed TVA to determine the cost involved in such an operation. Further, this expansion was designed to help protect TVA from future vagaries of the coal market. The decrease in competition among suppliers of coal, and the general increase in uncertainty in the coal market was a matter of concern for TVA officials. Although the 225 million tons the purchase entailed by no means released TVA from its dependence on the coal market, it did help ensure a part of its future needs.

The second expansion of scope occurred in 1972 when TVA entered the nuclear fuel cycle. This limited expansion of program scope occurred as a result of TVA's mission and the increasing difficulty posed by the use of coal. As with the 1966 expansion of

program scope to include a part of the coal supply process, TVA's expansion into the nuclear fuel cycle would increase the agency's ability to generate electricity at the lowest possible cost and to determine the true cost of generating electricity. It was very evident that under these conditions TVA would be looking more and more to nuclear power plants to supply its new generating capacity. The expansion into the nuclear fuel cycle was designed to help ensure its future supply of nuclear fuels and to help prevent the agency from being as vulnerable to price increases for uranium as it has been to increases in coal prices.

The third expansion of program scope occurred in 1974 when TVA established a mitigation program for communities in the vicinity of the Hartsville nuclear power plant. The program had two principal aspects: financial and informational. The financial aspect was designed in response to the impact of construction crews on these surrounding communities. The tax base in this rural area was not capable of providing the services necessary for the several thousand families that would temporarily become a part of the communities. The informational aspect was in response to the Concerned Citizens of Tennessee's publicity in the area. Because there was no group organized in the area to support TVA and nuclear power, many of the charges made against TVA and nuclear power by CCT leaders went unanswered. Charges that go unanswered often gain the appearance of truth. The mitigation program, therefore, put representatives from TVA in the communities to supply information about TVA and the nuclear plant to be constructed and to publicize TVA's response to CCT's charges.

In addition to the slow/limited change in program scope effected by the decision to start a mitigation program, TVA, in 1974, also attempted a rapid/extensive change in program scope by making a conditional bid to buy Peabody Coal Company. Several factors affected TVA's decision to make this offer, the most important being the high level of uncertainty in the environment caused by the coal situation. The price of coal had increased by a factor of six in just six years, and there was no reason to believe it would stabilize at that price. Further, supply of coal was limited because of uncertainty in the coal market and the miner's strike. If TVA was to continue to provide electricity to the entire Tennessee Valley at a price that would encourage economic development, either some certainty would have to return to the coal market or TVA would have to become its own supplier. Obviously, TVA was powerless to affect the condition of the coal market. When the Federal Trade Commission ordered Kennecott Copper Corporation to divest itself of Peabody, the opportunity seemed available for TVA to secure a major part of its coal supplies for years to come. Only when Peabody's reserves were discovered inadequate did TVA rescind its offer.

A major facilitation factor involved in this situation was TVA's high level of autonomy. A government agency making a bid to purchase the world's largest coal company without first having to gain congressional approval requires a tremendous amount of discretion. Although the strong opposition engendered by the bid was a major factor in causing the Senate Public Works Committee to hold oversight

hearings over the agency and several Senators expressed displeasure over the action, Congress made no attempt to force TVA to rescind its offer.

ALTERNATIVE PERSPECTIVES ON PROGRAM DEVELOPMENT

The purpose of this section is to evaluate the utility for explaining the process of program development of the alternative perspectives presented in Chapter I. The closed-system perspective, represented here by incrementalism, focuses on the decision-making process as intra-organizational dynamics. Incremental decision-making is characterized by limited information gathering and analysis. Incremental change is characterized as a process of means-end adaption in which means and ends are continuously undergoing change to better conform to each other; or, as an increment of change to an already existing base.

The open-system perspective focuses attention on four phenomena both internal and external to the organization. First, the organizational environment is examined because it is here, according to this perspective, that the major impetus for change occurs. Second, the level of comprehensiveness in the decision-making process is examined. The more comprehensive an organization is in examining its alternative courses of action, the more likely it will perceive the need for large-scale change. Third, the level of organizational autonomy is examined because the higher the organization's autonomy, the more effectively it can isolate itself from changes in the environment

Fourth, the manner in which an organization's goal is interpreted is examined. The dominant interpretation of the goal, the organization's "mission," is focused on because programs function to achieve missions. Thus, a change in the mission through a reinterpretation of the goal may require program change. The question addressed in the remainder of this chapter is, Which of these two perspectives is more effective in explaining the pace and magnitude of change in program size, scope, and technology? In order to answer that question, the change in size, scope, and technology in TVA's power program will be examined from both the closed- and open-system perspective.

Change in Program Size

The size of TVA's power program, since its inception, has changed at a rapid pace and extensive magnitude. Viewing change in TVA's power program through the incremental perspective requires one to examine the size of "increments" from the "base." Figure II.1 on page 69 and Figure IV.1 on page 153 present data on TVA's total generating capacity in this form. As can be seen from these figures, change in the size of TVA's power program does not conform to this pattern. The very large size of the increments, that is, the rise in the line from one year to the next, indicates a near constant pattern of non-incremental growth. This is even true after the power program became well established with a relatively large base.

Presenting changes in the size of TVA's power program as increments of change to a base, however, does yield insight potentially

useful in understanding the process of program development. Although the change was not what was expected, according to this perspective, examining the change as increments to a base provides us a useful manner in which to think about and communicate the massive amount of information in these figures. The fact that the size of TVA's power program has developed in a non-incremental fashion indicates that a process of development involving constantly large changes has occurred.

Examining change as a process of means-end adaption, which also characterizes incrementalism, however, does not accurately depict the change that occurred in power program size. If the first board of directors had decided the power program would be an adjunct addition to the private power system present in the Valley, this action would have constituted means-end adaption. That is, the ends of providing support to private power companies would have conformed to the agency's means of generating electricity, which, at the time, consisted of a single dam. However, Lilienthal's decision that TVA would become the sole source of electricity in the Tennessee Valley established, as means, a power program that did not yet exist. Further, throughout TVA's existence these means have remained constant. As demand for electricity has increased in the Valley, TVA officials have repeatedly decided to expand the means to meet the ends rather than modify ends to fit the means available.

The incremental process of decision-making, described in Chapter I as characterized by limited information gathering and analysis, is an inaccurate depiction of the extensive and continuous

process employed at TVA. As this case well indicates, TVA does not limit its focus to those things marginally different from the status-quo. Rather, through annual review of power needs, it constantly monitors its environment to aid in planning for long-range changes in demand. Further, since its beginning, the agency has been active in examining alternatives, such as coal and nuclear technology, that differ significantly from the status-quo. This is true whether the agency is making a decision related to changes in program size, scope, or technology.

The open-system perspective, on the other hand, does provide some insight into why the power program's size developed at a rapid pace and extensive magnitude. Indeed, all four concepts in the model help explain the rapid/extensive development of TVA's power program. The high level of comprehensiveness in its decision-making process has always enabled TVA to plan for changes in the demand for its electricity. The elaborate information gathering and analyzing process the agency has routinized allows for the consideration of all feasible alternatives in adding new generating capacity to its system. The twenty years TVA spent analyzing nuclear energy before adding it to the TVA system provides an example of the extent to which TVA is willing to expend resources to maintain all feasible alternatives as viable options. The use to which TVA puts the information it gathers is dependent on the other three aspects of the open-system perspective: goal, autonomy, and environment. The agency's goal was distinguished in the case as unified resource development. However, it

was also noted this goal has been interpreted as the provision of electricity at the lowest possible cost. TVA officials justify this interpretation of the goal as follows:

> At the heart of this rapid development is the basic philosophy which underlies all TVA programs and activities - the natural resources of the Tennessee Valley region must be developed in a unified manner for the benefit of all the people. This philosophy, clearly reflected by Congress in the TVA Act, was the first and most basic decision in the development of the TVA power program. Electricity must be made available at low cost to the farmer as well as the city dweller, to the poor as well as the wealthy.
>
> This basic tenet has been the basis for all decisions as regards the development of the TVA power system. It was reflected in TVA's decision to build coal-fired steam plants when the region's demand for electricity first showed signs of outstripping the river's power generation capacity. It was the basis for Congress' decision to allow the agency to sell bonds or notes so that needed power generation facilities could be constructed without relying on the uncertainty of Government appropriations. Today, it supports the decision of TVA to construct nuclear power plants so that the region will continue to enjoy an ample supply of electricity at reasonable prices.[1]

The establishment of providing low-cost electricity as TVA's mission occurred over the span of several years. However, its importance to TVA can be dated to the 1933 decision that TVA's power program would operate independently of the private power system in the Valley. In order to accomplish this mission, the agency has had to expand the size of its power program at a pace and magnitude sufficient to meet

---

[1]"Decisions Relating to the Provision of Ample Electrical Energy for the Tennessee Valley Region," in The Tennessee Valley Authority Experience, ed. by Hans Knop (2361 Laxenburg, Austria: International Institute for Applied Systems Analysis, 1974), p. 268.

the increased demand in the Valley. This means that once the mission to provide this electricity at the lowest possible cost was established, the pace and magnitude of change in program size were determined by demand, not by intra-organizational dynamics.

