NUREG/CR-2750

Socioeconomic Impacts of Nuclear Generating Stations

Summary Report on the NRC Post-Licensing Studies

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Mountain West Research, Inc.
with
Social Impact Research, Inc.

Prepared for
U.S. Nuclear Regulatory
Commission

GPO Printed copy price: $7.50

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Manuscript Completed: May 1982
Date Published: July 1982

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NRC FIN B6268

FOREWORD

Under NEPA and the guidelines and regulations established by the Council on Environmental Quality (CEQ), NRC evaluates the full range of anticipated effects -- both radiological and non-radiological -- that may result from each proposal to construct and operate a nuclear power generating facility. These effects must also be compared with the environmental consequences of available alternatives to the proposed action. Each decision to grant a construction permit or a license to operate must be based on a balancing of environmental, economic, and technical benefits and costs.

NRC regulations require three major stages in the NEPA process. First, applicants for a license to operate a nuclear generating station prepare an Environmental Report which evaluates baseline environmental conditions and changes to those conditions which are likely to occur as a result of constructing and operating the facility. The NRC staff subsequently reviews the applicant's data and other sources of information for the purpose of developing an independent assessment of construction and operating effects. The staff's assessment, which includes a balancing of costs and benefits, is summarized in an environmental impact statement which is circulated for widespread public review. At the conclusion of a hearing in which the staff's analysis is subject to examination by intervenors, an initial decision is made by the Atomic Safety and Licensing Board, an independent panel of administrative law judges.

Socioeconomic impact assessment is one component of the comprehensive review of environmental effects of nuclear power stations which is developed by applicants and reviewed by the NRC staff. The staff tries to assure the timely disclosure of information to local officials and the general public through the impact statement mechanism thus permitting the development and implementation of mitigation programs.

As electric utilities responded to forecasts of growing electricity demand by planning substantial increases in nuclear generating capacity, the early and mid-1970's were a period of heightened licensing activity. At the same time public awareness and concern over nuclear energy and the siting of large energy facilities increased. These concerns were expressed by interested parties in the forum provided by the licensing process. Since 1975 the attention given to socioeconomic issues in NRC impact statements has increased; this emphasis has been matched by the increasingly complex analytical tools that have been brought to bear on socioeconomic impact assessment. Socioeconomic issues brought forward include stress on community facilities and services, the cost and availability of housing, fiscal impacts on local government, traffic impacts, and the social cost of visual intrusion.

The increased emphasis on socioeconomic impacts underlined gaps in the staff's information on construction and operating-related effects, which relied primarily on the field experience of the staff and isolated confirmatory research studies. The research reported here grew out of

the NRC staff's belief that only a comprehensive, multi-station socio-economic impact study could meet the following four important needs. First of all, any research effort would have to identify the social and economic impacts of constructing and operating a nuclear power station on individuals, communities, and institutions. To assure some level of comprehensiveness, the cases to be studied would have to represent the contextual diversity of nuclear power plant sites. Second, the research would have to identify those variables which determine, or at least influence, the variations in impacts experienced by communities. Third, the study would have to compare objective measures of impact with subjective evaluations of impact made by social groups that were studied. This would serve two purposes; it would reveal how adequately objective measures of impact delineate the scope of impact assessment, and a cross site comparison of the significance of impacts would help to focus staff evaluations in future licensing activities. The fourth and final research objective involved the development of guidance and recommendations to the NRC for improving its procedures and requirements in the conduct of socioeconomic impact analysis and evaluation.

The objectives cited above necessitated a carefully developed research plan. Indeed, this research effort places strict attention on methodology through the use of a replicable method for analyzing impacts and through the use of analytical techniques for extracting those impacts attributable to the nuclear power station from the matrix of other social and economic changes in the community. We believe that the research described in this document represents a state-of-the-art application of socioeconomic methods in the retrospective assessment of nuclear power station impacts.

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ABSTRACT

The Post-Licensing Studies had four objectives. The first was to identify the socioeconomic effects resulting from the construction and operation of each of twelve nuclear power stations. The socioeconomic variables examined included: economic, demographic, housing, government, public response, and social organization characteristics. The second objective was to determine the way in which the identified effects were evaluated by study area groups. The third objective was to identify the determinants of the project-related effects. This task required knowledge of what combination of site, project, or other determinants was responsible for the project-related effects and for the evaluation of the effects. The fourth objective was to make recommendations with respect to assessment methodologies that could best be used to project the socioeconomic effects of the construction and operation of proposed nuclear generating stations. The objectives of the Post-Licensing Studies are met by the twelve individual case studies and by the Summary Report. The case studies identified the social and economic effects of the construction and operation of the nuclear power stations and describe the evaluation of the effects by area residents. The Summary Report describes the collective findings of the individual case studies, compares the findings across sites to identify possible determinants of the effects, and examines the implication of the findings for future siting decisions and for the methodology most appropriate for projective assessments.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES (Continued)

ACKNOWLEDGEMENTS

The NRC Post-Licensing Studies stretched over a period of nearly four years and benefited from contributions over that period too numerous to identify. Thoughout, however, a core group of five have shared equally in the conceptualization and execution of the case study research: Kristi Branch, David Pijawka, and myself of Mountain West Research, Inc. and Cynthia Flynn and James Flynn of Social Impact Research, Inc. Mike York made significant contributions early in the study before leaving to become Director of Research for the Arizona Office of Economic Planning and Development. Pamela Bergmann joined the study midway and authored two of the case studies. Marsha Weisiger co-authored one of the case studies. Each of the case studies are individually authored. The order of authorship of this volume reflects the contribution of team members to the preparation of this summary report.

The NRC Project Coordinators--Donald Cleary, Michael Kaltman, and Clark Prichard--provided support throughout. This was especially critical early in the study when the accident at Three Mile Island caused significant revision in our study plan and schedule.

Charlene Riedell was responsible for report production and editing and handled what was an immense job with skill and a high degree of professionalism. Shirley Dawson and Patricia G. World did much of the word processing under time pressure and still produced a quality product. I am particularly grateful for their contribution.

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CHAPTER 1: INTRODUCTION

1.1 History and Purpose of the Post-Licensing Studies

In March 1978, the United States Nuclear Regulatory Commission (NRC) issued a request for proposal to conduct post-licensing case studies of the socioeconomic impacts resulting from the construction and operation of twelve nuclear power stations. The motivation for the research was the anticipated increased demand on NRC staff to testify in licensing and permitting actions on the projected impacts of nuclear power plants and the staff's needs for empirically based impact data. In October 1978, a contract was let to Mountain West Research, Incorporated in association with Social Impact Research, Incorporated to complete the proposed research.

The Post-Licensing Studies focused on four specific objectives. The first objective was to identify the socioeconomic effects resulting from the construction and operation of each of the twelve nuclear power stations. This task necessitated a clear identification of the difference in a study area's socioeconomic conditions as they occurred with the nuclear station and those that would have prevailed had the station not been built. The principal socioeconomic variables that were examined included: economic, demographic, housing, government, public response, and social organization characteristics. The second objective was to determine the way in which the identified effects were evaluated by study area groups. The evaluation depended on the attitudes and values of the group in light of the magnitude, duration, and distribution of the objective effects of the nuclear station. The third objective was to identify the determinants of the project-related effects. This task required knowledge of what combination of site, project, or other determinants was responsible for the project-related effects and for the evaluation of the effects. The fourth objective was to determine whether current assessment methodologies could have been used to anticipate the most significant of the project-related effects. On this basis, recommendations were to be generated with respect to assessment methodologies that could best be used to project the socioeconomic effects of the construction and operation of proposed nuclear generating stations.

The four objectives of the Post-Licensing Studies are met by the twelve individual case studies and by this summary report. The case studies identify the social and economic effects of the construction and operation of the nuclear power stations and describe the evaluation of the effects by area residents. This Summary Report describes

the collective findings of the individual case studies, compares the findings across sites to identify possible determinants of the effects, and examines the implication of the findings for future siting decisions and for the methodology most appropriate for projective assessments.

1.2 Three Mile Island Accident

The Three Mile Island (TMI) Nuclear Generating Station was one of the nuclear plants selected for study in the NRC project. The March 1979 accident at the TMI plant had two principal effects on the scope of the post-licensing work. First, the research related directly to the Three Mile Island nuclear station was expanded. This research was analyzed and described in three reports: Three Mile Island Telephone Survey, a summary of a July 1979 telephone survey assessing the socioeconomic effects of the accident on residents in south-central Pennsylvania (Flynn, 1979); The Social and Economic Effects of the Accident at Three Mile Island, a follow-up study describing the accident-related socioeconomic consequences from late March through September 1979 (Flynn and Chalmers, 1980); and the Three Mile Island Case Study Report, the document describing the project-related socioeconomic effects of the pre-accident period, the two-week period following the accident, and the subsequent two years (Flynn, 1981). Second, research on the remaining case studies was expanded to include the socioeconomic consequences resulting from design modifications which came about because of the TMI accident, as well as changes in both public response to, and public evaluation of, the nuclear generating facilities.

1.3 Organization of the Summary Report

The Post-Licensing Studies Summary Report is organized into a total of nine chapters. The following description briefly summarizes each chapter and the way in which it relates to the study objectives.

Chapter 1: Introduction

Chapter 1 introduces the history and objectives of the Post-Licensing Studies and provides an overview of the organization of the Summary Report. In addition, the effect of the accident at Three Mile Island on the study design is discussed.

Chapter 2: Conceptual Framework for the Assessment of Socioeconomic Impacts

The assessment of project-related impacts requires a well defined conceptual model that links the event or project being assessed to the affected variables of

interest. Whether the assessment is post facto or projective, a conceptual framework is essential to the research design, to the selection of data to be collected, and to the inferences which may be drawn. Chapter 2 presents the conceptual framework used in the Post-Licensing Studies and relates it to alternative concepts proposed in the assessment literature.

Chapter 3: Methodology for the Post-Licensing Case Studies

An examination of the impacts of the construction and operation of a nuclear generating station on local social and economic conditions over a ten- to fifteen-year time period presents a potentially unbounded research problem. Chapter 3 describes the methodology that was developed to provide the necessary focus for the case study research and to maintain comparability among the individual case studies.

Chapter 4: Socioeconomic Changes due to the Construction and Operation of Nuclear Generating Stations

Chapter 4 presents the major conclusions of the Post-Licensing Studies regarding the objective, project-related changes in each study area's socioeconomic environment. The chapter provides a basic description of the relevant characteristics for each project and its respective study area. In addition, conclusions are presented on the identifiable project-related changes in each study area's economy, demographic conditions, housing and settlement patterns, public sector activities, and social organization. Data from the case studies are summarized for all five socioeconomic characteristics, and variations in the effects across sites are discussed.

Chapter 5: Public Response to the Construction and Operation of Nuclear Generating Stations

The assessment literature recognizes that public response to the siting, construction, and operation of nuclear power stations is a complicated phenomenon. Because the Post-Licensing Studies focused on a relatively small study area in the vicinity of the plant, the causal factors responsible for the public response were studied (i.e., was the response based on local issues, or did it spring from national or regional concerns?) as was the relationship of the response to study area residents. A chronological examination of the issues that arose at each of the case study sites is presented as well as an analysis of the effects of public response on study area residents (including effects on social organization and decision-making structures--both in terms of leadership and levels of participation).

Chapter 6: Socioeconomic Consequences of the Accident at Three Mile Island

In previous chapters (Chapters 3 and 5), the social and economic consequences of the construction and operation of the nuclear generating station at Three Mile Island prior to the accident were analyzed in conjunction with the other eleven case studies. In Chapter 6, the effects of the accident at Three Mile Island on local residents are examined (during the two weeks following the accident and during the subsequent two-year period). In addition, the effects of the accident on the other case study sites are examined, primarily in terms of public response and the economic effects of TMI-related repairs and modifications.

Chapter 7: The Significance of Socioeconomic Change due to the Construction and Operation of Nuclear Generating Stations

Preceding chapters identified the objective, project-related changes in the study areas' social and economic environment (Chapter 4), and described public response and the effects of the accident at Three Mile Island (Chapters 5 and 6). Given the established information base, Chapter 7 addresses the evaluation of the objective changes by social groups in the study areas. Additionally, the overall significance of the project-related effects is presented. Significancy was ascertained through a comparison of the magnitude and duration of the effects and the way in which the effects were distributed among, and evaluated by study area groups.

Chapter 8: Findings of the Post-Licensing Studies Relative to the Socioeconomic Impact Literature

In Chapter 8, existing literature concerning the social and economic effects of the construction and operation of nuclear generating stations is reviewed and related to previously reported findings (Chapters 4 through 7). Chapter 8 comparisons are organized around evidence of objective changes, the local evaluation of those changes, and the overall judgments of significancy.

Chapter 9: Implications of the Findings for Projective Assessments and Planning Studies

Chapter 9 moves beyond the twelve case studies to the implications of their findings for siting, projective assessments, and planning studies. The analysis examines the extent to which significant problems associated with existing nuclear stations could have been avoided either through better siting or through the improved anticipation of adverse effects concomitant with effective mitigation planning. The chapter addresses the organization and scoping of siting, assessment, and planning studies, as well as the detailed technical issues involved in completing this work.

CHAPTER 2: CONCEPTUAL FRAMEWORK FOR THE ASSESSMENT OF SOCIOECONOMIC IMPACTS

2.1 Introduction

All phases of the Post-Licensing Studies research were completed within a conceptual framework that connected the construction and operation of the nuclear power stations to the socioeconomic characteristics of the study areas. Thus, the conceptual framework provided a series of cause-and-effect relationships that linked the nuclear power stations to changes in the socioeconomic environment. This causal model allowed the consequences of nonproject-related actions affecting the study areas to be separated from the effects of the nuclear station. Moreover, it served to focus the research effort, thereby providing guidance for selecting relevant data and for prioritizing tasks in the study process.

The socioeconomic assessment process has evolved rapidly since the mid-1970s. During that time, two changes in the process have influenced the conceptual framework adopted for the Post-Licensing Studies. First, assessment as an end in itself has been de-emphasized relative to assessment as a means to effective planning. As a result, assessments have begun emphasizing the socioeconomic variables that are important to persons responsible for anticipating and mitigating the consequences of large-scale industrial developments. This change has created an increased concern with the size, composition, and spatial distribution of both demographic and economic effects and their role in determining the demand for housing and for public facilities and services.

Second, socioeconomic assessments have begun to distinguish between objective changes in an area's socioeconomic environment and the subjective evaluation of these project-related changes by persons affected. The evaluation of project impacts by affected groups has begun to play an increasingly important role in the assessment process as decision-makers realize the importance of anticipating public response to programs and projects. Therefore, the conceptual framework of the Post-Licensing Studies utilized an integrated approach that emphasized the socioeconomic characteristics which are important to mitigation planning. In addition, the study was designed to allow for the identification of the objective changes due to the project, the distribution of those effects to functional social groups, the determination of the groups' evaluation of those effects, and an overall evaluation of significance.

The remainder of this chapter outlines the integrated approach taken by the Post-Licensing Studies in the assessment of socioeconomic changes within a specified study area resulting from the construction and operation of a nuclear generating station. It identifies both the project-related driving variables and the variables in the cause-and-effect relationships that determined project-induced changes in the study area's socioeconomic environment. The chapter concludes by relating this conceptual framework to other approaches described in the literature.