Since the pace and magnitude of change are determined by the relationship between the organizational mission and demand, attention shifts to the ability of TVA to accomplish this mission and meet the demand. The most important factor determining this is whether or not the agency possesses the autonomy necessary to carry out its decisions. The importance of autonomy to the pace and magnitude of changes in program size has been evident at several different times in TVA's history. In the early and mid-1950's, because TVA lacked the autonomy necessary to expand the size of its power program, the agency was several times refused the appropriations necessary to construct new generating capacity. This reliance on Congress slowed change in the size of the power program and threatened to reduce it to a slow/limited level if the self-financing amendment could not be passed. Throughout the 1960's and early and mid-1970's, however, because the agency possessed the necessary autonomy, its program experienced a faster pace and more extensive magnitude of change than at any time in its history.

In discussing change in program size to this point, discussion has focused on the increase in on-line generating capacity. An important distinction must be made here between increases in on-line generating capacity and commitment to bring new generating capacity

on-line at a future date. In the decisions to increase program size between 1966 and 1974, TVA committed itself to phenomenal changes in the size of on-line generating capacity for 1970 through 1986. The size of this commitment was unparalleled in the agency's history. TVA, however, was forced to make these long-term commitments because of the twelve year lead-time for nuclear power plants. TVA's only other alternative was coal-fired steam plants, which, in the early and mid-1970's, had a five year lead-time. The choice TVA faced, therefore, was to commit itself to this pattern of unparalleled change or wait seven years and begin construction of new coal-fired generating capacity. The uncertainty in the coal market, however, forced TVA to commit itself to add the nuclear generating capacity. Thus, the environmental uncertainty of this time period required the agency to make long-term commitments in its program size.

Change in Program Scope

TVA's power program has experienced five important expansions in program scope: 1) the establishment of the power program as a sole source of electricity in the Tennessee Valley; 2) the establishment of a distribution system; 3) entry into the coal market; 4) entry into the nuclear fuel cycle; and 5) establishment of a mitigation program. Also, a sixth expansion was proposed, to include all the aspects of coal supply, but eventually was rescinded.

Program change that is of a non-size nature, such as in scope and technology, are not described as increments to a base. Rather,

according to the incremental perspective, they are adaptions of means to ends or ends to means. From this perspective, three of the five actual changes in program scope can be explained: entry into the coal market, entry in the nuclear fuel cycle, and the establishment of the mitigation program. All three changes were attempts by TVA to adapt its means, that is, its power program, so as to be better able to achieve the ends of economic development through the provision of low-cost electricity. None of these expansions in scope resulted in a change in the power program as means.

The expansions into the coal market in 1966 and the nuclear fuel cycle in 1972 were designed to help ensure that the coal-fired and nuclear plants could continue to operate despite fluctuations in the coal and uranium markets. The mitigation programs established beginning in 1974 were to help ensure acceptance of TVA's nuclear plants by the local communities where they were to be built. None of these expansions had any significance or were useful to TVA except in the sense that they contributed to the already established power program.

The establishment of the power program as the sole source of electricity in the Tennessee Valley, the establishment of a system to distribute that electricity and the attempted purchase of Peabody Coal Company, however, were all distinct attempts to change the very nature of the power program by enlarging it. They were not attempts to adapt the present means. The decision by the first board of directors that TVA would replace the private power companies established in the Tennessee Valley did not create a new power program. However, it altered

drastically the existing power program from an adjunct addition to the established power system to the sole source of power in the Valley.

The decision to establish a power distribution system was also more than just an adaption of means. Although, by distributing the electricity produced it did help the power program better achieve its ends, it added a separate and distinct function to the power program.

The attempted expansion of program scope represented by the conditional bid to buy Peabody Coal Company also defies explanation as a process of means-end adaption. Although this expansion would have improved the ability of the means to accomplish its ends, the coal aspect of TVA's power program could have become a program unto itself. Even if TVA had sold off those parts of Peabody it did not need to supply its own coal, the coal operation left to supply just its own coal would have been a fully functional operation separate from the power program.

The incremental perspective has proved very useful in explaining three changes in program scope: the rapid/limited expansion in the coal supply process and the nuclear fuel cycle and the slow/limited expansion to include a mitigation program. This leave two changes in scope and one attempted change in scope, however, unexplained: the rapid/extensive establishment of the power program; the rapid/limited establishment of the power distribution system; and the attempted rapid/extensive move into the entire coal supply process. The question which we are confronted with, therefore, is "If these changes were not the adaption of means to better fit ends, what were they?" In an

attempt to answer the question, the open-system perspective will be applied to these three changes. Thus, attention will be focused on the environment, certain characteristics of the decision-making process, autonomy, and the organizational goal/mission. In focusing on the environment, the first thing that becomes apparent is that each of these expansions occurred or was attempted when the environment was in a complex/dynamic state and characterized by a high level of uncertainty. The two expansions of program scope, that established TVA as the sole source and major distributor of electricity in the Tennessee Valley, were made when a large number of private power companies were working actively against the agency, relations between TVA and these private companies had totally broken down, and the agency's future was uncertain because of the dozens of legal challenges in which it was embroiled, including several challenging its very existence. The offer to buy Peabody Coal Company occurred at a time when the number of influential forces in TVA's environment, such as EPA and NRC, was high and relations with EPA and coal contractors had deteriorated. Also, the cost of coal was at a record high, its availability was limited, and the future of the coal market was highly uncertain because of rising opposition to strip-mining and miners' strikes. These expansions in program scope, therfore, seem to be responses to forces impinging upon TVA from its environment.

Further, each time one of these non-incremental changes in scope occurred, the agency's goal or mission was threatened. Although during the 1930's, the agency's mission had not matured, it was clear

that TVA's electricity would play some role, along with navigation and flood control and the agricultural program, in economic development. Also, Lilienthal's interpretation of the yardstick function of TVA required the agency be able to experiment in all phases of the generation and distribution of electricity. Therefore, when the private power companies brought suit to limit TVA's activities in the power area, the agency's ability to perform what was even then an important function required it to establish a service area and ensure that power could be distributed throughout that area.

In 1974, when TVA attempted to buy Peabody Coal Company, 80.53 percent of its on-line generating capacity was coal-fired. The near tripling in the price of coal over the year obviously threatened TVA's ability to provide electricity at a low cost. More importantly, however, the miners' moratorium and strike and the general uncertainty of the coal market was making it difficult for TVA to secure coal at any price. Thus, the threat was not only to the low-cost aspect of TVA's mission, but to the very ability of the agency to supply electricity.

The level of autonomy that TVA possessed during these two time periods was very high. The autonomy provided the first board of directors by President Roosevelt and the Congress allowed for heavy emphasis to be placed on generating and distributing electricity. The autonomy provided TVA in 1974, primarily by the self-financing legislation of 1959, allowed the agency to make a conditional offer that, if realized, would make it the owner of the nation's largest coal company. Very few government agencies have ever possessed such autonomy, and, although

it may not have served as a stimulus to TVA's attempting such expansions of scope, they certainly could not have been attempted without such autonomy.

The fourth aspect of the open-system perspective is the level of comprehensiveness in both the information-gathering and analysis stages of the decision-making process. Information gained from this aspect, however, tells us little about these changes in program scope. The forces impinging upon TVA from its environment that served as the impetus for the three expansions in program scope could be revealed by the most cursory decision-making process.

The question asked above concerning what manner of change were the two expansions and one attempted expansion of scope can now be answered. They were responses to highly complex, dynamic, and uncertain environments that threatened the agency mission or goal. Further, it can be asserted a high level of autonomy was necessary as a facilitative condition for these changes to occur.

The incremental and open-system perspectives both proved useful in explaining the expansion of scope in TVA's power program. The incremental perspective's explanation of change as means-end adaption accurately depicts the rapid/limited entry into the coal supply process, the rapid/limited entry into the nuclear fuel cycle, and the slow/limited expansion to include a mitigation program. The open-system perspective, on the other hand, more accurately depicted the rapid/extensive establishment of the power program as the sole source of electricity in the Tennessee Valley, the rapid/limited expansion to

being a major distributor of that electricity, and the attempted rapid/extensive change to include all the aspects of the coal supply process.

Change in Program Technology

TVA has adopted new technologies on two occasions in its thirty-five year history: coal technology during the post-World War II period and nuclear technology in 1966. Both of these changes were at a rapid pace and over an extensive magnitude. In neither instance can the change be depicted as the incremental adaption of means to ends or ends to means.

In the mid and late 1940's, TVA's mission had not fully matured as it had in 1966. The power program, however, was the dominant program within TVA and agency officials were very concerned about providing low-cost electrical energy to its clients in the Valley. Further, this desire was directly linked to the goal of economic development.

In 1946, the agency was confronted with increasing demand and technological problems. The problem in 1946 was that the Tennessee River could no longer meet the rapidly increasing demand for more electricity. In 1966, the problem was a number of difficulties associated with the use of coal, including strip-mining and SO_2 emissions.

The exact choices TVA confronted immediately prior to these two changes in technology were quite different, however. After World War II, the agency could not maintain its program means and ends because the means were no longer adequate to attain the ends. The

provision of low-cost electrical energy for economic development could no longer occur because demand for that electricity exceeded the ability of the Tennessee River to provide it. Therefore, either means or ends had to change. A change in ends would require TVA to forsake its role as sole source of electricity in the Valley. This would not be an adaption but a major change. A change in means would require the adoption of an entirely new technology, because there is no manner in which generating capacity can be continuously adapted to generate greater output.

In 1966, TVA's ends were even less susceptible to change than they had been in the middle and late 1940's. The means, however, were capable of being adapted to the increased demand by an addition to the size of coal-fired generating capacity. This did not occur, however, and thus the incremental perspective does not accurately depict the situation.

Although the incremental perspective proved quite useful in explaining certain changes in scope, neither of the changes in program technology that TVA's power program has experienced conform to it. Thus, the open-system perspectives will be applied to these changes in an attempt to explain why they occurred.

In 1946 when the agency requested an appropriation to construct its first peace-time coal-fired generating capacity, TVA's environment was in a simple/static state and was characterized by a high level of certainty. There was no real opposition to TVA and the only uncertainty concerned how it would meet the increasing demand for electricity.

Once TVA requested the appropriation to adopt a new technology, environmental complexity increased as several private power companies entered the political arena in which TVA was operating. TVA's relationship with them deteriorated rapidly, increasing the rate of environmental change, and the agency's ability to meet future demand for its electricity became very uncertain because of these companies' opposition to TVA's change in program technology.

Thus, although the open-system perspective focuses on the environment as the principal stimulus for program change, in this instance the program was the stimulus for environmental change. The decision to adopt a new technology, however, was required if the mission was to be fulfilled. TVA could not continue to supply the Tennessee Valley with electricity, at any price, if it did not adopt a new technology. Mission, therefore, can be labeled the major determinative factor in this change in technology.

The level of comprehensiveness in the information gathering and analysis stage of the decision-making process is also important. TVA had acquired a number of coal-fired steam plants in the 1930's when it bought out the private power companies in the Valley. The agency immediately took over operation of the plants and developed expertise in this aspect of electricity generation. Further, when Congress appropriated funds during World War II for construction of a large-scale coal-fired steam plant in the TVA system, the agency constructed the plant itself. Thus, when demand for electricity after World War II exceeded the available hydro-capacity, TVA had already

developed expertise in both the construction and operation of coal-fired steam plants. Thus, the information and ability necessary to analyze this only feasible alternative to hydro-electricity capacity in the mid and late 1940's was well established with TVA.

The required level of autonomy was lacking for such a decision, however. TVA, in 1946, was dependent on Congress for appropriations for all construction projects. Although Congress had never attempted to interfere with increases in the size of TVA's power program, only under a war-time situation had it actually made an appropriation for a facility whose sole purpose was to generate electricity. The three years required by TVA to gain the appropriation was a direct result of its low level of autonomy.

The open-system perspective shows the 1966 decision to adopt nuclear technology to have been a very different process. TVA was not forced, as was noted above, to adopt a new technology. The coal situation was beginning to deteriorate, but only because public opinion was beginning to rise against environmental degradation, and especially strip-mining. Coal, however, was readily available at $4.50 a ton.

The agency's environment was in a simple/static state and was characterized by a high level of certainty. There were no environmental forces impinging upon the agency that might force it to go nuclear. Further, unlike the 1946 decision to try to adopt coal technology, the 1966 decision did not immediately increase environmental complexity, change, and uncertainty.

As with the previous change in technology, however, the

decision to adopt nuclear technology seems to be rooted in the agency's mission. Two specific factors relating to the mission are important to understand this decision. First, the analysis of bids indicated the nuclear plant would save TVA several million dollars a year. Although this was a small amount relative to the total cost involved, it did mean the nuclear plant could provide electricity for TVA at a low cost, even relative to coal. Second, the yardstick function, which had been incorporated into the mission, required TVA to play a leadership role in the development of new low-cost technologies for generating electricity. If TVA was to play this role for nuclear technology it had to expand into that field when it did because of the move in that direction by many public and private utilities at about the same time.

The level of comprehensiveness in the information gathering and analysis stages of the decision-making process was also important for this decision. TVA had been gathering information and developing expertise in the area of nuclear technology for twenty years prior to requesting bids for a nuclear plant. The agency made use of this high level of expertise, as well as an outside consulting firm, and spent almost three months analyzing the bids. Although public and private utilities across the country were beginning to order nuclear generating capacity, the expertise TVA had developed in this area allowed it to provide the leadership role it sought by ordering larger, and therefore cheaper, units and also by playing an active role in the plant's construction.

The level of autonomy at this time was such that, unlike in 1946, the 1966 decision required no outside approval. The self-financing legislation of 1959 had released TVA from the need, through the appropriations process, to gain congressional approval for its large-scale construction projects. Although Congress was still fully capable of stopping TVA's adoption of nuclear technology, the lack of concern in Congress over TVA's activity in 1966 allowed the agency the autonomy necessary to make the decision without concern for its political ramifications.

The open-system perspective was proven very useful in explaining changes in TVA's technology. Although other factors were obviously involved, the major factor in determining both decisions was the agency's mission. In 1946, TVA's decision to adopt coal technology was necessary if it was to continue to supply electricity to the Tennessee Valley. In 1966, in addition to believing it could generate electricity more cheaply at a nuclear plant, the move to nuclear power was necessary at that time if TVA was to maintain its role as a leader in low-cost generating of electricity.

CONCLUSION

The incremental and open-system perspectives both proved useful in describing and explaining the development of TVA's power program. The concepts of base and increment derived from the incremental perspective helped depict changes in the size of TVA's power program, even though those changes were much larger than this perspective leads one to expect. Further, although the incremental perspective did not

explain changes in program technology, the process of means-end adaption accurately depicted two of the three rapid/limited changes in program scope that occurred, and the single slow/limited change in that scope.

The open-system perspective was more useful in depicting a single instance of rapid/limited change in program scope. More importantly, however, changes, attempted or actual, of a rapid/extensive type in program size, scope, and technology were all more accurately depicted by the open-system perspective.

Although generalizing from a single case is always difficult, the obvious inability of the closed-system perspective, as represented here by incrementalism, to explain instances of rapid/extensive program change indicates a genuine need for an alternative theoretical perspective. The following chapter attempts to move beyond the limitations of this single case, and focus on the general process of program development. Further, it will attempt to enhance the utility of both perspectives by delineating the more general nature of the relationship between program change and the different aspects of both perspectives.