2.2 An Approach to the Assessment of Socioeconomic Change due to Construction and Operation of a Nuclear Generating Station

Despite the large number of effects due to the construction and operation of a nuclear generating station, three variables are central to understanding the socioeconomic effects of the plant on the area in which it is located: (1) the size of the work force residing in the local area; (2) the amount of project-related materials, equipment, and services purchased in the local area; and (3) the project-related taxes accruing to local taxing jurisdictions. The project's direct employment and associated wage and salary income provide the local area with an important economic stimulus as local residents and in-migrating workers obtain project-related jobs. Additional project-related income is generated when local purchases of materials, equipment, or supplies are made by the utility or its contractor. Moreover, as project-related income is spent and respent in the local area by workers, additional nonbasic employment and income will be generated. Finally, the project's effects on the local tax base will result in a variety of fiscal effects, including secondary impacts on the provision of public services and facilities.

This conceptual framework represents a relatively simple set of cause-and-effect relationships that link the direct attributes of building and operating a nuclear generating station to an integrated chain of socioeconomic responses that may result. The framework is shown schematically in Figure 2-1. The economic effects directly associated with a project will lead to induced economic effects. These employment and income effects are important in their own right. They are also important because they represent the demand for labor which, in conjunction with the local supply of labor, determines the labor force in-migration necessary to balance local labor market conditions. Net migration due to the project, in the form either of in-migration or reduced out-migration, will be the principal determinant of project-induced population

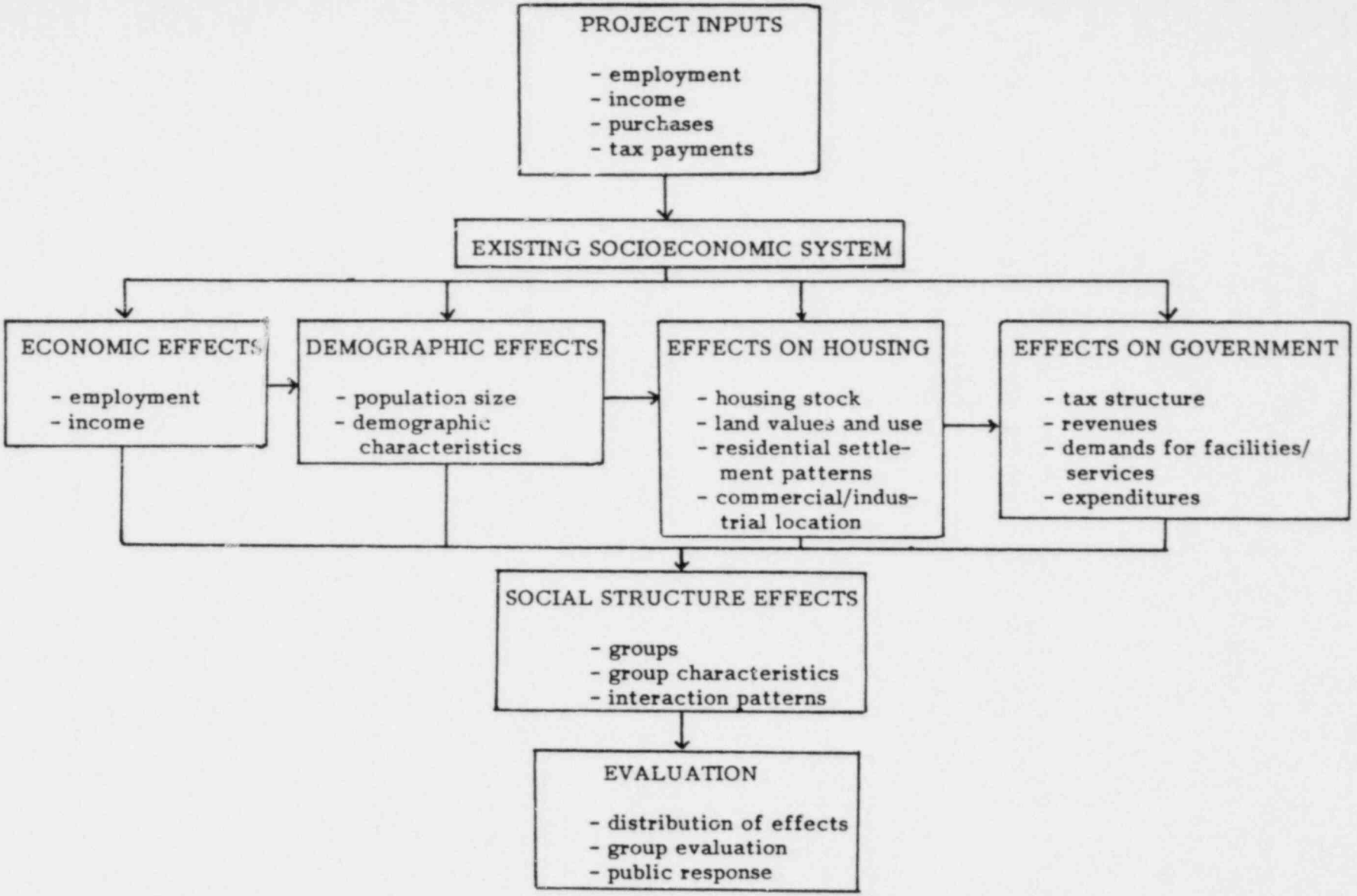

FIGURE 2-1

CONCEPTUAL FRAMEWORK
FOR THE ASSESSMENT OF SOCIOECONOMIC CHANGE
DUE TO CONSTRUCTION AND OPERATION OF A
NUCLEAR POWER STATION

change, which will, in turn, affect housing demand and settlement patterns. The effects on the public sector can then be examined. Changes in both revenues and facilities/services demands may be expected. Finally, some changes in the social structure of an area may stem from the changes outlined above. New groups may appear, the characteristics of existing groups may change, and patterns of interaction among the groups may be affected.

All of the previously summarized effects are observable changes in the socioeconomic environment that can be studied independent of the value system of the observer. For the sake of clarity, we have sometimes referred to these as objective changes. It is well recognized, however, that defining the objective changes associated with a project is only part of what is required. It is equally important that the salience of the changes be described for those persons affected by them. This requires explicit consideration of the values of affected groups in order to understand their evaluation of individual effects and their overall evaluation of the project. This provides an important part of the foundation for understanding locally based public response to a project as well as providing very important input into the researcher's ultimate value judgment with respect to the significance of the project.

2.3 Relationship of the Post-Licensing Studies Conceptual Framework to Socioeconomic Assessment Literature

The theoretical framework utilized in the Post-Licensing Studies represents an integrated approach to socioeconomic assessment that deals systematically with economic and demographic changes; with effects on housing, settlement patterns, and local government; with changes in social structure and public response; and with the evaluation of those changes by functional social groups. By the late 1970s, the flow of causation from economic effects to demographic, housing, public facilities/services, and fiscal effects was well recognized. The federal resource management agencies, state permitting authorities, and private energy and resource developers had all recognized the major causal relationships linking the effects of these socioeconomic componerts. The increased emphasis on project planning and mitigation (particularly in energy development in the West) had focused attention on the need to anticipate project-related effects, not only on housing, but also on public facilities/services demands, and on local government resources available to meet those demands. While the particular methodologies used to project changes in the individual components of a socioeconomic assessment varied significantly, the overall conceptual framework which linked the

components was quite similar. Therefore, the Post-Licensing Studies incorporated what was, and what continues to be, the generally accepted view of the interrelationships among the components of the socioeconomic environment.[1]

In contrast to the previously described economic/demographic and public sector variables, when the NRC Post-Licensing Studies were first conceptualized in 1978, there were no causal models in the social impact assessment literature that described specific relationships between project-related changes and measurable social processes. Furthermore, the models that existed were generally not amenable for use in empirical research. The methodological problems in social impact assessment were the result of three interrelated factors. First, previous studies had failed to focus systematically on changes in social structure and process. The appropriate unit of analysis, the functioning sociological group, had not been identified. Most of the research used either the entire community or the individual resident as the unit of analysis. Second, the analyses mixed economic, demographic, and infrastructure effects with changes in social organization and evaluation without recognition of the causal relationships that link the variables or of the logical relationships that must be maintained among them. The numerous checklist approaches to social impact assessment, such as the Social Assessment Manual (Fitzsimmons, 1975), are symptomatic of this problem. Third, the failure of social impact assessments to fully analyze and define the economic, demographic, facilities/services, and fiscal effects of a proposed action resulted in an inability to subsequently analyze changes in a community's socioeconomic resources and to analyze the distribution of those resources among groups in a community. That is, until objective changes in economic, demographic, and infrastructural conditions are defined and distributed among groups, it is difficult to ascertain how group structure will be affected or how group interaction patterns will be modified.

The Post-Licensing Studies present a social assessment component that is built on a well defined causal chain of economic, demographic, and infrastructure relationships. Given these linkages, it is possible to focus directly on the truly social dimensions of the

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[1]For a survey of the relevant literature and a more detailed discussion of the relationships among these sets of variables, see Chalmers (1977).

socioeconomic environment.[1] Moreover, the necessary building blocks for identifying and analyzing changes in social organization are available as outputs from the previous analyses. Given this foundation, the social analysis defines social structure and social processes so that, within a given study area, social organization can be observed and described and significant social effects resulting from the construction and operation of a nuclear generating station can be discerned.

Additionally, the conceptual framework of the Post-Licensing Studies makes it possible to evaluate project-related effects directly rather than as a subset of the social analysis as had been the case in previous assessment work. The evaluation represents a synthesis of all project-induced changes and their saliency to study area groups. The decision-theory literature, as it is applied to facility siting by Keeney (1977) and to water-resource planning by Keeney (1976) and Anderson (1981), explicitly recognizes that resource and energy developments generate social effects in several dimensions, and that the values of the affected publics are likely to vary with respect to some, or all, of those dimensions. Thus, it is difficult to discuss evaluation unless objective changes in the socioeconomic environment are well defined and unless those changes have been distributed among the study area groups.

In summary, prior to the Post-Licensing Studies, the conceptual approach to socioeconomic assessments exhibited a mixture of economic, demographic, infrastructure, and social effects with no logical sequence in the development of the interrelationships among the components or in the evaluation of the effects. The conceptual framework for the Post-Licensing Studies provides a structured relationship that identifies the linkages between the study components. Out of this structure, a clear picture emerges, both of the objective changes associated with the construction and operation of nuclear power stations and of the importance of those changes to residents of the local areas.

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[1] William Freudenberg calls these "social-social" dimensions.

CHAPTER 3: METHODOLOGY FOR THE POST-LICENSING CASE STUDIES

3.1 Introduction

The purpose of this chapter is to outline and describe the methodology utilized in the NRC Post-Licensing Studies. Following a discussion of the general methodological issues raised by the studies and an overview of the structure of the individual case study reports, a more detailed discussion of the way in which the study area was defined and of the methods used to estimate major project effects is presented.

3.2 General Methodological Concerns

3.2.1 Post Facto Research

Retrospective versus projective focus

The intuitive appeal of post facto research is unquestionably great and much has been, and will continue to be, learned from case studies. It is not commonly recognized, however, that most of the analytic issues remain the same whether one is doing retrospective or projective studies. For example, it is necessary to develop a model in post facto research to hypothesize what conditions would have been in the absence of an existing project so that the "with" and "without" scenarios can be compared to determine impacts. While both the "with" and "without" conditions must be developed in a projective assessment, the same model is used to develop both scenarios and the problem is conceptually the same as in a retrospective study.

In spite of this fundamental similarity, post facto research and projective studies exhibit very important differences in emphases; namely, projective assessments are more oriented to planning, while retrospective studies are more oriented to research. In projective assessment, the object is not prediction for its own sake, but rather to anticipate project-related changes so that the changes can be accommodated or modified. In addition, because of the dynamic nature of the planning process, the need in projective assessments is not so much to produce a single picture of the future, but rather to develop a projection and analysis process that can be used again and again as new information becomes available. Project monitoring, for example, has become an essential component of the assessment and planning process.

In retrospective assessments, the emphasis is different. Focus is on research rather than planning—what can be learned about the nature and distribution of the socioeconomic consequences resulting from the construction and operation of nuclear

generating stations by studying places where nuclear stations have been constructed. To the extent that these consequences can be isolated and their significance to local populations evaluated, the research objective, which is of intrinsic interest to social scientists, has been accomplished. An additional question is raised, however—what are the implications of the post facto findings for the way in which projective assessments are designed and implemented. Thus, although the methodology for the Post-Licensing Studies is oriented toward the research objective of retrospective studies, it has also been designed with the expectation that the findings will be relevant to the analysis and planning requirements of projective studies.

Attribution of project effects

Since the Post-Licensing Studies are post facto studies, an appropriate methodology had to be identified for attributing changes in each study area's socioeconomic environment to the construction and operation of the nuclear generating station under consideration. The methodological issues associated with determining what would have happened in the absence of a given action require causal models with predictive content. However, systematically tested causal models are not available for all parts of the assessment process. Additionally, even in those parts of the analysis where validated procedures exist, it is not always possible to re-create the historical data necessary for their use.

To date, there has been no systematic attempt in the case study literature to base an assessment of a nuclear station's impacts on an area's socioeconomic characteristics as they existed with the plant compared to an hypothesized set of conditions without the plant. Typically, studies, such as those by the National Association of Counties (1976), describe the historical record in affected communities but make no attempt to attribute causation to the nuclear station. The seriousness of the attribution problem varies depending on the phenomena being studied. For example, in the case of traffic congestion on a site-access road, the causal link to the nuclear station is relatively easy to establish. However, when analyzing changes in an area's economic, demographic, facilities/services, or social characteristics, establishing causation is much more complex. Even in the case of community conflict over nuclear safety, the causal link to the nuclear station may be complicated because of other issues of concern in the community or the region.

Two basic approaches may be taken in addressing the attribution problem. The first is to identify and isolate the effects of all other exogenous forces acting on the study area and to subsequently attribute the residual effects to the nuclear station. The second approach involves making explicit causal arguments that directly tie postulated effects back to some known aspect of the construction or operation of the station. Nevertheless, both approaches require the use and acceptance of the same kinds of behavioral hypotheses. In other words, when using the first approach, it is necessary to define the direct and indirect effects of other exogenous forces acting on the study area so that the effects due to the station can be determined as residuals. When using the second approach, the same kinds of hypotheses and behavioral relationships are used to directly argue the nature and extent of socioeconomic effects stemming from the construction and operation of the station. Thus, the most convincing case for attributing effects to the nuclear station results from using both approaches--control of other exogenous influences and the identification of direct causal linkages to the plant. Where possible, both approaches were pursued in the case studies. In general, however, the social and economic changes that occurred in the study areas over the ten- to fifteen-year period of investigation were so complex that the second approach was relied upon more heavily than the first.

Data availability and verification

Research for the Post-Licensing Studies posed significant data-collection and verification problems. The study period for each site spanned ten to fifteen years, and the project effects were distributed over large geographic areas containing numerous governmental jurisdictions. Comparable time-series data were unavailable for many of the key variables and could be reconstructed only through a combination of inductive and deductive strategies. In general, reliance was placed on utility records, state and local government data sources, newspaper accounts, and the recollection of key informants. Each case study manager spent a total of four to six person-weeks in the project study area. During this field work, approximately 100 interviews were conducted, most of which were with study area residents. Since direct verification of project-related information was difficult and often impossible, reliance was placed on the internal consistency of information provided by a variety of sources. In cases where internal consistency was maintained, the data were used with confidence; however, in cases where information was inconsistent, caveats were offered or it was simply acknowledged that it was not possible to determine what had transpired.