CHAPTER VI

TOWARD A THEORY OF PROGRAM DEVELOPMENT

This chapter will not attempt to develop a full-scale theory of program development. Rather, its aim is to take a major step in that direction. The knowledge gained from close examination of the TVA case will be used as a foundation from which to expand beyond the limits of a single case. A series of propositions will be formulated to relate each of the four types of changes distinguished in Chapter I to the forces that result in that type of change. No attempt will be made, however, to determine whether the change that results will be a change in program size, program scope, or program technology. As was noted in Chapter I, the lack of prior conceptualization on the phenomenon of program development limits the theoretical level at which present studies of programsmay proceed. This study has focused on stimuli for program change and program level responses by the organization to those stimuli. Attention has not been directed at the forces that determine whether that response will occur in the program's size, scope, or technology.

The development of TVA's power program suggests that both the closed- and open-system perspectives are useful in explaining certain types of program change. The concepts that underlie both of these perspectives will thus be utilized in this chapter. However, the inability of the closed-system perspective, represented by incrementalism, to explain a variety of the changes that occurred in TVA's power

program indicates the need for an alternative perspective. Because incrementalism is a well developed perspective, this chapter does not attempt to further that development. Rather, emphasis will be directed toward the relationship between the different aspects of the open-system perspective and program change. This chapter intends both to refine further the open-system perspective and to add to our knowledge of the process of program development.

As was noted in Chapter I, the dearth of prior studies that focus on program change greatly limits the extent to which our findings can be generalized. Generalizing from a single case often produces nebulous results, especially when that case examines phenomena which have received little or no prior attention. One difficulty posed by this particular case, for purposes of generalizing to the process of program development, is the limited types of change that have been experienced by TVA. All of the changes in TVA's power program size and technology were of the rapid/extensive type. Further, of the six actual and attempted changes in program scope, two were rapid/extensive, three rapid/limited, and one slow/limited. Thus, although we have a host of information on factors producing rapid/extensive change, we have only limited or no information on the other three types. In addition, this study has shown program development to be an extremely complex pheonomenon affected by a multitude of factors both internal and external to the organization. Therefore, this concluding chapter will suggest only some of the more basic relationships affecting the process of program change. The nature of these relationships will be presented as a series of theoretical propositions.

Figure VI.1 presents the open-system perspective of program development in a more refined manner than was done in Chapter I. The figure indicates that the main impetus for program change occurs in the organization's environment. However, the relationship is not direct. That is, although the environment serves as the principal stimulus for program change, the process cannot be described in simple stimulus-response terms. Before a program can change in response to a change in the environment, the environmental change must be perceived by the organization. Thus, the comprehensiveness of the information gathering and analysis stages of the decision-making process must be taken into consideration. After gaining information on environmental change, the organization evaluates that change for its probable effect on the organization's internal goal, that is organizational maintenance, and the ability of the organization to accomplish its mission. Program change is then implemented to enhance the internal goal and/or the mission. The ability of the organization to implement the necessary change, however, depends on the level of autonomy the organization possesses.

The body of this chapter is divided into sections according to the different types of program change. Although logic would seem to dictate that the simplest type of change, slow/limited, be presented first, a dearth of information is available in the case on this type change. Therefore, in order to maximize the use of the case material, that type of change for which most information is available, rapid/extensive, will be presented first.

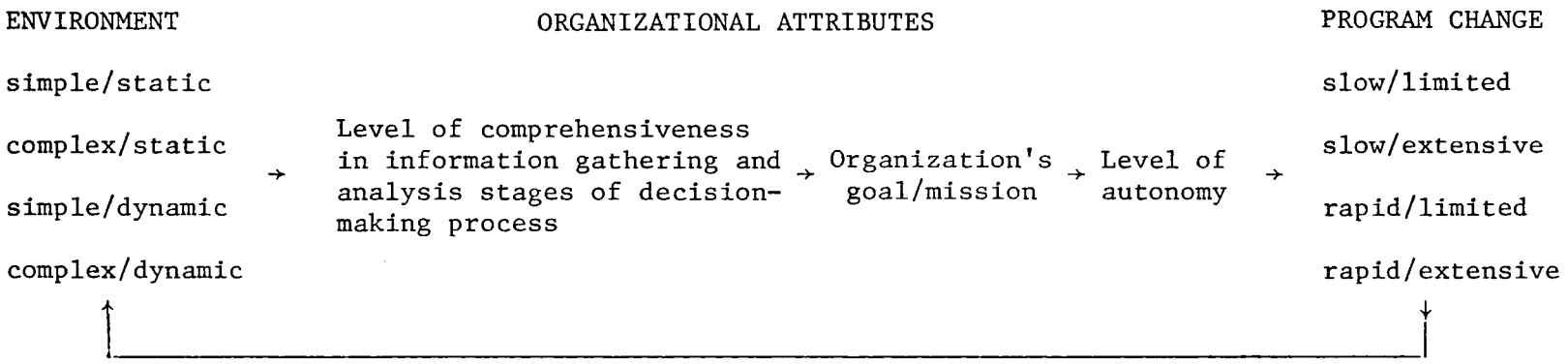


Figure VI.1

The Open-System Perspective of Program Change

RAPID PACE AND EXTENSIVE MAGNITUDE

This is the type of change that has been most frequently experienced by TVA. Although according to common belief government organizations are highly stable and resistant to even the smallest of changes, the case presented in this study demonstrates that this need not be true. Rapid/extensive change is the most difficult type of change to effect. More than any of the other three types of change, the rapid/extensive type requires the existence of specific conditions in those variables that comprise the open-system perspective.

There are two sources of stimuli for rapid/extensive program change: the organization's environment and the organization's mission. Rapid/extensive program change requires the organization renegotiate its relationships with established forces in its environment and negotiate new relationships with those forces added to the environment as a result of the program change. Thus, when the organization's program is undergoing rapid/extensive change, its relationship with its environment is necessarily highly interactive.

If the environment is in a complex state, this indicates new forces are entering the organization's environment that affect the program and thus must be dealt with. If the environment is in a dynamic state, this indicates that the relationships that the organization has established with forces already in its environment are undergoing rapid change. Either of these two conditions will cause uncertainty for the organization. If both conditions exist simultaneously, that is the environment is in a complex/dynamic state, the level of uncertainty will be extremely high.

In order to cope with this uncertainty, the organization is forced to implement program change. This change must be extensive because the rate of change and level of complexity in the environment are extensive. Further, if this extensive change occurs at a slow pace the environmental condition with which the change was designed to cope will have evolved to a different state before implementation of the change is completed. Therefore, the change must be rapid paced as well as extensive.

P_1: If the organization's environment is in a complex/dynamic state, rapid/extensive program change will occur.

The stimulus for rapid/extensive program change may not necessarily occur in the environment. The organization's mission is also capable of stimulating such change. Organizations that are firmly committed to a mission will implement whatever type of program change is necessary to allow them to accomplish that mission. However, if an organization implements rapid/extensive program change it will cause new forces to be added to its environment to deal with the new part of the program, such as suppliers and regulators, and will change the relationship between the organization and the established forces in its environment. Therefore, the environment will necessarily become more complex and dynamic.

P_2: Program change of a rapid/extensive type in an environment with a low level of complexity and/or change will cause the environment to change to a complex/dynamic state.

Thus, the complex/dynamic environment and the rapid/extensive changing program tend to reinforce each other.

The environment, however, in addition to stimulating program change also serves to inhibit that change. Program change that continues at a rapid/extensive level for any length of time will eventually grow into another program's bailiwick. The organization(s) whose bailiwick is impinged upon will attempt to have the growth of the focal organization restricted. It may do this by attempting to impose limits on its size, scope, or technology. Although it is generally a program's size that concerns an organization's competitors, expansions of scope and technology are often easier to critcize than changes in size. Organizations expanding their program scope or adopting new technologies can be accused of establishing a vertical monopoly and reducing competition.

P_3: Continued program change at a rapid/extensive level will generate conflict with other organizations.

P_4: Other organizations will attempt to inhibit the focal organization's growth by attacking its right to expand program scope and/or technology.

A major difficulty that rapid/extensive program change poses for organizations is its highly irreversible nature. Once a rapid/extensive change is proposed, forces in the organization's environment begin to change immediately. Thus, even if the decision is reversed prior to implementation, the environment will have already entered more complex and dynamic state. Further, rapid/extensive program change is extremely costly to implement. It will require the expenditure of funds for such things as new personnel, equipment, and raw materials. For both of these reasons, organizations that implement

rapid/extensive program change must be certain that the change will not be detrimental to the organization's internal goal, that is organizational maintenance, or its mission. Because rapid/extensive change is associated with an uncertain environment, the organization must maintain a comprehensive process for the gathering and analysis of information to maximize the probability its program change will not be overly detrimental to the internal goal and that it will aid the program in the intendend manner.

P_5: Organizations that implement rapid/extensive program change will maintain comprehensive processes for the gathering and analysis of information.

The direction of this relationship, at times, may be the opposite of that posited. An organization with a stable program but a comprehensive process for gathering and analyzing information is more likely to perceive an environmental condition that necessitates rapid/extensive change if such a condition exists.

P_6: An organization with a comprehensive process for the gathering and analyzing of information is more likely to implement rapid/extensive program change than one with a limited process of gathering and analyzing information.

The discovery of the need for rapid/extensive program change, however, is not adequate to make it happen. In addition, the organization requires substantial autonomy. Autonomy was defined in Chapter I as concerning the level of control the organization exercises over its principal resources and its legitimacy. For an organization to repeatedly implement rapid/extensive program change, it must possess both of these aspects of autonomy.

Organizations that do not exercise control over their principal resources will attempt to gain control over those resources in order to ensure organizational maintenance. The pace and magnitude of the change to include these principal resources will be directly proportional to level of complexity and change in the environment. Thus, if the environment is in a complex/dynamic state, with respect to a principal resource, the organization will implement rapid/extensive change in an attempt to gain control over the resource. TVA, for example, had taken steps in the past to acquire coal reserves, but it was only when the coal market became highly dynamic and uncertain that the agency made a serious effort to acquire control of the coal it needed.

P_7: An organization whose principal resource has an environment that is complex and/or dynamic and highly uncertain will implement rapid/extensive program change in an attempt to gain control over that resource.

Rapid/extensive change also requires the organization have legitimacy. That is, the major forces in its environment must perceive it to have the right to change in the manner in which it proposes. The ultimate source of legitimacy for all federal government organizations is their enabling legislation and Congress. If an organization does not have the autonomy to implement program change in a certain area, and thus must gain approval from a central authority as TVA had to gain congressional appropriations for coal-fired steam plants prior to the 1959 self-financing legislation, it cannot repeatedly implement rapid/extensive change. The fact that the authority to make important

commitments is vested outside the organization indicates the program has a low priority with the central authority. Thus, before approval of change can be gained, it must be placed on the central authority's agenda and subjected to its decision-making process. The length of time involved in this process often exceeds the duration of the environmental stimuli for the change.

Further, the process by which the organization gains approval from the central authority provides an access point by which any group opposed to the change may hinder that change. The high level of success that anti-nuclear power groups have enjoyed is an indicator of how this approval process can be used by opponents of program change. The NRC licensing process has been used to slow, and in a few cases to stop, adoption of this new program technology in several power programs across the country.

P_8: Legitimacy is a necessary prerequisite for repeated rapid/extensive program change.

RAPID PACE AND LIMITED MAGNITUDE

This is the type of change that characterized TVA's expansions of scope to include the establishment of a power distribution system and entry into the coal supply process and the nuclear cycle. Unlike rapid/extensive type change, change of a rapid/limited type is stimulated principally from only one source, the organization's environment.

This type of change most commonly occurs in response to a sudden increase in the rate of environmental change. Although the level of complexity may vary from simple to complex, the most prominent part

of the environment is the changes that are occurring in the organization's relationships with other organizations and forces in its environment. This environmental change represents a serious threat to the organization's internal goal because organizations depend on the components in their environment, with which they have established relations, both to provide the organization its input and to consume its output. Changes in these relationships can block such flows. Deprived of its input or market for its output a program can continue to function only for a short period of time. Therefore, the organization is forced to implement rapid change. However, the serious threat this environmental change represents to the internal goal increases its importance relative to the organizational mission. If the organization were to implement extensive change, this could further increase the level of change in the environment and, perhaps, increase the level of complexity. This situation could easily produce negative consequences for the internal goal, as it did when TVA attempted a rapid/extensive change of scope by making a conditional bid to buy Peabody Coal Company. Rapid/limited program change, in effect, becomes a mechanism used by the organization to protect its program from further environmental change.

P_9: Rapid/limited program change occurs when the organization's environment experiences a sharp increase in its rate of change.

Because of the heightened importance of the internal goal produced by the high rate of environmental change, extensive program change could occur only if the organization were unconcerned with its internal goal and were totally dedicated to its mission.

P_{10}: Organizations confronted with a sharp increase in the rate of environmental change will implement rapid/limited program change given any possible relationship between internal goal and mission except that of total dominance by the mission.

If rapid/limited change is to have its desired effect, that is protection of the internal goal, it must be implemented before the environment becomes too dynamic. The organization, therefore, must have an information gathering and analyzing process that is capable of perceiving relatively small changes in the rate of environmental change. Although the process need not be comprehensive, it must occur at frequent enough intervals that major changes in the rate of environmental change cannot fully mature without being detected in time for the organization to respond. An organization which gathers information at too infrequent an interval will generally not perceive the need for program change until the environment has reached too dynamic a state for rapid/extensive change to be useful.

P_{11}: Rapid/limited program change will occur in organizations that have decision-making processes that, at a minimum, gather information at intervals frequent enough to detect slight changes in the rate of environmental change.

Program change of the rapid/limited type, requires the organization possess autonomy relating to both its legitimacy and control over its principal resources. An organization that must acquire approval from a central authority cannot implement program change at the pace necessary to protect its program from an increasingly dynamic environment. The United States Postal Service (USPS) is an example of an organization that gathered and analyzed the information necessary

to perceive the need for rapid/limited change to protect its program, but lacked the autonomy to implement the change. USPS had neither control over its principal resources nor legitimacy in the areas that were necessary for it to protect its program. The principal resource over which it lacked control was rates and, thus, its revenues. USPS's Board of Governors was required to share control over its rates with an independent regulatory agency, the Postal Rate Commission. USPS, before it could raise its rates, had to request the Commission to study the need for a rate change. USPS was then required to wait for the Commission's report and implement its rate change within the limits set down by the Commission. While USPS waited for the Commission to respond to its requests, which has taken as long as two years, massive debts have been accumulated.

USPS also lacked legitimacy to operate in an important area. Congress has forbidden the agency to close rural post offices except under very specific circumstances that never seem to arise. This has prevented USPS from making its service more efficient and thus being able to lower its costs.

USPS has thus lacked the autonomy necessary to make rapid/limited changes in postal rates and postal services. When an organization cannot act rapidly enough to make limited program changes, and its environment remains in a dynamic state, eventually extensive program change will be necessary. The House of Representatives, this year, has voted to terminate the seven year old USPS. Similar legislation requiring extensive change, although not quite of the magnitude that

has been approved in the House, is being debated in the Senate and has received the support of President Carter.

P_{12}: A high level of autonomy is a necessary prerequisite for rapid/limited program change.

P_{13}: An organization that operates in a dynamic environment but lacks the autonomy to implement rapid/limited program change, will eventually be confronted with the need for rapid/extensive change.

SLOW PACE AND EXTENSIVE MAGNITUDE

Braybrooke and Lindblom note that even the most limited change, if considered over a long enough period of time, can be labeled extensive.[1] In addition, change can proceed at an apparent slow pace yet, in a surprisingly short time, result in extensive change. American involvement in Viet Nam can be characterized in such a manner. Over a period of two decades, changes in the size, technology and scope of America's anti-Communist program increased until, in the mid-1960's, an extensive change in that program had occurred. Although TVA did not experience any change of this type, it is possible to extrapolate from the conditions affecting rapid/limited and rapid/extensive change to situations that would affect both slow/limited and slow/extensive change.