With the exception of the 1979 telephone survey at the Three Mile Island nuclear plant and a telephone survey at the Peach Bottom nuclear station (30 miles south of the Three Mile Island facility), no surveys were conducted at the case study sites. Therefore, information on group values and attitudes and on the evaluation of the project's effects by group members was based on interviews with key informants.

3.2.2 Conceptual Perspective on Cross-Site Versus Case Study Analyses

During the conceptualization phase of the Post-Licensing Studies, it was recognized that two distinct models existed for designing the case study methodology. Under one model, the research would focus on the ultimate comparison of the results as they occurred across the twelve case study sites (i.e., the cross-site analysis). The other model would begin by focusing on the individual case studies. In either case, there had to be a well defined methodology that would be pursued in a parallel fashion at each of the study sites.

In the model that emphasized the cross-site analysis, it would be necessary to decide at the beginning of the study what questions the analysis was designed to answer. Following the identification of hypotheses to be investigated, both the dependent and independent variables for which data would be required could be specified. The presumption underlying this approach is that the prior knowledge regarding the socioeconomic effects of nuclear generating stations would be sufficient to identify the relevant hypotheses to be pursued at each case study site.

The second model represents a more inductive approach since it views the individual case studies as hypothesis generating rather than hypothesis testing. The emphasis of this approach is on designing a methodology that would be utilized in each case study and that would reveal the significant changes in an area's socioeconomic environment due to the construction and operation of a nuclear generating station. The primary argument in support of this approach is that only after the case study analysis has been completed would it be possible to identify the interesting and relevant hypotheses that need to be evaluated in the cross-site analysis. The problem associated with this approach is that by not identifying the hypotheses at the beginning of the study, there may be insufficient data to allow the subsequently generated hypotheses to be tested rigorously.

Because of the small sample size (twelve nuclear generating stations) and because of the uncertainty surrounding the identification of key causal relationships, the Post-Licensing Studies proceeded according to the second approach.

3.3 Site Selection and Preliminary Site Visit Report

The selection of the twelve nuclear generating stations to be examined in the Post-Licensing Studies was completed by Nuclear Regulatory Commission staff in October and November 1977. The site selection process was guided by the following six considerations:

1. All nuclear units at the sites must have been operating for at least six months by the time a contractor was selected for the Post-Licensing Studies.

2. The units should not have been constructed so long ago that relevant socioeconomic data would prove difficult to acquire.

3. The stations should not have been the object of other post-licensing examinations.

4. Individual units should be at least 800 MWe. (Net electrical ratings of this magnitude appeared to be within the range of the units proposed for future construction.)

5. If possible, the final selections should exhibit a wide variation with respect to the site's distance to a major city (which influences commuting and in-migration patterns) and the rate of population growth in the plant's host county (which may reflect socioeconomic changes associated with the plant's construction).

6. The selections should be balanced geographically.

Eighteen nuclear power generating stations that met the first four criteria were identified. Those sites and associated data are illustrated in Table 3-1. As shown, this set of stations furnished a broad range of settings for the Post-Licensing Studies. The twelve stations finally selected for examination by the NRC are listed in Table 3-2 and are shown in Figure 3-1.

Prior to the finalization of the case study methodology, a reconnaissance trip was taken to each of the twelve stations identified for study. The purpose of the trips was to increase the study team's understanding of the range of conditions at each site. Twelve Preliminary Site Visit Reports were subsequently prepared; these described the chronology of the project, summarized the construction (cost, work force, major incidents) and operation (cost, work force, taxes, major incidents), provided an overview of the local area, and summarized apparent socioeconomic impacts and issues.

TABLE 3-1

CANDIDATE SITES FOR POST-LICENSING STUDIES OF SOCIOECONOMIC IMPACTS

Plant Name	County/State	Region	Year(s) of Commercial Operation (if applicable)	% of Total Construction Completed (if applicable)	Design MWe	Population within 5 Miles	Distance to Nearest City of 50,000 (Miles)	Host County Per Capita Income 1965	Host County Per Capita Income 1975	Host County Per Capita Income % Change	Host County Population (Thousands) 1965	Host County Population (Thousands) 1975	Host County Population (Thousands) % Change
Fitzpatrick	Oswego, N.Y.	NE	1975		821	3,000	36	2,452	4,565	86.2	93.7	109.8	17.2
Oconee 1-3	Oconee, S.C.	South	1973, 1974, 1974		887, 887, 887	2,274	26	1,794	4,181	133.0	39.1	43.7	11.8
Peach Bottom 2&3	York, Penn.	NE	1974, 1974		1065, 1065	6,145	35	2,698	5,766	113.7	257.0	285.6	11.1
Rancho Seco	Sacramento, Calif.	West	1975		913	352	25	2,991	5,903	97.2	601.4	688.0	14.4
Surry 1&2	Surry, Va.	South	1973, 1973		822, 822	769	17	1,532	4,430	189.1	6.3	5.6	-11.1
Zion 1&2	Luke, Ill.	Mid W	1973, 1974		1040, 1040	40,196	6	3,977	7,767	95.2	340.1	396.8	16.7
Browns Ferry 1-3	Limestone, Ala.	South	1974, 1975, 1977		1065, 1065, 1065	2,618	30	1,682	3,977	136.4	41.1	43.5	5.8
Brunswick 1&2	Brunswick, N.C.	South	1977, 1975		821, 821	3,550	16	1,208	3,763	211.5	21.6	32.6	50.9
Calvert Cliffs 1&2	Calvert, Md.	NE	1975, 1977		845, 845	3,425	38	2,007	954	146.8	18.7	26.2	40.1
Crystal River 3	Citrus, Fla.	South	1977		825	324	55	1,758	4,350	147.4	14.1	37.9	168.7
St. Lucie 1	St. Lucie, Fla.	South	1976		802	1,165	40	2,006	4,814	139.9	46.5	66.3	42.5
St. Lucie 2	St. Lucie, Fla.	South		0	842	1,165	40	7,006	4,814	139.9	46.5	66.3	42.5
Diablo Canyon 1&2	San Luis Obispo, Calif.	West		99, 92	1106, 1106	10	45						
McQuire 1&2	Mecklenberg, N.C.	South		86, 54	1180, 1180	3,066	17	3,092	6,421	107.8	307.9	375.0	21.8
Sequoyah 1&2	Daisy, Tenn.	South		81, 74	1148, 1148	7,455	16						
Arkansas 1	Pope, Ark.	South	1974		850	7,149	65	1,536	4,175	171.8	26.7	34.1	27.7
Arkansas 2	Pope, Ark.	South		96	912	7,149	65	1,536	4,175	171.8	26.7	34.1	27.7
D. C. Cook 1	Berrien, Mich.	Mid W	1975		1054	10,599	28	2,861	5,789	107.3	159.8	170.8	6.8
D. C. Cook 2	Berrien, Mich.	Mid W		98	1060	10,599	28	2,861	5,789	102.3	159.8	170.8	6.8
Salem 1	Salem, N.J.	NE	1977		1090	1,507	27	2,838	5,878	107.1	59.9	62.6	4.5
Salem 2	Salem, N.J.	NE		77	1090	1,507	27	2,838	5,878	107.1	59.9	62.6	4.5
Three Mile Island 1	Dauphin, Penn.	NE	1974		819	36,372	9	2,736	6,176	125.7	224.4	224.2	0
Three Mile Island 2	Dauphin, Penn.	NE		97	906	36,372	9	2,736	6,176	125.7	224.4	224.2	0

Source: U.S. Nuclear Regulatory Commission, 1977.

TABLE 3-2

NUCLEAR GENERATING STATIONS SELECTED
FOR POST-LICENSING STUDIES

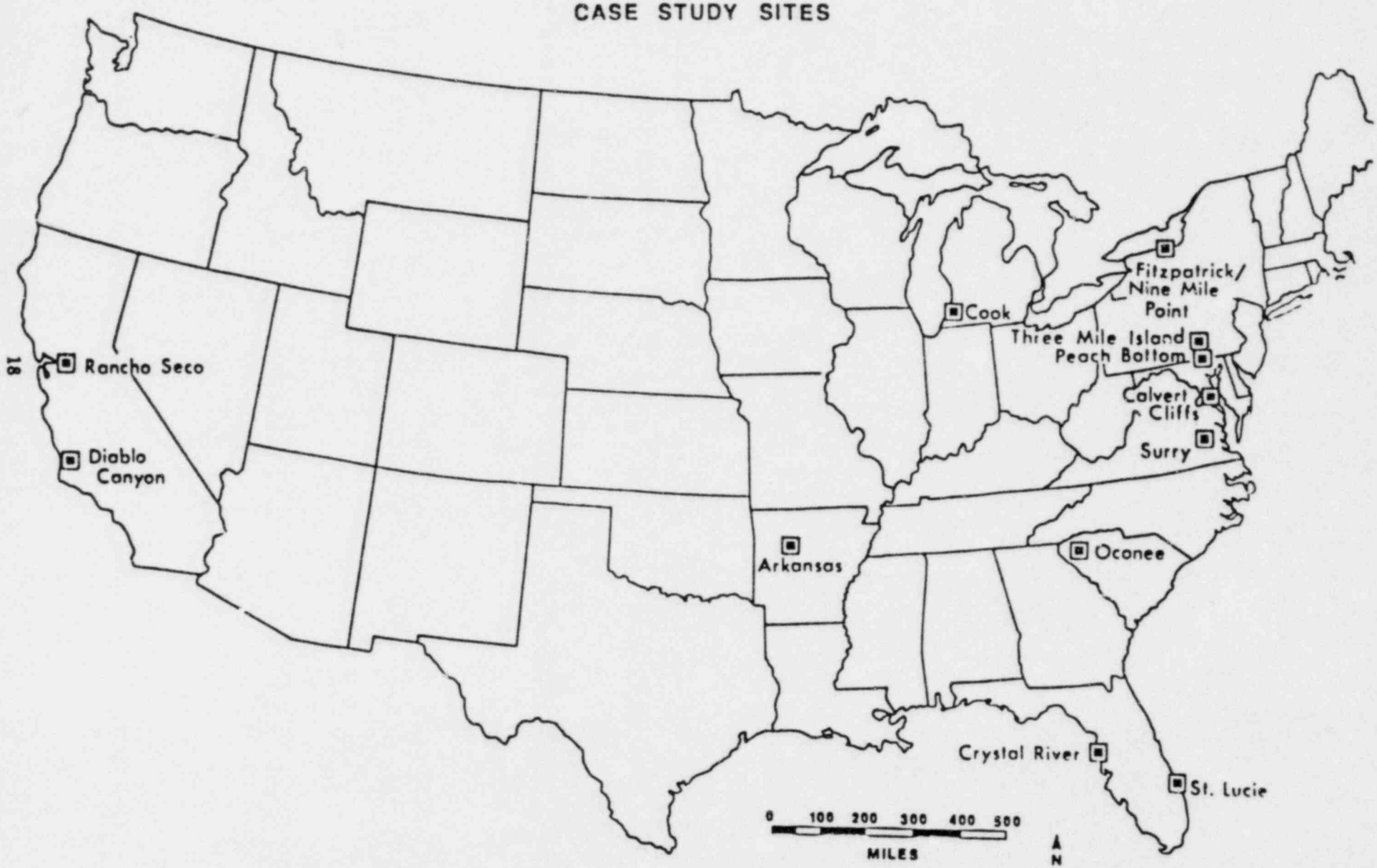
Nuclear Plant	Location
Arkansas 1 and 2	Pope County, Arkansas
Calvert Cliffs 1 and 2	Calvert County, Maryland
Cook 1 and 2	Berrien County, Michigan
Crystal River 3	Citrus County, Florida
Diablo Canyon 1 and 2	San Luis Obispo County, California
Fitzpatrick/Nine Mile Point	Oswego County, New York
Oconee 1, 2, and 3	Oconee County, South Carolina
Peach Bottom 2 and 3	York County, Pennsylvania
Rancho Seco 1	Sacramento County, California
St. Lucie 1 and 2	St. Lucie County, Florida
Surry 1 and 2	Surry County, Virginia
Three Mile Island 1 and 2	Dauphin County, Pennsylvania

Source: Mountain West Research, Inc., 1981.

FIGURE 3-1. UNITED STATES NUCLEAR REGULATORY COMMISSION

POST-LICENSING STUDY

CASE STUDY SITES



3.4 Overview of the Case Study Organization

The individual case study reports were organized to reflect the conceptual framework outlined in Chapter 2. This can be seen clearly in Figure 3-2, which identifies the ten chapters of each case study report and indicates the logical relationships among the chapters.

3.5 Study Area Definition

Before describing the methods used to estimate major socioeconomic effects of nuclear stations, it is necessary to describe the procedure followed to define the "study area" for each site.

A description of the region in which a nuclear power plant is located and the identification and selection of the study area are important elements in the overall case study methodology. To determine the appropriate units of analysis for this process, the counties which were contiguous to the project site and which were recipients of appreciable direct project effects were identified and a "study region" subsequently defined. Within this "study region," exhaustive allocation areas were established including the minor civil divisions (or municipal units) receiving appreciable direct project effects. For each of the allocation areas, the distribution of jobs, workers, purchases, and tax payments was determined for both the peak construction year and for 1978, the benchmark operations year. The distribution of direct project effects and the population size of each of the allocation areas were then examined to identify those in which the greatest intensity of direct project effects had occurred. Based on the intensity of direct project effects and the relationships in the area, a study area was then chosen.

3.5.1 Definition of the "Study Region"

Preliminary Site Visit Reports were prepared for each of the twelve nuclear stations during the first five months of this study. These reports gave useful information on the direct consequences of the project as well as on the characteristics of the area in which the project was located. This provided the information to determine the set of contiguous counties in which discernible effects of the project may have been felt. Whether or not effects were discernible depended on interaction between the absolute size of the effects and the size and complexity of the area in which the effects occurred. For many sites, the "study region" was defined as a single county. At other sites, the "study region" included four or five counties.

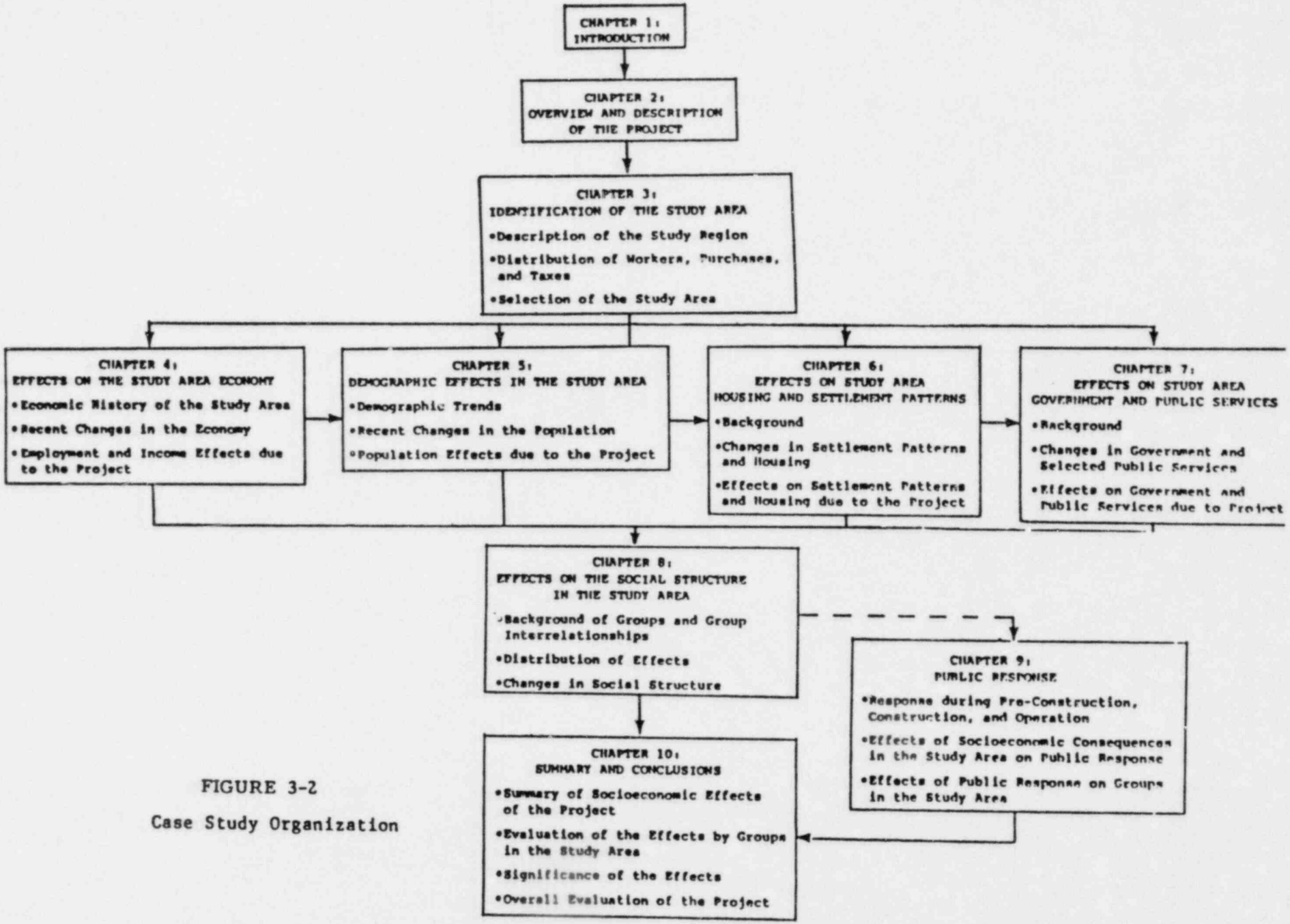


FIGURE 3-2

Case Study Organization

Once the "study region" was established, it was further subdivided into an exhaustive set of places or allocation areas. Frequently, the county in which the plant was located was disaggregated into several allocation areas, while the other counties in the "study region" were not disaggregated below the county level. The disaggregation was based partly on conditions pertaining to data availability, partly on conditions pertaining to the actual distribution of project effects, and partly on the desire to maintain subcounty areas that made sense as functional economic or social units.

3.5.2 Distribution of Project Effects within the "Study Region"

Once the study region had been defined and allocation areas determined within it, the incidence of direct project effects of four types was estimated for each of the allocation areas. The direct project effects that were studied included: direct basic employment (i.e., employment by place of work); residential location of direct basic workers (i.e., employment by place of residence); purchases of services, materials and equipment by the utility; and tax payments. Each of these was distributed to the allocation areas for both the year of peak construction and the benchmark operations year (1978). The aggregate incidence of direct project effects and indications of the pattern of their distribution over time were principal components in the determination of the intensity of direct project effects and the identification of the "study area."

Distribution of direct basic employment by place of work simply required assignment of the project work force to allocation areas in which the nuclear station was actually located. Conceptually, this distribution dealt with economic activity in terms of a given number of jobs allocated to place of work. More important was the distribution of direct basic workers by place of residence. This refers to persons, not jobs, and allocates them by their place of residence rather than by their place of work.

The third criterion for selection of the study area required that the utility's purchases of materials, equipment, and services be distributed among the allocation areas. These data were developed from purchasing records of the utility and gave a reasonable sense of the volume of local purchases and of their distribution among the allocation areas. Finally, tax payments were distributed among the allocation areas. It was often the case that the allocation of taxes was quite uneven among jurisdictions within the host county. Local governments outside the host county rarely received revenue from the plant.

3.5.3 Selection of the "Study Area"

Once the direct project effects had been distributed to the allocation areas, the concentration or intensity of the effects was measured for each of the allocation areas. Areas in which the direct effects were absolutely small, or were small relative to the level of other activity occurring in the area, were eliminated from inclusion in the study area. The background considerations in this decision process were of two general types. First, there were the pragmatic considerations associated with defining the "study area." The larger and more complex the area, the more difficult the data collection and analysis requirements to complete the case study. Thus, considerable emphasis was placed on defining the study area in such a way that the research task was manageable, given the level of effort allocated to each site. The second consideration had to do with the fact that functional social and economic relationships exist in a region and, if they are to be understood and play an appropriate role in the analysis, the study area must be defined in a way that respects their geographic boundaries.

These considerations provided the context in which the final decisions were made with respect to the areas to be studied. It is important to note that there was no a priori claim, nor could there be, that these were impact areas. That judgment could only be made at the end of the study after the full range of project impacts was determined. The methodology followed for selection of study areas was such that portions of a county were frequently chosen as study areas. Clearly, therefore, the question being addressed in the Post-Licensing Studies was not an assessment of the total impacts of the nuclear station, but rather an assessment of the effects within a "study area" in which the effects were generally discernible. Other effects certainly occurred in areas outside the study area, but the effort required to identify them would have far exceeded the resources of this study. In fact, it is not obvious that it would even be possible to identify many of these effects because they occurred in sufficiently large places that they were neither noticed nor attributed to the nuclear facility.

3.6 Methods Used to Estimate Major Effects

3.6.1 Work Force Characteristics

An analysis of socioeconomic effects resulting from the construction and operation of a nuclear generating station required specific information about the project-related work force. First, the workers were divided into four groups:

1. Nonmovers--employees who were residents in the study area prior to employment on the project and who did not move because of this employment;

2. Movers accompanied by families--employees who moved into the study area because of employment on the project and who were accompanied by families;

3. Movers unaccompanied by families (or single)--employees who moved into the study area because of employment on the project and who were not accompanied by families; and,

4. Daily long-distance commuters--employees living outside the study area who commuted daily into the study area to work at the project.

During the construction period, information on worker characteristics was based on interviews with union business agents; utility and contractor personnel; construction workers who were presently employed by the utility; realtors; and apartment, mobile home, and motel managers. In a few cases, worker surveys which had been conducted during the construction period were available. For the 1978 operations year, employee rosters were used to determine residency and family characteristics. Additional worker information was estimated based on interviews with utility supervisory personnel and with the workers themselves.

It is important to note here that the classification of the work force into nonmovers, movers, and commuters depends directly on the definition of the study area. For example, a worker may well relocate in order to work on a project but may settle outside the area designated as the study area. In this case, the worker would be identified as a commuter, not a mover. On the other hand, had the study area been defined to be larger, the same worker would have been classified as a mover. Thus, the number of both movers and nonmovers will be lower relative to the number of commuters in the case of a small study area.

This point has serious methodological implications. If, for example, a principal objective of the research were to forecast the supply of nonmovers that could be expected from a given area, some effort would have to be made to normalize with respect to the size of the population living within a certain distance of the project. That is, the question could be meaningfully posed as to what are the determinants of the number of nonmovers per thousand residents living within 5 miles of a project. Within this framework, the effects of demographic characteristics, occupation, distance, and

competing jobs could all be studied as they related to the supply of project workers. This approach would require, therefore, that areas of uniform size be studied at each of the sites.

As has already been explained, the study areas chosen in the Post-Licensing Studies are of different sizes. Some are small parts of an urban area, others are small parts of a rural county, and others are comprised of entire counties. The rationale for the study area selection was carefully constructed to best meet the overall objectives of the study. Emphasis was placed, therefore, on areas within which socioeconomic effects could be expected to be discernible and which made sense as functional social and economic units. This resulted in a great deal of heterogeneity in study area size from site to site and complicates the interpretation of the data on work force characteristics. This cost in terms of being able to carry out analysis of work force characteristics was recognized at the outset. It was decided that this objective should be de-emphasized in this work because the absence of survey data on the construction work force at most of the sites makes this analysis speculative in any event. The more effective way to approach these questions is based on the use of survey data and homogeneous study areas as in the work of Malhotra and Manninen (1980).

3.6.2 Economic Effects

3.6.2.1 Introduction

The purpose of this subsection is to describe the methodology used to estimate the economic consequences of the construction and operation of the nuclear generating stations. It is necessary to address the effects of the project on economic activity in the area studied (i.e., jobs and income on a place-of-work basis) and the effects of the project on the labor force status of study area residents (i.e., total labor force, employment, and income characteristics on a place-of-residence basis).

To accomplish these objectives, an economic base analysis (supplemented with an input-output analysis) is utilized. The premise of the analysis is that the economic activities of the project—the direct employment at the project, the purchases of goods and services for the project, and other market effects of the project (for example, the consequences of the massive taxes paid by many of the utilities)—caused additional economic activity in the study area. The determination of the total project effects on

employment and income in the study area requires the quantification of both the direct project activity and the additional induced nonproject activity.

3.6.2.2 Basic Income and Employment

Direct Basic

The first of the three components of total project-related basic income and employment is designated as "direct" basic income and employment. Workers employed in the actual construction or operation of the plant are referred to as "direct" basic employees; the income they earn is "direct" basic income. The income and employment of these workers are discussed in two ways: (1) on a place-of-work basis, to show the number of jobs and amount of income generated by the project and the effect of these jobs and income on the study area economy; and (2) on a place-of-residence basis, to show the number of area residents employed at the project, their income, and the effect on the study area labor force. The determination of direct basic income and direct basic employment by place of work is derived from project employment and wage data. Because of differences in residential and wage characteristics, the direct basic work force is considered to be a composite of three types of workers: (1) construction workers; (2) regular operations workers; and (3) repair, maintenance, and refueling workers. The determination of direct basic income and employment by place of residence in the study area requires information about the wage rates and residential locations of each of the three types of direct basic employees.

Indirect Basic

The second component of total project-related basic income and employment is referred to as "indirect" basic, the earnings and employment resulting from the purchase of goods and services in the study area for plant construction and operation. The amount of indirect basic income produced by a given value of purchases is determined by the ratio of indirect basic income to product value, which varies according to the type of goods or services involved in the transactions. The indirect basic income and employment in the study area resulting from the project are calculated by applying an income-and-employment-to-value-of-purchases ratio derived from the Regional Industrial Multiplier System (RIMS) to the total value of materials purchased by the

utility in the study area. The RIMS approach is well documented elsewhere and is not described in detail here. (U.S. Water Resources Council, 1973.)[1]

"Other" Basic

The third component of total project-related basic income and employment is referred to as "other" basic. This category of basic income and employment accounts for changes in basic employment or income beyond those described above. In particular, the project may result in wage-induced effects and fiscally induced effects. In the case of wages, it is often suggested that the higher wages paid at the nuclear station may attract workers from lower paying jobs. If those workers could not be replaced, or if the resulting higher wages rendered the activities unprofitable and they subsequently ceased to exist, the resulting reduction in income and employment would be considered a reduction in "other" basic.

The second possibility is that the large amounts of plant-related tax revenues associated with some nuclear stations may generate public sector employment. However, it is important to distinguish this "other" basic employment in the government sector from nonbasic government employment that results from the multiplier effect of basic income. Most public sector employment (such as school, sanitation. and police) is a direct function of economic and demographic growth; thus, only if there has been an increase in government employment beyond that expected to accompany associated population, employment, and income growth would part of the government employment growth be classified as "other" basic.

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[1]In general, the RIMS technique develops industry-specific input-output multipliers based on national interindustry relationships at the 496-sector level of disaggregation, adjusted to reflect the availability of required inputs from suppliers in the county. In the simplest case, if an industry does not exist in the county economy, any requirements from that industry are assumed to be supplied by imports from outside the county economy. If an industry does exist in the county at the same, or greater, proportion to the county economy as the industry is to the national economy, the county demands from that industry are assumed to be met within the county economy. If an industry represents a smaller proportion of the county economy than it does of the national economy, some of the county demand is assumed to be supplied from within the county and some is assumed to be imported. (Drake, personal communication, 1980.)

Total Basic Income and Employment

Total basic employment and income are the sum of the three basic components—direct basic, indirect basic, and "other" basic. It is useful to note the combination of empirically based and deductively derived conclusions on which this methodology depends. For example, primary data concerning direct basic employment and income were obtained from the utility although some of the necessary data categorizations required assumptions based on key informant interviews. Observations regarding indirect basic employment could not be made directly, since few workers (or their employers) would recognize that those jobs were the result of purchases made by a utility company in the course of the construction or operation of a nuclear generating station. Consequently, primary data obtained on local purchases were converted to local employment and income figures based on deductive reasoning and secondary data sources. The resulting estimates were scrutinized to determine whether any primary data existed that contradicted or refuted the derived results. This mixture of empirically based and deduced results is characteristic of the methodology pursued throughout the study.

3.6.2.3 Nonbasic Income and Employment

Nonbasic employment and income, the final component of project-related employment and income effects, result from the expenditure (and re-expenditure) of basic income in the local economy. The amount of project-related nonbasic employment and income in the study area economy is determined by the interaction of two factors: (1) the amount of "effective" basic income created by the project, and (2) the size of the nonbasic-to-basic employment and income multipliers in the local economy. Both of these factors are influenced by the study area's economic characteristics.

Effective Basic Income

A proportion of the project-related income is earned by workers who maintain residences outside the study area. These workers generally spend a smaller proportion of their income in the local area than do resident workers earning the same income who live "full-time" in the study area. To account for this, the project-related basic income must be adjusted so that each dollar is equivalent in its effect on the study area economy. Once the income has been adjusted so that it is equivalent to income earned by local workers, it is referred to as "effective" basic income.

Two principal factors affect the amount of effective basic income that results from a project: (1) the residential location of the workers earning the basic income, and (2) the magnitude of outside financial commitments (i.e., the maintenance of a household outside the study area) among workers residing in the study area. The effects of these factors are analyzed by dividing the project-related basic workers into four groups: nonmovers, movers accompanied by families, movers unaccompanied by families (or single), and daily, long-distance commuters.

Based on information concerning residential location, commuting patterns, and outside financial commitments, as well as on an examination of the availability of goods and services in the local economy, the basic income of each of the four groups is weighted so that its effect, in terms of generating induced economic activity within the study area, will be commensurate across groups. The resulting weighted income estimate is referred to as "effective" basic income. Because the county-specific multipliers are based on the consumption patterns of county residents (nonmovers), nonmovers serve as the standard for defining effective basic income; all of their income is treated as effective (i.e., their income is weighted by a factor of 1.0). For each of the remaining categories of workers, data outlined by the Consumer Expenditure Survey (U.S. Bureau of Labor Statistics, 1973) were utilized to determine the proportion of income spent in the local area by those workers compared to the amount spent by nonmovers. Examination of the study area economy and discussions with workers, local planners, and area residents were used to estimate the percentage of local expenditures for each of the major consumer items made by each category of workers.