Although the principal stimuli for slow/extensive program change is within the organization, in its mission, the environment also

---

[1]David Braybrooke and Charles E. Lindblom, A Strategy of Decision (New York: The Free Press, 1963), p. 64.

plays an important role. Program change of a slow/extensive type results from an increased uncertainty in the organizational environment growing out of an increase in environmental complexity. The level of change in the environment may vary from static to dynamic; however, any change that is occurring is overshadowed by the high level of complexity. This complexity is caused when new forces, such as government regulations and new competitors, enter the organization's environment and increase the number of environmental components that must be dealt with. Since change in the organization's relationship with its environment is either not occurring or is obscured by the high level of complexity, no eminent danger to the internal goals from loss of input sources or output consumers is apparent. Therefore, there are no strong environmental stimuli for program change.

This increased complexity, however, poses a serious threat to the organization's mission. The entry of new forces into the organization's environment in such forms as government regulations and regulatory agencies, interest groups, and competitors all place restraints on the ability of the organization to perform its mission. This increase in complexity, coupled with the absence of strong environmental stimuli, prevents the organization from implementing rapid program change.

P_{14}: An organization whose environment is characterized by a high level of complexity that overshadows any environmental change that is occurring will implement slow paced program change.

The magnitude of change that will occur in this situation depends on the relative strength of the organization's mission and

internal goal. If the mission is dominant over the internal goal the organization will implement the extensive change necessary to ensure its ability to accomplish its mission. Again, however, because of the high level of complexity and lack of environmental stimuli the change will be slow paced. If the internal goal is dominant over the mission, the organization will implement limited change for fear that extensive change will further increase environmental complexity and also the rate of environmental change.

P_{15}: An organization whose environment is characterized by a high level of complexity that overshadows any environmental change that is occurring, will implement slow/extensive change if its mission is dominant over its internal goals.

P_{16}: An organization whose environment is characterized by a high level of complexity that overshadows any environmental change that is occurring, will implement slow/limited change if its internal goal is dominant over its mission.

Organizations that implement slow/extensive program change do not need frequently and comprehensively to gather and analyze information on their environments and the effect of their program change. Change of this type will have no immediate effect and the effect it eventually does have will take several years to reach a measurable state. Therefore, the organization will make only periodic investigations of the state of its environment.

P_{17}: An organization whose program changes at a slow/extensive level will be characterized by decision-making processes that infrequently make comprehensive examinations of their environments.

An organization that implements slow-paced change requires much

less autonomy than one that implements rapid-paced change. If the magnitude of the change is to be extensive, however, the organization will require some legitimacy in the area into which it is expanding. It is possible, however, that the organization can legitimize its activity by slowly establishing itself in the new area and creating a need for its services. The Central Intelligence Agency (CIA), for example, slowly expanded its clandestine operations to include the geographical area of the United States. Although this was specifically forbidden by its enabling legislation, and eventually was questioned by high level government officials, the agency was able to carry out these operations for years without its legitimacy being questioned simply because they had been doing it for a long time.

P_{18}: Organizations that implement slow/extensive program change will establish their own legitimacy in the area into which they expand.

SLOW PACE AND LIMITED MAGNITUDE

This is the type of change most commonly associated with incrementalism. A decision-making process characterized by little effort to gather and analyze information produces change that is an increment to a base or that adapts a policy's means to its ends or its ends to its means. In the terms used in this study to describe program change it is slow in pace and limited in magnitude.

Occasional change of the slow/limited type can occur under any circumstances. However, for change to continuously occur at a slow pace and limited magnitude a specific set of circumstances must exist.

Primarily, the organization and its environment must share a high level of agreement over the role of the organization. Because the program experiences little change, the organization can develop stable relationships with its environment if such agreement exists. As these relationships develop, the environment enters a simple/static state that is characterized by a high level of certainty. Environments of this type do not produce strong stimuli for program change.

P_{19}: An organization characterized by slow/limited program change has an environment with a low level of complexity and a low level of change and, thus, has a high level of certainty.

As the incremental perspective asserts, an organization that exists in such a simple/static environment can maintain its program while expending very little of its resources for information gathering or analysis. If environmental conditions do not change, the organization can predict, with a high degree of certainty, the condition of its environment at any point in time. Therefore, as long as the organization does not implement rapid and/or extensive program change, which might cause environmental change, limited information gathering and analysis will be adequate for program decision-making.

P_{20}: An organization that maintains program change of a slow/limited type will expend few resources to gather information on the state of the environment.

Probably the most distinctive feature of slow/limited program change is its high level of reversibility and adaptability. Because program change occurs only at a slow pace and limited magnitude, reversing a change is a simple process. Further, because its environment

is in a simple/static state, there are little or no environmental stimuli for program change. Therefore, any demand that arises for rapid and/or extensive change must originate within the organization. The principal intraorganizational source of demand for program change is the organization's mission. If, however, the mission is subservient to the internal goal, the demand will be for that type of change that maximizes program and environmental stability. Since the environment is in a simple/static state, the organization will implement that type of change that is easiest to reverse if it increases the rate of environmental change or complexity. That type of change is slow/limited.

P_{21}: An organization that functions in a simple/static environment and emphasizes its internal goal over its mission will implement program change of only the slow/limited type.

The level of autonomy required to implement slow/limited change is very small. The fact that the environment is in a simple state indicates the program, as it is presently constituted, is viewed as legitimate by the relevant forces in the environment. Further, the static state of the environment indicates that the program is receiving its principal resources from its suppliers. Given such conditions, there is no need for an organization that is concerned primarily with its internal goal to possess any but the slightest level of autonomy.

P_{22}: An organization that repeatedly implements slow/limited program change will be characterized by a low level of autonomy.

If the organization does possess a high level of autonomy, but implements only slow/limited change it will lose the legitimacy necessary to change, through attrition, in the same manner an organization that

implements slow/extensive change establishes autonomy. The fact that the organization does not implement anything but slow/limited change will create in the forces in the environment the exptectation that it not implement any other type of program change.

P_{23}: An organization that possesses a high level of autonomy but implements only slow/limited change for an extended period of time will have its autonomy greatly curtailed.

CONCLUSION

Figure VI.2 presents a listing of the factors associated with each of the four types of program change discussed in this dissertation. As such, it represents a more refined version of the open-system perspective than was presented at the beginning of this study and the beginning of this chapter. To extrapolate beyond this perspective to a more general model of the process of program development or a statement of cause-effect relationships is well beyond the scope of a single research project.

This study has attempted to lay a foundation upon which further work can be based. The importance of understanding organizational environments, level of comprehensiveness in the decision-making process, organizational goal/mission, and organizational autonomy has been documented here. Further, the nature of the relationship between these variables and different types of program change have been suggested. The success of this study will be a factor of the amount of attention it attracts to this vitally important area and, also, of the value it proves to those who focus that attention.

Associated Conditions	Type of Program Change
Simple/Static Environment (Certain) Internal Goal Emphasized Decision-Making Process is Characterized by Limited Gathering and Analyzing of Information Low Level of Autonomy	Slow Pace and Limited Magnitude
Increasing Rate of Complexity in the Environment Mission is Emphasized Decision-Making Process is Characterized by Only Periodic Comprehensive Examinations of the Environment Organization Requires Little Autonomy and Will Establish Its Own Legitimacy	Slow Pace and Extensive Magnitude
Increasing Rate of Change in the Environment Internal Goal is Emphasized Decision-Making Process is Characterized by Frequent Gathering of Information High Level of Autonomy	Rapid Pace and Limited Magnitude
Complex/Dynamic Environment (Uncertain) Mission is Emphasized Conflict With Environment Decision-Making Process is Characterized by Comprehensive Gathering and Analysis of Information High Level of Autonomy	Rapid Pace and Extensive Magnitude

Figure VI.2

Factors Associated With Different Types of Program Change

SOURCES CONSULTED

SOURCES CONSULTED

1. Published Materials

Anderson, James E. Public Policy-Making. New York: Praeger Publishers, 1975.

Anderson, James E., David W. Brady and Charles Bullock, III. Public Policy and Politics in America. North Scituate, Mass.: Duxbury Press, 1978.

Anderson, Frederick R. NEPA in the Courts. Baltimore: Resources for the Future, Inc., distributed by the Johns Hopkins University Press, 1973.

Babbie, Earl R. Survey Research Methods. Belmont, Calif.: Wadsworth Publishing Company, Inc., 1973.

Braybrooke, David and Charles Lindblom. A Strategy of Decision. New York: The Free Press, 1963.

Duncan, Robert B. "Characteristics of Organizational Environments and Perceived Environmental Uncertainty." Administrative Sciences Quarterly 17 (September, 1972), pp. 313-27.

Green, Harold P. "The Risk Benefit Calculus in Nuclear Power Licensing." Nuclear Power and the Public. Edited by Harry foreman. Garden City, New York: Doubleday & Company, Inc., 1972, pp. 168-88.

Grumm, John G. "The Analysis of Policy Impact." Policies and Policy-Making - Handbook of Political Science. Vol. 6. Edited by Fred I. Greenstein and Nelson W. Polsby. Reading, Mass.: Addison-Wesley Publishing Company, 1975.

Hage, Jerald and Michael Aiken. Social Change in Complex Organizations. New York: Random House, 1970.

Halperin, Morton H. Bureaucratic Politics and Foreign Policy. Washington, D.C.: The Brookings Institution, 1974.

Heclo, H. Hugh. "Review Article: Policy Analysis." British Journal of Political Science. 2 (January, 1972), p. 83-108.

Hewlett, Richard G. and Oscar E. Anderson, Jr. A History of the United States Atomic Energy Commission. Vol. I: The New World, 1939-1946. University Park: The Pennsylvania State University Press, 1962.

Hewlett, Richard G. and Francis Duncan. A History of the United States Atomic Energy Commission. Vol. II: Atomic Shield, 1947/1952. University Park: The Pennsylvania State University Press, 1969.

Hobday, Victor C. Sparks at the Grassroots. Knoxville: The University of Tennessee Press, 1969.

Hofferbert, Richard I. The Study of Public Policy. New York: Bobbs-Merrill Company, Inc., 1974.

Isaak, Alan C. Scope and Methods of Political Science. Homewood, Illinois: The Dorsey Press, 1975.

Jones, Arnold R. "The Financing of TVA." Law and Contemporary Problems. 26 (Autumn, 1961), pp. 725-40.

Jones, Charles O. An Introduction to the Study of Public Policy. 2d ed. North Scituate, Mass.: Duxbury Press, 1977.

Lawrence, Paul R. and Jay W. Lorsch. "Differentiation and Integration in Complex Organization." Administrative Sciences Quarterly. 12 (June, 1967), pp. 1-47.

Lilienthal, David E. The Journals of David E. Lilienthal. Vols. 1-6. New York: Harper and Row Publishers, 1964-1966.

Lilienthal, David E. TVA: Democracy on the March. New York: Harper & Brothers Publishers, 1944.

Lindblom, Charles E. "The Science of Muddling Through." Public Administration Review. 19 (Spring, 1959), pp. 79-88.

Liroff, Richard A. A National Policy for the Environment. Bloomington, Indiana: Indiana University Press, 1976.

Martin, Roscoe C. "Retrospect and Prospect." TVA: The First Twenty Years. Edited by Roscoe C. Martin. University, Alabama: University of Alabama Press, 1956.

McBride, Don. TVA and the National Defense. TVA Library, Knoxville: unpublished manuscript, 1975.

McCraw, Thomas K. Morgan vs. Lilienthal: The Feud within the TVA. Chicago: Loyola University Press, 1970.

McCraw, Thomas K. TVA and the Power Fight; 1933-1939. New York: J. B. Lippencott Company, 1971.

Metzger, H. Peter. The Atomic Establishment. New York: Simon and Schuster, 1972.

Mohr, Lawrence B. "The Concept of Organizational Goal." American Political Science Review. 67 (June, 1973), pp. 470-81.

Morgan, Arthur E. "Planning in the Tennessee Valley." Current History. 38 (September, 1936), pp. 664-67.

Murphy, Jerome T. "The Education Bureaucracies Implement Novel Policy: The Politics of Title I of ESEA, 1965-72." Policy and Politics in America. Edited by Allan P. Sindler. Boston: Little Brown, and Company, 1973, pp. 160-98.

Natchez, Peter B. and Irvin C. Bupp. "Policy and Priority in the Budgetary Process." American Political Science Review. 67 (September, 1973), pp. 951-63.

Owen, Marguerite. The Tennessee Valley Authority. New York: Praeger Publishers, 1973.

Perrow, Charles. Organizational Analysis: A Sociological View. Belmont, Calif.: Brooks/Cole Publishing Company, 1970.

Pfeffer, Jeffrey and Gerald Salanick. The External Control of Organizations. New York: Harper and Row Publishers, 1978.

Pritchett, C. Herman, The Tennessee Valley Authority: A Study in Public Administration. Chapel Hill: The University of North Carolina Press, 1943.

Rorty, James, "TVA's H. A. Morgan." Commonwealth. 48 (June 18, 1948), pp. 226-30.

Schulman, Paul R. "Nonincremental Policy Making: Notes Toward an Alternative Paradigm." American Political Science Review. 69 (December, 1975), pp. 1354-70.

Selznick, Philip. TVA and the Grass Roots. Berkeley: University of California Press, 1949.

Steers, Richard M. Organizational Effectiveness: A Behavioral View. Santa Monica, Calif.: Goodyear Publishing Company, Inc., 1977.

Tennessee Valley Authority. "Decision Relating to the Provision of Ample Electrical Energy for the Tennessee Valley Region." The Tennessee Valley Authority Experience. Edited by Hans Knop. 2361 Laxenburg, Austria: International Institute for Applied Systems Analysis, 1974, pp. 262-78.

Thompson, James D. Organizations in Action. New York: McGraw-Hill Book Company, 1967.

Wanat, John. Introduction to Budgeting. North Scituate, Mass.: Duxbury Press, 1978.

Wenner, Lettie McSpadden. "Pollution Control: Implementation Alternatives." Policy Analysis. 4 (Winter, 1978), pp. 47-65.

Wessenauer, G. O. "Comprehensive Fuel Service for Browns Ferry." Paper presented at the Conference on Nuclear Fuel Exploration to Power Reactors, Southern Interstate Nuclear Board, Skirvin Hotel, Oklahoma City, Oklahoma, May 24, 1968.

Wessenauer, G. O. "The Fuel Market as Seen by the User." Paper presented at the Atomic Industrial Forum, Hilton Head, South Carolina, September 13-16, 1970.

Wildavsky, Aaron. Dixon - Yates: A Study in Power Politics. New Haven: Yale University Press, 1962.

Wildavsky, Aaron. "TVA and Power Politics." American Political Science Review. 55 (September, 1961), pp. 576-90.

Wildavsky, Aaron. The Politics of the Budgetary Process. 2d ed. Boston: Little, Brown and Company, 1974.

Zumwalt, W. "Short- and Long-Term Load Forecasting Models." The Tennessee Valley Authority Experience. Vol. 1. Edited by Hans Knop. 2361 Laxenburg, Austria: International Institute for Applied Systems Analysis, 1974, pp. 311-32.

2. Tennessee Valley Authority Reports

Tennessee Valley Authority. Annual Report of the Tennessee Valley Authority and Appendixes - for the Fiscal Year Ended June 30, 1934. Washington, D.C.: United States Government Printing Office, 1935.

_____. Annual Report of the Tennessee Valley Authority: 1970-1971. Knoxville: Tennessee Valley Authority, 1971.

_____. Annual Report of the Tennessee Valley Authority: 1973. Knoxville: Tennessee Valley Authority, 1973.

_____. Annual Report of the Tennessee Valley Authority: 1975. Knoxville: Tennessee Valley Authority, 1975.

_____. Comparison of Coal-Fired and Nuclear Power Plants for the TVA System. Chattanooga, Tennessee: Tennessee Valley Authority, Office of Power, 1966.

_____. Light Water Nuclear Plant Feasibility Study. Chattanooga, Tennessee: Tennessee Valley Authority, Division of Power Planning and Engineering, 1965.

_____. Nuclear Power Staff of the Division of Power Supply in TVA. TVA Nuclear Power Cost Study - 1954. Chattanooga, Tennessee, January, 1955.