Based on these estimates, the relative effect on the study area economy of income paid to each of the four groups was calculated by dividing the percentage of local total expenditures for each group by the percentage of total expenditures made in the study area by nonmovers. Based on these calculations, the income of nonmovers and movers accompanied by families was weighted by a factor of 1.0, while the income of unaccompanied movers and daily long-distance commuters was weighted by a factor of less than one.

Nonbasic-to-Basic Multipliers

The second set of factors used to determine the nonbasic employment and income effects of the project in the study area are nonbasic-to-basic employment and income multipliers. The size and characteristics of the economy being analyzed determine the

size of the multipliers—the larger and more diversified the economy, the larger the multiplier. The nonbasic income and employment to effective basic income multipliers employed in the analysis were derived from a county specific input-output analysis by the Regional Interindustry Multiplier System (RIMS).[1]

When the study area represented a subcounty area, additional adjustments were necessary to reduce the size of the multipliers so they would be appropriate to the size of the study area economy. This adjustment was made by applying the results of research on the size and distribution of nonbasic response to increased basic activity in size-ordered economic systems (Anderson et al., 1981). Data from this research were used to calculate the ratio of nonbasic response to an increase in basic income among economies in a system based on the position of the economy in a six-order size hierarchy. The placement of an economy in the size hierarchy is based on the total personal income of the area's residents.

For small study areas, it is possible to check the estimates of nonbasic employment against employment records in the study area and come to conclusions based on both the derived and empirically based estimates. For large study areas, however, the nonbasic response is a sufficiently small part of total employment change that it is impossible to directly observe the consequences of the nuclear station. While all exogenous forces acting on the economy could be quantified, it would still be necessary to use a multiplier analysis to attribute nonbasic response to the exogenous changes so that the effect of the nuclear station would remain as a residual. The alternative is to estimate the effect of the station directly, as has been suggested here.

3.6.2.4 Summary

The sum of the four components of project-related employment and income—direct basic, indirect basic, "other" basic, and nonbasic—is the total employment and income created in the study area by the construction and operation of the nuclear station. These data are presented on both a place-of-work and place-of-residence basis, given assumptions based on labor force availability and commuting patterns. In general, if the demand for labor in the study area has been growing faster than the local supply, it

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[1]Individual analyses were conducted by Ronald Drake of Regional Analytics for each of the twelve counties.

is assumed that the indirect basic, "other" basic, and nonbasic workers are movers. On the other hand, if the demand for labor has been sluggish relative to local supply (perhaps, the area has been experiencing out-migration), the indirect basic, "other" basic, and nonbasic workers are assumed to be nonmovers. In intermediate cases, a mix of movers and nonmovers is assumed.

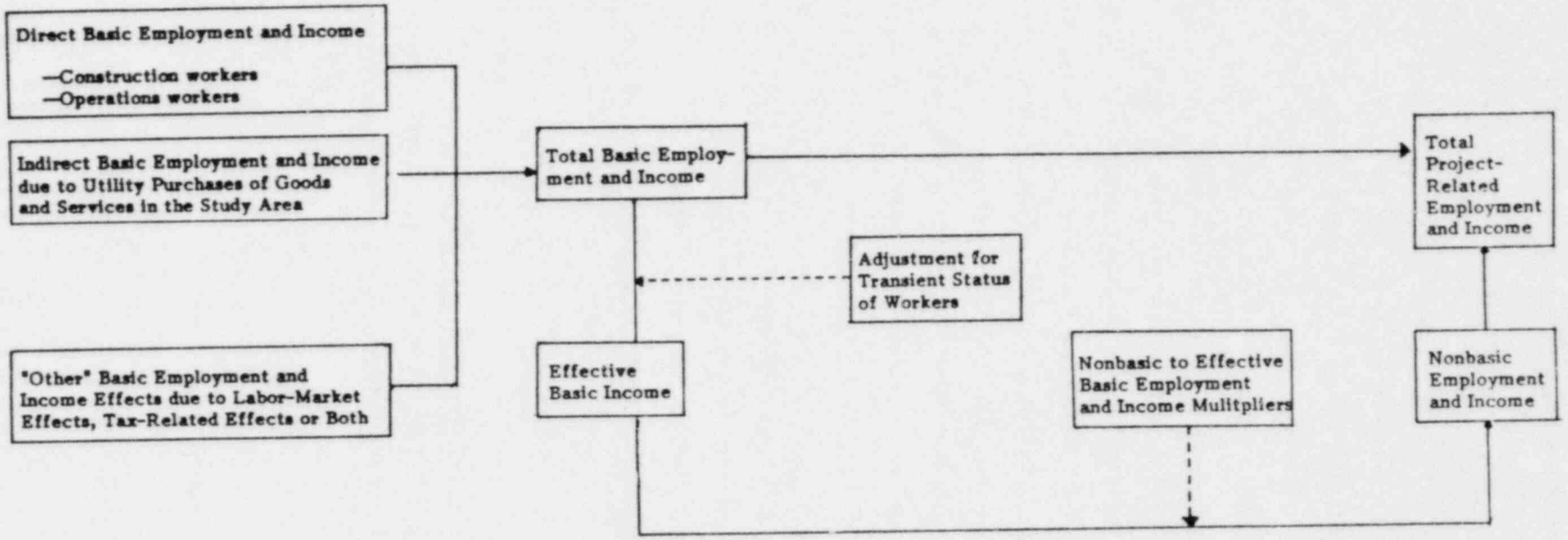
The above analysis was completed in detail for each case study for the peak construction year and the benchmark operations year. The final step in the estimation of project-related economic effects was to take those estimates and calculate the ratios of total project-induced employment and income to direct basic employment and income for these two years. Ratios were then interpolated for all intervening years. This provided the basis for estimating project-induced effects over the entire study period based on the annual series of direct basic employment. Figure 3-3 provides a summary of the steps used to estimate the total project-related employment and income effects.

It should be noted that at the outset of this study, serious consideration was given to the feasibility of modeling all economic change occuring in the study area over the study period. This would have enabled an analysis of economic conditions "with" and "without" the nuclear station with the difference between the two being the measure of impact of the station. The procedure would have required that an exhaustive set of effective basic income estimates be prepared for the entire study period. A simulation model would then have been calibrated so that the actual course of employment and income change over the study period was well accounted for. Once the model was constructed and its ability to reconstruct the actual experience of the study area demonstrated, another simulation could have been run except that all activity due to the nuclear station would be deleted. The two simulations could then be compared to determine the impact of the nuclear station.

This analysis would have required that county (or multiple-county) study areas be used because of data constraints. Even more important, comparable effort to that devoted to the study of the nuclear station would have to have been devoted to the analysis of all exogenous events impacting the study area if this procedure were to have been pursued. It was ultimately determined that the increased level of effort associated with this approach was not justified in terms of increased reliability of the results. In fact, it was felt that more reliable results would be obtained by concentrating directly on

FIGURE 3-3

ESTIMATION OF PROJECT-RELATED EMPLOYMENT AND INCOME EFFECTS



the nuclear station and then tracing out the consequences stemming from the construction and operation of the station.

3.6.3 Demographic Effects

The determination of project-related demographic effects was keyed to estimates of basic and nonbasic employment associated with each nuclear station. Two sources of population change were considered: (1) increases due to the in-migration of workers and their household members, and (2) increases resulting from the diminished out-migration of local residents and their household members.

The project-related population increase due to in-migration to the study area was composed of movers and their accompanying household members. The distribution of the basic and nonbasic jobs among the four categories of workers was based partly on local labor market conditions and commutation patterns and partly on survey data assembled for similar projects (Malhotra, 1979). Average family size for the direct basic construction workers was also based on construction worker survey data compiled by Malhotra (1979), while family size data for direct basic operations workers, indirect and "other" basic workers, and nonbasic workers were based on state-specific census data.

Workers and their household members who would normally have out-migrated during the project period to obtain employment but who stayed because they found work in project-related jobs, comprise the second component of project-induced population change. To estimate the magnitude of this project-induced population effect, the number of nonmovers employed in project-related jobs was considered in light of other local employment opportunities and of unemployment and migration patterns for the study area. In most of the study areas, the strong labor demand relative to labor supply and the associated in-migration made it clear that this effect was of no quantitative importance. However, in a few cases, where study areas had been experiencing little or no growth and had been characterized by out-migration, it is assumed that a portion of the jobs obtained by local residents (nonmovers) may have prevented out-migration that would otherwise have occurred. While these estimates are necessarily conjectural, when they are considered in light of the number of nonmovers and the dominant demographic and migration trends affecting the areas, they are reasonable order-of-magnitude estimates.

It is here that a modeling approach is essential to an accurate estimate of population effects. Economic/demographic simulation models are now commonly used to represent the interaction between labor demand, labor supply, and migration (Mountain West Research, Inc. 1982; Anderson et al., 1981). If such a model had been used, economic/demographic conditions with the nuclear station could have been contrasted to conditions without the station in order to estimate the effects on migration. As was explained in the previous section, there were several disadvantages of this approach that caused it not to be pursued.

3.6.4 Housing and Settlement Pattern Effects

The purpose of this section is to describe the methodology used to estimate the effects of the nuclear station on the study area housing stock in terms of new construction, upgrading or conversion of existing units, and increased use of mobile homes or apartments. The effects of the project on the cost and availability of housing were also examined using key informant interviews and available secondary data.

Increased demand for housing is created by the construction and operation of a nuclear generating station through the in-migration of workers and their accompanying household members and through the retention of local residents who would otherwise have out-migrated. Information on household status was used to generate estimates of the increased demand for housing units due to the nuclear station. Information on the composition of the demand by type of unit was included in those cases where it was available. This project-related demand was then contrasted to the increase in the housing stock over the study period to identify the importance of the nuclear station in determining housing market conditions. Finally, available secondary data were examined for evidence of changes in the cost and general availability of housing due to the project. While data limitations made rigorous examination of these questions difficult, conclusions could be drawn based on existing data and key informant interviews.

3.6.5 Local Government Effects

The examination of the effect of the nuclear station on local government presents difficult methodological problems because of the number of jurisdictional units in each study area and because of the complexities associated with an analysis of several service areas for each jurisdiction. Therefore, this section focused on the structure of political units in the study area; the revenues and expenditures of major governmental agencies; and the cost, availability, and quality of selected public services. These three dimensions

received emphasis because they provided sensitive and comparable indicators of project effects and because they affected many aspects of social organization in the community. The analysis is designed to highlight changes associated with significant social or political consequences rather than to provide a comprehensive fiscal evaluation.

The analysis began by examining the political structure of each study area for evidence of changes in structure or process due to the nuclear station. A detailed analysis was then made of the direct revenue flows from the project to local government jurisdictions. Changes in tax bases as well as in tax rates were examined over time to estimate project effects. No attempt was made to estimate revenue flows from induced residential or commercial property or from higher levels of project-induced consumption sales in the study areas.

Following an examination of the direct revenue effects, total expenditures and their functional distribution were scrutinized for any project-related effects. Because of the large number of expenditure categories and their varied determinants, few effects could be attributed to the nuclear stations without a more detailed analysis. Thus, three public services--education, transportation, and public safety—were selected for more detailed examination. The objective was to examine these services for any project-related changes in their quality, cost, or availability.

The selection criteria for these services required that they be identified in the assessment literature as being vulnerable to impact and that they be ones for which:

1. The magnitude and nature of project-related demand could be estimated with reasonable confidence;
2. The mechanisms/alternatives for response (by public services) to increased demand were relatively straightforward and direct; and[1]
3. The project-related demand was potentially of sufficient magnitude to affect the quantity, cost, and availability of the service.

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[1]The first two conditions are critical if, as in this study, a substantial portion of the analysis is based on the evaluation of key officials. Unless these key officials have a clear understanding of project-related demand, this evaluation will not be valid.

An additional reason for selecting transportation and public safety for analysis was that they exemplify services which are affected by commuters into the study area as well as by permanent residents of the area. While most case studies also include a brief discussion of the project's effects on social services, social services were not analyzed in detail because the relationship between the types of project-related changes is not sufficiently clear and because the provision of social services is shared by such a wide variety of governmental agencies that accurate analysis was beyond the scope of this study.

The analysis of each of the selected services begins with a consideration of project-induced demand, then considers revenue effects due to the project, and concludes with an appraisal of the overall effects of the project on the cost or availability of public services.

3.6.6 Social Structure Effects

Social impacts of large industrial projects such as nuclear facilities can be assessed in three major ways. Project effects on social change have been measured by attempts to define changes in a number of basic social activities such as changes in crime and divorce rates. The experience in attributing these changes to a nuclear plant or a rural industry has not been successful. In areas where major social changes have occurred (e.g., boom towns), the social indicator approach has been of some use. However, in areas where large demographic change has not occurred due to a project, this approach has not adequately addressed the problem of project attribution.

Further, while the use of various indices to measure social well being has been used to measure the degree to which social change is positive, there does not exist a set of indices or standards that is universally accepted. The attribution of such changes to an individual event, such as building a nuclear facility, poses methodological problems. Measuring social change at aggregate levels--income, education, crime rates--does not focus on the causal mechanisms that shape the change. Moreover, statistical measurements of change by means of social indicators usually have not addressed the issue of group variation in the social attribute that is being investigated.

Social impacts have also been defined on the basis of individuals' judgement of the changes and its effects on the individual or community. Thus, individuals have been asked to identify the present or probable impact and their evaluation of the change.

Although such assessments are worthwhile and important, especially in light of the increased inportance placed on public involvement, they are evaluative. As such, they are most valid in measuring the perceptions and evaluations of the changes at the time of the interview. The Post-Licensing Studies included an evaluation component of the effects, but objective indicators of social impact were important to gauge, particularly for projective purposes.

Thus, the approach taken considered the need for measuring "objective" social changes and the understanding of causal mechanisms for these changes. For projective purposes, it was important to link economic, demographic, and other effects to social impact. It was also important to identify the gains and losses of the effects and the variation of these in a study area. The question of who gains or loses as a result of a project's effects, and the consequences of this to social structure and behavior, has received much theoretical attention; however, few empirical studies had been undertaken prior to the Post-Licensing Studies. Variation in effects may result in changes in stratification patterns, political organization, and group evaluation and response. Thus, the approach adopted herein was based on determining social structural changes—an examination of organizational change on the basis of the distribution of effects. Such studies in the social impact assessment literature have tended to examine the "structure" of interaction and community coping mechanisms.

Social structure effects are identified by describing the major functional social groups at the beginning of the study period, the characteristics of the groups, and the major features of the relationships among the groups. A premise of the study is that relationships among people in a community[1] are structured and that people in a community form functional and interacting groups that can be identified and described.

The aggregation of study area residents into groups has three principal objectives: (1) to define groups which accurately reflect the functional organization of people within the study area; (2) to identify groups to which differential effects (economic, demographic, housing, or governmental) of the nuclear stations were

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[1]Warren's (1978) definition of a community is used: that combination of social units and systems that performs the major social functions having locality relevance. Functions are defined to include: production, distribution, consumption, socialization, social control, social participation, and mutual support.

distributed or for which the evaluation of those effects is unique; and (3) to identify groups which are discernible to study area residents and upon which they can focus in discussing the composition of the community, the economic, political, and social relationships within the community, and the distribution of project-related effects community wide.

Based on a review of the literature on community organization, social structure, and large-scale project effects, seven attributes were identified that seemed most critical to the specification and description of the groups and the social structure, and to the analysis of the effects of the nuclear project on them. These seven attributes were:

(1) Size of the group;
(2) Livelihood of group members;
(3) Demographic characteristics;
(4) Geographic location (residential and occupational);
(5) Property ownership characteristics;
(6) Dominant attitudes and values toward growth, environment, community participation, and planning; and
(7) Patterns of interaction among group members (cohesion).

A profile of each group was developed on the basis of these seven attributes by synthesizing secondary data and information from key informants. Because the purpose of these profiles is to explicate the social structure and to provide a basis for the analyses of project effects, the modal characteristics of each group were described as well as an indication of the group's diversity.

The patterns of interaction among group members are examined for three spheres of activity--economic, political, and social. The focus of the discussions regarding the interactions among group members in these three spheres is as follows: employment and income; political control, representation, and participation; and social participation or control of formal social organizations and the degree of informal social contact.

Once the groups within the study area are identified and characterized and the relationships among the groups are defined, the economic, demographic, housing, government, and public services effects of the project are distributed among the groups. Changes in the profiles of the groups and in the relationships among groups during the study period are then identified, and the role of the project in those changes is determined. Much of the information is based on interviews with key informants who

were knowledgeable about the groups in the area. Secondary data were also used to substantiate the information provided by the key informants and to further define the groups.

Thus, the overall strategy in attributing changes in social organization in the study area to the nuclear station is to distribute project effects to groups, examine the resulting changes in group profiles, and then see whether the changed group profiles appear to have had any effect on patterns of political, social, or economic interaction among groups. To the extent that the number of groups, the profiles of the group or the interaction patterns of the groups have been affected, the nuclear station will be said to have caused a change in the social organization of the study area.

3.6.7 Public Response

The Post-Licensing Studies addressed the question of public response as a component of social impact assessment. Public response is defined as expressions of concern by local governmental bodies and/or the public to the nuclear plant and its potential or real effects. Public response may manifest itself in concern over effects that may or may not be expressed in the political arena. Public response may in itself also have effects on social structure and behavior, in particular changes in political patterns of behavior. The analysis of public response also assessed the degree to which the existing local political authorities addressed problems resulting from the plant and the way in which these were handled. Were changes necessary in the political structure to effectively deal with plant-related issues? Prior to this study, these issues were not systematically addressed in socioeconomic impact studies.

The description and analysis of public response is a logical step following the assessment of the distribution of effects and changes to social groups. The effects of the plant on the social groups and the evaluation of these effects (perceived or real) in the context of group values set the stage for understanding group behavior and response. What were the plant-related issues and to what degree did study area residents participate in resolving the issues? To what degree were community norms—levels of political participation, values with respect to growth, and methods of resolving community conflicts—important in understanding study area response?

In describing the public response, the issues regarding the nuclear plant are identified; the relevant institutions, constituencies, and political activities are described;

and the effect of public response on the study area's sociopolitical process is assessed. In addition, the degree to which residents of the study area participated in public activity is ascertained, their level of concern over the facility is gauged, and the salience of issues provoked by the construction and operation of the nuclear facility is measured.

Two types of public response arose during the study period: (1) the formal response within the hearings and legal process through the contentions of the interveners and the viewpoints expressed by those who made limited appearances, and (2) the informal response outside the hearings process. Resolutions passed and public statements made by governmental bodies and business organizations and the use of the press by environmentalists are examples of such informal activities. Key informant interviews, existing public opinion surveys, and accounts in the local and regional press are the key sources of information for the public response section.

3.6.8 Evaluation and Significance

Of particular importance in this study was ascertaining the evaluation of the project's effects on study area residents. Earlier, the study examined the magnitude of the objective effects distributed by group. In this section, the analysis focuses on the individual group's perception of the effects on a number of dimensions. Evaluation of the effects is based on the group's perception of the magnitude and duration of each effect—economic, demographic, housing, fiscal, and social—on the group. In addition, each group is asked to assess the importance of the effects of the plant to the group and to the study area as a whole.

Existing studies are available that have measured the community's perception of impacts, but these studies have tended to aggregate individual comments and have not dealt with social groups per se. Moreover, these studies have tended to elicit observations of the impacts at a given point in time. The approach of the Post-Licensing Studies addresses the evaluation issue over the entire historical experience of the plant.

The final section of each case study report is an assessment of the significance of the project and, as such, serves as a summary statement. Project significance is determined by the following parameters: the magnitude and duration of the plant's effects; the distribution of the effects across groups; the evaluation of the plant and its effects; and the importance of the plant vis-a-vis other developments or events in the study area.

CHAPTER 4: SOCIOECONOMIC CHANGES DUE TO THE CONSTRUCTION AND OPERATION OF NUCLEAR GENERATING STATIONS

4.1 Introduction

The foundation of this study is the socioeconomic assessment of twelve nuclear generating stations. The first objective of the study is to determine the nature and extent of socioeconomic changes experienced in the vicinity of these plants as a result of their construction and operation. The purpose of this chapter is to summarize the changes experienced in socioeconomic conditions at each of the twelve case study sites. The discussion of project effects is organized around the conceptual framework explained in Chapter 2. The effects are estimated and attributed to the nuclear generating stations using the methodology presented in Chapter 3. Once the effects have been summarized, variation in effects across sites is examined and an explanation is sought in terms of project characteristics and area characteristics, or the characteristics of other external forces acting on the area at the time.

The discussion begins with a brief description of the twelve projects and the areas in which they are located. These characteristics are then related to the sampling stratification criteria described in Chapter 3. Having identified the twelve sites, the areas to be intensively studied are identified for each site. These "study areas" are defined according to the criteria described in Chapter 3. They range from entire counties to one or two townships that make up only a small fraction of a county.

The direct and indirect changes in socioeconomic conditions in the study area resulting from construction and operation of the nuclear generating stations are then organized in terms of the causal model presented in Chapter 2. The characteristics and residential location of the work force at each site are first identified. This is followed by a summary of the economic consequences of the project, in terms of both employment and income. Employment change is linked to demographic change in the study area, and change in demographics is, in turn, linked to change in the housing market demand and to changes in both the revenues and expenditures of local governments. Chapter 4 concludes by summarizing the changes that occurred in the social structure of the study areas due to the project.

It is important to note that all of the material reviewed in this chapter deals with "objective" changes associated with the nuclear generating station. Issues dealing with

the response and subjective evaluation of local residents to these changes are presented in Chapters 5 and 7. The intent here is to identify the changes in underlying socioeconomic conditions that were the basis for these reactions and evaluations.

4.2 Project and Project Area Description

4.2.1 Project Characteristics

The twelve projects investigated in the case studies are identified in Table 4-1. Five of the sites are located in the South, four in the Northeast, two in the West, and one in the Midwest. Most of the projects were announced in the mid- to late 1960s. Typically they included two units, each having a net output of about 800 Mw. The issuance of construction permits was clustered in the years 1968-1970 with operating permits generally following four to six years later. Two of the projects, Nine Mile Point and St. Lucie, had units still under construction in mid-1981. Operating permits had also not been issued for Diablo Canyon at that time.

The timing associated with the construction of the twelve projects is such that all except Diablo Canyon had some operating experience prior to the commencment of case study research in 1978. Peak construction typically occurred during the period 1970 to 1972—a period of sufficient recency to allow for the efficient collection of both primary and secondary data.

Table 4-2 presents a few characteristics of the areas in which the projects are located. Three measures of population are presented--population within five miles, population of the host county, and distance to the nearest city of 50,000 or more persons. These are supplemented with information on the growth experience of the county over the period 1970 to 1980 together with an indication of the major factors responsible for growth.

Each of the three population measures gives a different perspective on population density in the vicinity of the site and they must, therefore, be considered jointly. Population in the immediate vicinity of the sites ranges from over 36,000 within a five-mile radius of Three Mile Island, to fewer than 1,000 at four of the sites. It doesn't necessarily follow, however, that the projects located in sparsely settled areas are located in the smaller counties. The two California sites are among the four sites least

TABLE 4-1

PROJECT LOCATION AND CHRONOLOGY

Project Name	Location		Nearest Town/City	Announcement Date	Units	Size	Construction Permit	Operating Permit
	State	County						
Arkansas	Arkansas	Pope	Russellville	1967	Unit 1	836 Mw	1970	1974
					Unit 2	836 Mw	1972	1978
Calvert Cliffs	Maryland	Calvert	Prince Frederick	1967	Unit 1	845 Mw	1969	1974
					Unit 2	845 Mw	1969	1976
Cook	Michigan	Berrien	Benton Harbor/ St. Joseph	1967	Unit 1	1050 Mw	1969	1974
					Unit 2	1100 Mw	1969	1977
Crystal River	Florida	Citrus	Crystal River	1967	Unit 1	825 Mw	1968	1976
Diablo Canyon	California	San Luis Obispo	San Luis Obispo	1966	Unit 1	1084 Mw	1968	N/I
					Unit 2	1084 Mw	1970	N/I
FitzPatrick/ Nine Mile Point	New York	Oswego	Oswego	1968	Unit 1	821 Mw	1970	1974
				1963	Unit 1	610 Mw	1965	1969
				1971	Unit 2	1100 Mw	1974	N/I
Oconee	South Carolina	Oconee	Seneca	1966	Unit 1	860 Mw	1967	1973
					Unit 2	860 Mw	1967	1973
					Unit 3	860 Mw	1967	1974
Peach Bottom	Pennsylvania	York	Delta	1966	Unit 2	1098 Mw	1968	1973
					Unit 3	1098 Mw	1968	1974
Rancho Seco	California	Sacramento	Galt	1964	Unit 1	913 Mw	1968	1974
St. Lucie	Florida	St. Lucie	Fort Pierce	1968	Unit 1	802 Mw	1970	1976
					Unit 2	802 Mw	1977	N/I
Surry	Virginia	Surry	Williamsburg	1966	Unit 1	788 Mw	1968	1972
					Unit 2	788 Mw	1968	1973
Three Mile Island	Pennsylvania	Dauphin	Middletown	1966	Unit 1	792 Mw	1968	1974
					Unit 2	880 Mw	1969	1978

N/I: not issued as of July 1981.

Source: NRC Post-Licensing Studies, Chapter 2, 1980/81.

TABLE 4-2

AREA CHARACTERISTICS OF THE TWELVE PROJECT LOCATIONS

	Nearest City of 50,000+	Distance to Nearest City of 50,000+ (mi.)	Population Within 5 Miles	1980 Host County Population	Average Annual Growth 1970-1980 (Percent)	Growth Factors
Arkansas	Little Rock, Ark.	65	7,149	Pope 35,000	2.8	Rapid growth due to expansion of light industry and agribusiness.
Calvert Cliffs	Washington, D.C.	38	3,425	Calvert 30,000	3.8	Population increase due to suburbanization and retirement migration.
Cook	South Bend, Ind.	28	10,599	Berrien 172,800	0.6	Little growth in the 1970s.
Crystal River	Clearwater, Fla.	55	324	Citrus 54,703	11.0	Very rapid growth due both to retirement and employment-related migration.
Diablo Canyon	Santa Barbara, Calif.	107	10	San Luis Obispo 144,744	2.9	Growth due to retirement migration and tourism. Agriculture remains important.
FitzPatrick/ Nine Mile Point	Syracuse, N.Y.	38	3,000	Oswego 107,900	1.0	Little growth.
Oconee	Greenville, S.C.	26	2,274	Oconee 47,122	1.8	Industrial growth resulted in diminished out-migration in 1970s. Some retirement migration.
Peach Bottom	Baltimore, Md.	35	6,145	York 293,400	0.8	County growths due to continuing industrialization in City of York, and suburbanization from Harrisburg.
Rancho Seco	Sacramento, Calif.	25	352	Sacramento 785,300	2.1	Growth due to increased employment opportunities in Sacramento urban area.
St. Lucie	West Palm Beach, Fla.	40	1,165	St. Lucie 75,900	4.6	Growth due to in-migration of retirees.
Surry	Newport News, Va.	17	769	Surry 5,967	0.1	Stable population. Some diminished out-migration in 1970s.
Three Mile Island	Harrisburg, Penn.	9	36,372	Dauphin 226,400	0.1	Heavy dependence on manufacturing: hence, low rate of growth.

Source: NRC Post-Licensing Studies, 1980/81.

populated in terms of population in the five-mile ring but are located in two of the three largest counties studied. The population of the host counties is highly variable. In 1980, the population of Sacramento County, California, exceeded 785,000 followed by Dauphin County, Pennsylvania, with nearly 224,000. The population of Berrien County, Michigan, was more than 170,000, and San Luis Obispo County, California, was nearly 145,000, followed by Oswego County, New York, which was close to 108,000. Populations in the other host counties were predominantly in the range of 30,000 to 50,000.

Seven of the twelve sites are between 25 and 40 miles from a city of 50,000 or more persons. Surry and Three Mile Island are within 17 miles and 9 miles of Newport News and Harrisburg, respectively, while Crystal River, Arkansas Nuclear One, and Diablo Canyon are 55, 65, and 107 miles, respectively, from a city of that size.

The populations of the twelve host counties grew in every case over the period 1970 to 1980, although there was considerable variation across the twelve sites. Four of the counties in which sites were located grew at less than 1.0 percent per year, five grew at rates between 1.0 and 3.5 percent, and three grew at rates in excess of 3.5 percent.

Table 4-3 cross-classifies the sites by growth experience and size of host county and shows that the sites are well stratified by both growth experience and size. The general clustering of the sites in the southwest and northwest quadrants is partly a reflection of national growth trends during the past decade.

Perhaps the most serious limitation of the sample is the high representation of southern sites (5), and northeastern sites (4). There were, however, only four sites located in the Midwest or the West that met the criteria outlined in Chapter 3. Since three of these four were included in the sample, there was little more that could be done to increase the geographic representativeness of the sample. Moreover, regional variation per se does not appear to be of any particular signficance as a determinant of the socioeconomic effects of construction and operation of nuclear generating stations.

4.3 Study Area Definition

Study area definition was a topic of great importance to the study, from both a theoretical and a pragmatic viewpoint. Theoretically, the area had to be defined in a way that was consistent, both in its areal extent and its detail, with the model of cause

TABLE 4-3

CROSS CLASSIFICATION OF SITES
BY HOST COUNTY POPULATION
AND 1970-1980 GROWTH RATE

1970-1980 Average Annual Growth Rate (Percent)	Host County Population			
	Less than 50,000	50,000 to 150,000	150,000 to 250,000	More than 250,000
0 to 0.9	Surry		Cook, Three Mile Island	Peach Bottom
1.0 to 3.4	Arkansas, Oconee	Diablo Canyon, FitzPatrick/ Nine Mile Point		Rancho Seco
3.5 and over	Calvert Cliffs	St. Lucie, Crystal River		

Source: NRC Post-Licensing Studies, Chapter 2, 1980/81.

and effect that was being used to study the effects of constructing and operating a nuclear generating station. Pragmatically, there was the very real danger of overlooking significant consequences of the station by being too superficial in studying a large area or by not studying an area at all because it was felt better to study a small area more intensively. The definitional problem was further complicated by the deliberate attempt of the study to represent as broad a range of siting conditions as possible in the twelve-site sample. Thus, a definitional strategy that appropriately balanced the theoretical and pragmatic considerations at one site often had very different, and less satisfactory, implications at another site.