_____. Power Annual Report - 1970. Knoxville, Tennessee: Tennessee Valley Authority, 1971.

_____. Power Annual Report - 1972. Knoxville, Tennessee: Tennessee Valley Authority, 1972.

_____. Power Annual Report - 1973. Knoxville, Tennessee: Tennessee Valley Authority, 1973.

_____. Power Annual Report - 1975 and 1976. Knoxville, Tennessee: Tennessee Valley Authority, 1975 and 1976.

3. Public Documents

Ashwander v. T.V.A. 297 U. S. 288, 56S.C. 466, 80 L.Ed. 688 (1936).

Calvert Cliffs Coordinating Committee v. Atomic Energy Comm'n. 499 F.2d 1109, 1 ELR 20346. D.C. Cir. 1971, denied, 404 U.S. 942 (1972).

General Accounting Office Report. Opportunities for Improvements in Reclaiming Strip-Mined Lands under Coal Purchase Contracts - Tennessee Valley Authority. GAO Rept. # B-114850, Aug. 9, 1972.

Jersey Central Power and Light Company. "Report on Economic Analysis for Oyster Creek Nuclear Electric Generating Station." The report is reprinted in the Hearings of the Joint Commission on Atomic Energy, 88th Cong., 1st Sess., 1964, pp. 846-98.

The National Environmental Policy Act of 1969. Pub. L. No. 91-190. January 1, 1970. 83 stat. 852, U.S.C. Sections 4321-4347 (1970).

Raven, Jack E., U. S. Environmental Protection Agency. Letter to Dr. F. E. Gartrell, Tennessee Valley Authority, May 22, 1972. Tennessee Valley Authority Office of Health and Environmental Science. Final Environmental Statement - Browns Ferry Nuclear Plant - Units 1, 2, and 3. Vol. 1. Chattanooga, Tennessee: Tennessee Valley Authority, 1972, pp. 3.12-1 - 3.12-2.

Skelton, William H., Chairman, Sierra Club, Tennessee Chapter. Letter to the Senate Committee on Public Works concerning Longshore's nomination. U. S. Congress. Senate. Committee on Public Works. Nomination of Thomas L. Longshore. 94th Cong., 2d Sess., 1976, pp. 249-55.

Tennessee Electric Power Co. v. T.V.A. 306 U. S. 118, 59S.C. 366, 83L. ed. 543 (1939).

U. S. Atomic Energy Commission. Testimony of G. O. Wessenauer before the AEC on April 23 and 24, 1970. Browns Ferry Unit No. 3 Hearing Record.

_____. The Nuclear Industry - 1966. Washington, D.C.: U. S. Atomic Energy Commission, 1966.

_____. The Nuclear Industry - 1968. Washington, D.C.: U. S. Government Printing Office, 1969.

_____. The Nuclear Industry - 1969. Washington, D.C.: U. S. Government Printing Office, 1970.

U. S. Congress. House. Subcommittee of the Committee on Appropriations. Public Works for Water and Power Development and Energy Research Appropriation Bill, 1974. Part 6: 93rd Cong., 1st Sess., 1973.

_____. 93rd Cong., 2d Sess., 1973.

_____. Public Works for Water and Power Development and Energy Research Appropriation Bill, 1976. Part 7: 94th Cong., 1st Sess., 1975.

_____. Part 4: 95th Cong., 1st Sess., 1977.

_____. Public Works for Water, Pollution Control and Power Development and Atomic Energy Commission Appropriations Bill, 1971. Parts 3 and 4: 91st Cong., 2d Sess., 1970.

U. S. Congress. House. Subcommittee on Public Works of the Committee on Appropriations. Public Works Appropriations for 1967. Part 2: 89th Cong., 2d Sess., 1966.

U. S. Congress. House. Subcommittee of the Committee on Appropriations. Government Corporations Appropriations Bill for 1949. 80th Cong., 2d Sess., 1948.

U. S. Congress. House. Committee on Public Works. TVA Act Amendment - Increase Borrowing Authority. 91st Cong., 2d Sess., 1970.

_____. TVA Bond Issue Increase. 89th Cong., 2d Sess., 1966.

U. S. Congress. House. Committee on Public Works Subcommittee on Flood Control. Tennessee Valley Authority Financing. 85th Cong., 1st Sess., 1957.

U. S. Congress. Senate. Committee on Public Works. Nomination of William L. Jenkins to be a Member of the Board of Directors of the Tennessee Valley Authority. 92nd Cong., 2d Sess., 1972.

_____. Nomination of Don McBride to be a Member of the Board of Directors of the Tennessee Valley Authority. 89th Cong., 2d Sess. 1966.

_____. Nomination of Aubrey J. Wagner to be a Member of the Board of Directors of the Tennessee Valley Authority. 91st Cong., 1st Sess., 1970.

_____. Nomination of Thomas L. Longshore to be a Member of the Board of Directors of the Tennessee Valley Authority. 94th Cong., 2d Sess., 1976.

_____. Nomination of James F. Hooper, III to be a Member of the Board of Directors of the Tennessee Valley Authority. 94th Congress., 2d Sess., 1976.

_____. Tennessee Valley Authority Oversight Hearings before the Senate Public Works Committee. Part 1: 94th Cong., 1st Sess., 1975.

U. S. Congress. Senate. Subcommittee on Flood Control-Rivers and Harbors of the Committee on Public Works. Increase in Statutory Limitation of TVA to Issue Bonds. 89th Cong., 2d Sess., 1966.

_____. Revenue Bond Financing by the TVA. 89th Cong., 2d Sess., 1966.

_____. Increase in Statutory Limitation of TVA to Issue Bonds. 91st Cong., 2d Sess., 1970.

U. S. Congress. Senate. Operations of Muscle Shoals Properties, Etc. S. Rept. 130. 73rd Cong., 1st Sess., 1933.

4. Interviews*

Barron, John S. Interview in Knoxville, Tennessee. July 25, 1977.

Best, Edward. Interview in Maryville, Tennessee. June 17, 1977.

Darling, James. Interview in Knoxville, Tennessee. June 24, 1977.

Jenkins, William L. TVA Board Member 1972 - 1978. Interview in Knoxville, Tennessee. July 18, 1977.

*Unless otherwise noted, those interviewed were high level administrative officials within TVA.

McBride, Don. TVA Board Member 1966 - 1975. Interview in Knoxville, Tennessee. July 11, 1977.

McBride, Neil. East Tennessee Research Corporation. Interview in Jacksboro, Tennessee. June 3, 1977.

Patterson, David. Interview in Knoxville, Tennessee. June 13, 1977.

Powell, David. Interview in Knoxville. June 18, 1977.

Thomas, John. East Tennessee Energy Group. Interview in Knoxville, Tennessee. June 1, 1977.

Van Mol, Louis. Interview in Knoxville, Tennessee. June 16, 1977.

Watson, James E. Interview in Chattanooga, Tennessee. May 9, 1977.

Wessenauer, G. O. Interview in Chattanooga, Tennessee. May 9, 1977.

Williams, Godwin. Interview in Chattanooga, Tennessee. July 8, 1977.

5. Newspapers

Chattanooga Times. April 24, 1970.

_____. September 18, 1973.

Huntsville Times. June 2, 1972.

Knoxville News-Sentinel. July 21, 1966.

Knoxville Journal. July 30, 1966.

_____. July 29, 1970.

Memphis Commercial Appeal. March 29, 1966.

Memphis Press-Scimitar. November 16, 1965.

_____. August 13, 1970.

Nashville Tennessean. November 21, 1976.

New York Times. August 20, 1953.

_____. April 7, 1972.

_____. March 31, 1975.

_____. February 24, 1976.

_____. August 25, 1976.

Nuclear News. August 9, 1976.

Roanoke Times. July 5, 1967.

VITA

George Edward Rawson was born in Sonerville, Massachusetts on July 24, 1946. He attended elementary schools in Burlington, Massachusetts and was graduated from Burlington High School in June 1964. He received a Bachelor of Arts degree in Government from the University of Texas in 1972. In the fall of 1972 he accepted a teaching assistantship at Wichita State University in Kansas and began study toward a Master's degree. This degree was awarded in May 1974.

He entered the Graduate School of The University of Tennessee, Knoxville, in September 1973. He is presently on the faculty of Miami University in Oxford, Ohio.

He is married to the former Betsy Coates of Coahoma, Texas and they have one son, Jeffrey, who was born in Austin, Texas in June of 1972.