Chapter 3 discussed in detail the approach that was finally taken to define the study area. Briefly, a study region was determined based on the preliminary site visits. This region was then disaggregated into an exhaustive set of allocation areas. The distribution of direct project effects—effects felt to be significant in the chain of causal events flowing from the construction and operation of a nuclear station--was then examined for each of the allocation areas. The effects studied were the residential distribution of both the construction and operations workers, the geographic distribution of local purchases, and the distribution of direct project revenues among local jurisdictions. The relative significance of these direct effects to each of the allocation areas became the principal criterion for study area selection. These conclusions had to be tempered on occasion, however, by pragmatic considerations of data availability, resource limitation, and the need to deal with areas that made sense as functional social and economic units.

Table 4-4 summarizes for each site the original study region investigated, the study area finally selected, and the major considerations relating to residential location of workers, purchases, and taxes. In general, multicounty regions were investigated for each site, and considerable effort went into studying the spatial distribution of workers, purchases, and taxes in these study regions. It turned out that purchases in the region were usually too small to be significant in selecting the study area. Rather, the distribution of workers and taxes became the dominant considerations in study area selection.

Table 4-5 presents the resulting study areas and divides them into two groups, each of which is further subdivided. Seven of the stations have study areas that are comprised of entire counties while five have study areas that are made up of subcounty

TABLE 4-4

STUDY AREA SELECTION

Nuclear Station	Study Region and Study Area Selected	Study Area Selection Criteria		
		Location of Direct Work Force	Local Purchases	Local Revenues Generated
ARKANSAS Pope County Arkansas	The study region examined included Pope, Johnson, Logan, and Yell counties. Pope County was finally chosen as the Study Area. Pope County had the largest concentration of workers and of purchases, and it was the only local jurisdiction to receive significant tax payments.	67% of the peak construction force is estimated to have resided in Pope County. In 1978, 77% of the operations work force was estimated to reside there.	15% of materials purchases were made in Russellville. Over the whole construction period, this amounted to $3.6 million.	No taxes paid outside Pope County. In 1974 (peak construction), the generating station was 71% of Pope County assessed value. By 1978, the station was responsible for 80% of the Russellville school district revenues.
CALVERT CLIFFS Calvert County Maryland	The study region examined included Calvert, St. Mary's, Charles, Anne Arundel, and Prince George's counties. Calvert County was chosen as the Study Area. It had the largest concentration of workers and it received almost all of the local tax revenues.	51% of the peak construction force and 84% of the operations work force is estimated to have resided in Calvert County.	No significant local purchases in Calvert County.	Almost all taxes paid went to Calvert County. The plant accounted for 65% of the company's assessable tax base in 1978. $11 million was paid in 1978 to Calvert County.
COOK Berrien County Michigan	The study region examined included Berrien, Cass, and Van Buren counties. A subset of Berrien County, including Bridgman City and Lake Township was chosen as the study area because the direct effects were greater there in relative terms than in other areas.	5% of the peak construction force and 11% of the operations force resided in the Study Area. The ratio of workers to population was significantly higher here than for any other area in the study region.	No significant local purchases in Bridgman City or Lake Township.	Local taxes either went to Bridgman-Lake Township or to Berrien County. The revenue flow to Bridgman-Lake Township amounted to about $1 million in 1972 and $2.5 million in 1978.

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TABLE 4-4 (Continued)

STUDY AREA SELECTION

Nuclear Station	Study Region and Study Area Selected	Study Area Selection Criteria: Location of Direct Work Force	Study Area Selection Criteria: Local Purchases	Local Revenues Generated
CRYSTAL RIVER Citrus County Florida	The study region examined included Citrus, Hernando, and Marion counties. Citrus County was selected as the Study Area based on the relative concentration of workers in Citrus County and the fact that no plant-induced revenue was received by anyone in the study region except Citrus County.	26% of the peak construction force and 73% of the operations force chose to live in Citrus County.	No significant local purchases in any of the study region counties.	Local taxes in the study region went only to Citrus County jurisdictions within Citrus County. The plant represented about 25% of the county's assessed valuation in 1978. Total taxes paid amounted to $3.4 million in 1978.
DIABLO CANYON San Luis Obispo County California	The study region examined included San Luis Obispo and Santa Barbara counties. San Luis Obispo County was chosen as the Study Area. 85% of both the construction and operations work force lived in the county and revenue effects were concentrated there as well.	85% of the peak construction force and 85% of the operations force chose to live in San Luis Obispo County.	Local purchases in the study region were insignificant.	The plant accounted for 21% of the assessable tax base of San Luis Obispo County in 1978. About $12.4 million was paid in taxes. No county other than San Luis Obispo received any of these revenues.
FITZPATRICK/ NINE MILE POINT Oswego County New York	The study region was limited to Oswego County. Oswego City and Scriba Town were selected as the Study Area. The ratio of workers to population was higher in these two areas than anywhere else in the study region. Oswego City also received significant purchases and revenue effects.	In 1978, it was estimated that 44% of the work force lived in Oswego City and Scriba Town.	Significant purchases were made in Oswego County. A total of $14.1 million is estimated to have been spent of which $6.2 million is estimated to have been spent in Oswego City.	The plant accounted for 20% of assessed valuation in the Study Area. School district received substantial revenues, although not all of the district is in the Study Area.

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TABLE 4-4 (Continued)

STUDY AREA SELECTION

Nuclear Station	Study Region and Study Area Selected	Study Area Selection Criteria		
		Location of Direct Work Force	Local Purchases	Local Revenues Generated
OCONEE Oconee County South Carolina	The study region included Oconee, Pickens, Anderson, and Greenville counties. Oconee County was designated the Study Area based on the relative concentration of workers and of fiscal effects.	25% of the peak construction force and 59% of the operating force chose to live in Oconee County.	Purchases in Greenville County could have been a few hundred thousand dollars. No significant purchases in Oconee County.	Tax revenues of $3.7 million in 1978 went to Oconee County. This amounted to about 28% of the county budget.
PEACH BOTTOM York County Pennsylvania	The study region included York and Lancaster counties, Penna., and Harford and Cecil counties, Md. The Study Area chosen is only a very small part of York County and includes Delta Borough and Peach Bottom Township. The relative concentration of the work force in the area was the dominant consideration with the revenue also playing some role in the selection.	17% of the peak construction force and 8% of operations force lived in the Study Area. These percentages are small, but when the number of workers is related to the size of the Study Area population, the ratio is very large relative to any other part of the study region.	Purchases of materials within the study region were not significant.	Property tax revenues are distributed statewide. Peach Bottom Township received substantial earned income tax during construction.
RANCHO SECO Sacramento County California	The study region included the counties of Sacramento, Amador, San Joaquin, and El Dorado counties. The Study Area finally selected was the Galt County Census Division of Sacramento County. This selection was based on the relative concentration of workers living in the Galt CCD.	10% of the construction force and 8% of the operations work force lived in the Galt CCD. In 1978, the ratio of resident work force to population was higher than elsewhere in the study region.	Purchases in the local area were not large enough to play any role in Study Area selection.	The plant is not taxed so revenues played no role in Study Area selection.

(Continued on Next Page)

TABLE 4-4 (Continued)

STUDY AREA SELECTION

Nuclear Station	Study Region and Study Area Selected	Study Area Selection Criteria		
		Location of Direct Work Force	Local Purchases	Local Revenues Generated
ST. LUCIE St. Lucie County Florida	The study region included St. Lucie and Martin counties. The Study Area selected was St. Lucie County. This was based on the greater intensity of impact in St. Lucie County with respect to each of the three criteria—labor, purchases, and taxes.	About 40% of both the construction and the operations work force resided in St. Lucie County.	Over the entire construction period, as much as $20 million of purchases may have been made in Fort Pierce in St. Lucie County.	All property taxes on the plant were paid to St. Lucie County. These accounted for about 19% of the assessable base of St. Lucie County in 1978. These yielded revenues of nearly $4 million.
SURRY Surry County Virginia	The study region included Surry and Isle of Wight counties; both counties had similar percentages of workers living in them, but Surry had significant revenue effects while Isle of Wight had none. On this basis, Surry County was designated as the Study Area.	During the construction period, about 10% of the work force lived in Surry County and 14% in Isle of Wight County. In 1977, 20% of the operations force resided in Surry and 17% in Isle of Wight.	Almost all purchases were made outside the study region.	Surry County is the only local jurisdiction to receive revenues from the project. In 1973, Surry County received 86% of its revenues from the project. By 1978, this had dropped to 72%.
THREE MILE ISLAND Dauphin County Pennsylvania	The study region included Dauphin, Lebanon, Cumberland, Lancaster, and York counties. The subarea of Dauphin County, containing Londonderry Township, Middletown, and Royalton, was chosen as the Study Area. This choice was based partly on worker location and revenue considerations and partly on the existence of historic social and economic ties in the area.	About 8% of the construction force was estimated to have lived in the study area. During the operations period this is estimated to have risen to 20%.	Some purchases were made in the greater Harrisburg area. Over the entire construction period, these may have totaled $7 million.	The earned income tax benefited each of the jurisdictions in the Study Area. Property taxes of local governments were not significantly affected because of state equalization laws.

Source: NRC Post-Licensing Studies, Chapter 3, 1980/81.

TABLE 4-5

THE TWELVE NUCLEAR STATIONS AND THEIR ASSOCIATED STUDY AREAS

Typology	Nuclear Station	Study Area
COUNTY STUDY AREA.		
Rural County, Oriented to Agriculture and Small Industry	Surry	Surry County, Va.
	Calvert Cliffs	Calvert County, Md.
	Oconee	Oconee County, S.C.
	Arkansas	Pope County, Ark.
Coastal County, Oriented to Recreation and Tourism	Diablo Canyon	San Luis Obispo County, Calif.
	St. Lucie	St. Lucie County, Fla.
	Crystal River	Citrus County, Fla.
SUBCOUNTY STUDY AREA.		
Rural Area of Urban County	Peach Bottom	Delta Borough/Peach Bottom Township in York County, Penn.
	Rancho Seco	Galt County Census Division in Sacramento County, Calif.
Urban Area of Urban County	Cook	Bridgman City/Lake Township in Berrien County, Mich.
	FitzPatrick/Nine Mile Point	Oswego City/Scriba Township in Oswego County, N.Y.
	Three Mile Island	Londonderry Township/Royaltown/ Middletown Borough in Dauphin County, Penn.

Source: NRC Post-Licensing Studies, 1980/81.

areas. The county level of aggregation has great advantages in terms of data availability, but these advantages are overridden by the complexities associated with the analysis of large urban areas. Consequently, those study areas which comprise entire counties are the smaller, more rural counties. Those study areas which are subcounty areas are located in the larger, urban counties.

The seven study areas comprised of entire counties fall into two groups. One group, comprised of Diablo Canyon, St. Lucie, and Crystal River, is quite homogeneous; all three counties are coastal, have enjoyed recent growth, and are strongly oriented toward second-home development, retirement, and recreation. The other four counties are small and rural in orientation with agriculture and light industry being important parts of their economic base. Calvert County is coastal and it, too, has benefited from both retirement in-migration and tourism; however, it is much smaller and much less urban in orientation than the two Florida sites and the California site.

The five stations for which subcounty study areas were chosen are also usefully thought of in two groups. The Peach Bottom site in Pennsylvania and the Rancho Seco site in California are both located in the rural portions of large urban counties. In both cases, city data (York, Pennsylvania, and Sacramento, California) would have dominated the county data and so subcounty areas were chosen that restricted the focus to the rural areas in the immediate location of the station site. Thus, although the host county for each of these stations was very large, the study areas chosen for detailed investigation were small and rural, and had important commonalities with the study areas for the Surry, Calvert Cliffs, Oconee, and Arkansas stations.

The remaining three stations--Cook, FitzPatrick/Nine Mile Point, and Three Mile Island—also had study areas comprised of subcounty areas, but these areas were more urban in their orientation. The study area for Cook is located in the industrialized belt that runs around the southern tip of Lake Michigan. Bridgman and Lake Township are not themselves industrial, but their residents are very much integrated into the industrial economy. The study area for FitzPatrick/Nine Mine Point includes the industrial city of Oswego, New York, while the study area for Three Mile Island is well within the urban influence of Harrisburg, Pennsylvania.

Bearing in mind the limitations of any typology, it will be useful at times in the analysis that follows to distinguish the four rural counties, the three coastal counties, the two rural subcounty areas, and the three urban subcounty areas.

It is also necessary to keep in mind, however, the difference in the size of the study areas. Table 4-6 shows the twelve sites arranged by 1970 population. In general, the subcounty areas are smaller than the county areas although there are exceptions. The study areas range in size from Peach Bottom with a 1970 study area population of just over 2,000, to Diablo Canyon with a 1970 study area population of over 100,000.

4.4 Employment and Income

4.4.1 Direct Basic Employment

The average annual on-site work force by year for each of the 12 sites is shown in Table 4-7. The length of the employment history for each site depended upon when construction began. FitzPatrick/Nine Mile Point began construction in 1964 and had 16 years of employment history while Cook and Rancho Seco had only 11 years. There were five sites with 12 years, three with 13 years, and one with 14 years of employment history.

Peak employment occurred at year 4 in the cases of Rancho Seco and Surry, but not until year 16 for FitzPatrick/Nine Mile Point where there were two distinct construction peaks with the most recent one overlapping the operating of two units on site. The average for peak construction across all twelve sites was in year 5.

There were two 1-unit sites, eight 2-unit sites, and two 3-unit sites. The 3-unit site at FitzPatrick/Nine Mile Point still had one unit (Nine Mile Point-2) under construction when the field work for the study was conducted. Diablo Canyon had completed all the construction work but was still not in operation in September 1981. By summer 1981, Three Mile Island was still not operating after the accident in March 1979. All other sites were in an operations mode.

The range of peak employment was from 1,227 at Rancho Seco to 2,872 at Three Mile Island. The size of the peak employment appears to have been partly a function of the number of units and the generating capacity; however, the employment history of the sites was also subject to a number of important constraints including management decisions based upon projected load estimates, financing, regulatory requirements, labor availability, and delivery of equipment and supplies.

TABLE 4-6

THE TWELVE NUCLEAR STATIONS
ARRAYED IN ORDER OF
THEIR 1970 STUDY AREA POPULATION

Station	Study Area Type	Study Area Population
Peach Bottom	Subcounty - rural	2,202
Cook	Subcounty - urban	3,767
Surry	County - rural	5,882
Rancho Seco	Subcounty - rural	7,981
Calvert Cliffs	County - rural	12,888
Three Mile Island	Subcounty - urban	13,573
Crystal River	County - coastal	19,196
FitzPatrick/ Nine Mile Point	Subcounty - urban	24,532
Arkansas	County - rural	28,607
Oconee	County - rural	40,728
St. Lucie	County - coastal	50,836
Diablo Canyon	County - coastal	105,690

Source: NRC Post-Licensing Studies, 1980/81.

TABLE 4-7

DIRECT BASIC EMPLOYMENT—PLACE OF WORK

Site/Start Year	Years from Start of Construction															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Arkansas/1968 (2 units, 1248 Mw)	215	420	669	1,136	1,050	1,348	1,221	1,347	1,445*	1,005	688	462				
Calvert Cliffs/1968 (2 units, 1690 Mw)	156	487	1,092	2,050	2,064*	2,012	1,359	751	503	243	266	334				
Cook/1968 (2 units, 2150 Mw)	88	234	938	2,056	2,525*	1,472	2,076	571	1,550	1,574	756					
Crystal River/1968 (1 unit, 858 Mw)	3	36	313	845	1,390	1,648*	1,226	763	764	298	273	392				
Diablo Canyon/1968 (2 units, 2190 Mw)	158	295	705	921	1,441	1,866	1,510	2,116*	1,518	893	1,317	1,472				
FitzPatrick/Nine Mile Point/1964 (3 units, 2531 Mw)	57	199	495	838	835	596	554	1,345	1,637*	1,098	712	455	620	2,289	1,922	2,574*
Oconee/1967 (3 units, 2588 Mw)	144	466	1,276	2,108	2,342*	2,175	1,735	889	462	482	633	747	833			
Peach Bottom/1967 (2 units, 2130 Mw)	150	688	1,064	2,186	2,119	2,844*	2,230	1,234	300	308	342	414	469			
Rancho Seco/1969 (1 unit, 960 Mw)	103	360	866	1,227*	1,012	572	516	449	507	597	618					
St. Lucie/1969 (2 units, 1620 Mw)	138	163	472	904	1,607	1,938*	1,753	991	626	1,333	406	378				
Surry/1967 (2 units, 1576 Mw)	72	415	1,247	1,740*	1,538	855	222	226	238	272	307	494	1,729	1,374		
Three Mile Island/1967 (2 units, 1672 Mw)	31	389	1,172	2,077	2,716	2,872*	2,594	1,639	1,795	2,216	1,971	858	563			
TOTAL	1,315	4,152	10,309	18,088	20,639*	20,020	16,996	12,321	11,345	10,319	8,289	6,006	4,214	3,663	1,922	2,574
AVERAGE	110	346	859	1,507	1,720	1,668	1,416	1,026	945	860	691	601	843	—	—	—

* - Shows peak employment year.

Source: NRC Post-Licensing Studies, Chapter 2, 1980/81.

4.4.2 Work Force Characteristics - Nonmovers, Movers, and Daily Commuters

The purpose of this section is to describe the characteristics of the construction and operations work force at the 12 sites by examining the nonmover, mover, and commuter work force breakdown. In the methodology chapter of the report, commuters were defined as those workers who reside outside the study area and travel to the site on a daily basis. This section first describes the variation across sites with respect to the degree to which the work force resided in the study area during peak construction and in 1978. A major determinant of this variation is, of course, the size of the study area. For this reason, Table 4-8 also shows the 1970 population of the study area.

The percent of the total on-site work force residing in the study area during the year of peak construction averaged just over 30 percent. This implies that almost 70 percent of the work force commuted daily into the study area during the construction period. The percentage of work force residing in the study area is highly variable, however, and rises with the size of the study area, as would be expected (see Table 4-8). This percent ranged from 5.4 percent at the Cook site to 85.0 percent at the Diablo Canyon site. A breakdown of all the sites indicates that at four sites—Three Mile Island, Surry, Rancho Seco, and Cook—the percent of workers residing within the study area constituted 10 percent or less of the total number of workers on site. At four other sites—St. Lucie, Peach Bottom, Oconee, and Crystal River—the percent of the work force residing in the study area was between 10 percent and 40 percent of the total work force. The FitzPatrick, Diablo Canyon, Calvert Cliffs, and Arkansas sites were characterized by a large percentage (greater than 40 percent) of the workers residing in the study areas.

In light of the size of the county, Calvert Cliffs had a surprisingly high percentage of the work force residing in the county. This was due partly to the physical size of the county and the remoteness of the site, partly to the ample supply of housing in the county, and partly to the large resident labor force in the county that found employment at the station.

In 1978, commercial operation was ongoing for most of the nuclear stations and a noticeable shift had taken place: for all but two of the stations, the 1978 percentage of workers residing in the study area was higher than it had been at construction peak. In addition, the number of sites with 40 or more percent of workers living within the study area had increased from four to six. Although the size of the labor force at the sites had

TABLE 4-8

WORK FORCE CHARACTERISTICS: NONMOVERS, MOVERS, AND COMMUTERS
(Peak Construction Year and 1978)

	1970 Study Area Population	Peak Construction Year: Work Force TOTAL	Nonmovers #	Nonmovers %	Movers #	Movers %	Total Study Area #	Total Study Area %	Commuters #	Commuters %	1978: Work Force TOTAL	Nonmovers #	Nonmovers %	Movers #	Movers %	Total Study Area #	Total Study Area %	Commuters #	Commuters %
Arkansas	28,607	1,009	303	30.0	353	35.0	656	65.0	353	35.0	722	217	30.0	253	35.0	470	6.0	252	35.0
Calvert Cliffs	12,888	2,064	475	23.0	580	28.1	1,055	51.1	1,009	48.9	586	174	29.7	251	42.8	54	9.2	107	18.3
Cook	3,767	2,525	48	2.0	89	3.5	137	5.4	2,388	94.6	756	44	5.8	37	4.9	81	10.7	675	89.3
Crystal River	19,196	1,649	213	12.9	212	12.9	425	25.8	1,223	74.2	273	90	33.0	108	39.6	198	72.5	75	27.5
Diablo Canyon	105,690	2,116	495	23.4	1,304	61.6	1,799	85.0	317	15.0	1,317	316	24.0	805	61.1	1,121	85.1	196	14.9
FitzPatrick/Nine Mile Point	24,532	2,289	658	28.7	338	14.8	996	43.5	1,293	56.5	1,922	543	28.3	300	15.6	843	43.9	1,080	56.2
Oconee	40,728	2,342	295	12.6	300	12.8	595	25.4	1,747	74.6	747	317	42.4	62	8.3	379	50.7	368	49.3
Peach Bottom	2,202	2,230	246	11.0	169	7.6	415	18.6	1,815	81.4	414	26	6.3	22	5.3	48	11.6	366	88.4
Rancho Seco	7,981	1,227	63	5.1	58	4.7	121	10.0	1,106	90.0	597	31	5.2	14	2.3	45	7.5	552	92.5
St. Lucie	50,836	1,938	372	19.2	378	19.5	750	38.7	1,188	61.3	1,348	266	19.7	298	22.1	564	41.8	784	58.2
Surry	5,882	1,850	95	5.2	80	4.3	175	9.6	1,675	90.5	414	48	11.6	22	5.3	70	16.9	344	83.1
Three Mile Island	13,573	2,872	90	3.1	168	5.8	258	8.9	2,614	91.1	858	125	14.6	53	6.2	178	20.8	680	79.2
MEAN				14.7		17.6		32.3		67.7			21.0		21.0		42.0		58.0

Source: NRC Post-Licensing Studies, Chapter 2, 1980/81.

declined compared to the peak construction year, a greater proportion of the work force resided closer to the plants.

Of the total work force, the percent of workers that was classified as nonmovers ranged from a low of 2.0 percent at the Cook site to a high of 30.0 percent at the Arkansas site. In general, the number of workers available in the study area for construction and operation employment was relatively small, averaging about 15 percent during construction and 21 percent during operation. This may be explained by a number of factors: population density of the study areas, location of union labor halls, level of skilled labor in the study areas, and location of competitive metropolitan areas.

The Arkansas, Calvert Cliffs, FitzPatrick/Nine Mile Point, and Diablo Canyon plants had a relatively larger share of nonmovers than the other plants under study. The study areas for both the Arkansas and Diablo Canyon stations were growing rapidly, and a large indigenous construction work force existed in the areas prior to the announcement of these two plants. In particular, Russellville, the largest community in the Arkansas Study Area, was the central location of a large construction work force which had in-migrated earlier to work on a number of large-scale projects in both the public and private sectors. In addition, Russellville was the location of the carpenters' and laborers' union halls, and these craftspersons tended to locate near the union hall. The large in-migration of movers at Diablo Canyon resulted from the fact that the facility was located mid-point between two large metropolitan centers--San Francisco and Los Angeles--from which many of the workers in-migrated. However, the distances from the cities were outside the range of daily commutation. The availability of housing was also an important factor in explaining the high percentage of movers who in-migrated to the Diablo Canyon Study Area.

The data suggest that variation among sites with respect to commutation was related to: (1) distance to large metropolitan centers with large labor pools; (2) lack of housing availability; and (3) worker preferences for communities. At four of the sites—Peach Bottom, Rancho Seco, Surry, and Three Mile Island—commuters accounted for over 80 percent of the work force. At the Peach Bottom site, for example, 81.4 percent of the total on-site work force were daily commuters from outside the Study Area. In this case, two explanatory factors were identified for the high commutation rate. The Peach Bottom Study Area did not have housing available to accommodate the large number of workers who would have located in the Study Area, vacancy rates were

generally low, and the prevailing housing type--single-family structures--was not conducive for rentals or for family accommodations. In fact, many of the movers who were accommodated were housed after adjustments were made to the housing stock. Moreover, the high commuter rate was also the result of the relatively large number of communities outside the Study Area which could readily accommodate a large number of workers and which offered urban amenities not available in Peach Bottom Township.

The large number of commuters at Surry (90.5 percent of the total on-site work force) was the result of the location of nearby metropolitan centers--Newport News and Norfolk--with large labor pools within commuting distance of the Surry nuclear facility. Moreover, Surry County did not have the necessary supply of housing to accommodate a larger number of movers. In spite of the abnormally high vacancy rate in housing in the vicinity of the Three Mile Island plant (Olmstead Air Base was decommissioned at the time construction on TMI commenced), the work force was characterized by a commuter work force that constituted over 90 percent of the total plant-related work force. Here, too, the location of centers with large labor pools and within commuting distance of the nuclear station precluded the in-migration of workers to the Three Mile Island Study Area.

4.4.3 Employment and Income by Place of Work

The employment and income estimates for the 12 sites during the peak construction years are shown in Table 4-9. The average employment was 2,041, and ranged from 1,227 for Rancho Seco (a one-unit project) to 2,872 for Three Mile Island (a two-unit project).

The direct basic incomes were estimated in constant 1972 dollars and showed considerable variation due to the work force sizes and wage rates. The average total income for all sites was almost $35 million for the peak construction year. This figure produced an average annual wage of $16,960 for all 12 sites. For individual sites, the range was from $10,501 at Oconee to $25,482 at Diablo Canyon. The Oconee project was nonunionized and the wage rates in South Carolina were low compared to other areas of the country. The average income per worker at Oconee was only 62 percent of the average for the 12 sites. At Diablo Canyon, the work force was unionized and the wage rate was determined by the relatively higher pay scale of California. The Diablo Canyon wages were 150 percent of the 12-site average wage.

TABLE 4-9

EMPLOYMENT AND INCOME BY PLACE OF WORK[a]
(Peak Construction Year and 1978)

	Peak Construction Year									1978							
	Direct Basic		Indirect Basic		Other Basic		Effective Basic	Nonbasic		Direct Basic		Indirect Basic		Other Basic		Effective Basic	Nonbasic	
	Number	Income	Number	Income	Number	Income	Income	Number	Income	Number	Income	Number	Income	Number	Income	Income	Number	Incon
Arkansas	1,385	$21,045	5	$40	125	$1,200	$13,645	382	$2,155	1,025	$13,457	2	$16	130	$1,248	$9,423	264	$1,48
Calvert Cliffs	2,064	33,057	0	0	0	0	18,300	600	3,500	526	5,604	0	0	200	1,701	5,700	228	1,25
Cook	2,525	44,420	3	27	0	0	2,969	42	229	756	10,157	1	11	0	0	1,134	16	18
Crystal River	1,648	26,552	26	311	0	0	6,700	186	1,000	273	3,659	0	0	0	0	2,632	73	40
Diablo Canyon	2,116	53,920	0	0	0	0	38,112	1,425	7,965	1,317	36,077	0	0	0	0	25,888	968	5,41
Fitz Patrick/ Nine Mile Point	2,290	36,970	90	670	0	0	15,110	470	2,660	1,920	51,870	70	560	0	0	12,970	410	2,28
Oconee	2,342	24,593	0	0	0	0	5,905	132	732	747	7,787	0	0	217	1,451	5,327	119	66
Peach Bottom	2,230	39,200	0	0	0	0	5,900	20	106	414	5,464	0	0	0	0	800	3	4
Rancho Seco	1,227	27,154	1	7	0	0	2,777	51	307	597	9,087	0	0	0	0	759	13	8
St. Lucie	1,938	28,237	35	285	0	0	10,131	353	2,046	1,333	17,134	15	123	0	0	6,469	225	1,30
Surry	1,850	29,017	0	0	0	0	2,086	36	215	414	5,400	0	0	150	685	1,219	21	12
Three Mile Island	2,872	51,224	1	9	0	0	3,802	93	570	858	14,189	2	18	0	0	2,641	64	39

[a]All dollar figures are in thousands of constant 1972 dollars.

Source: NRC Post-Licensing Studies, Chapter 4, 1980/81.

Indirect basic employment and income resulted from purchases of goods and services needed to construct the stations. Generally, the more rural study areas and those without a developed industrial or commercial base simply could not supply any substantial amounts of equipment or supplies for the projects. Most of the necessary purchases were obtained outside the study areas and the effects of such purchases were small. Only three sites—Crystal River, FitzPatrick/Nine Mile Point, and St. Lucie—reported substantial indirect basic employment and income. The Florida sites (Crystal River and St. Lucie) purchased mixed cement off site. Further, St. Lucie had a relatively large city (Fort Pierce) near the site where substantial lumber and hardware needs could be met. FitzPatrick/Nine Mile Point was located in a highly industrialized area and recorded by far the largest indirect basic employment and income effects. It should be noted, however, that even at these three sites, indirect basic employment was less than 2 percent of direct basic employment; at the other sites it was zero or practically zero. Most of the sites required special equipment or such large quantities of supplies that it was economically more feasible to establish special sources of supply, transportation arrangements, and production facilities. For example, most sites built batch plants in order to meet their cement needs. Also, in most cases, the utilities and their contractors had purchasing offices that were headquartered outside the study areas with established supply networks.

Income and employment effects, due either to labor market effects or to the fiscal consequences of the station, were referred to as "other" basic income and employment. Examinations of conditions at each site revealed that only the fiscal component of "other" basic income and employment was of significance. It occurred at one site during construction and at four sites during the operation period.

The nonbasic employment and income effects were estimated for each study area based upon the residential location and spending patterns of the basic workers. The proportion of total income available for local spending by each type of basic worker (nonmovers, movers accompanied by families, movers unaccompanied by families, and commuters) was estimated and used to estimate "effective basic income." Effective basic income is defined more precisely as income after it has been adjusted to be commensurate with income received by existing residents of the study area. For example, if existing residents receive $10,000 income and spend $4,000 locally and transient construction workers receive $10,000 income but only spend $2,000 locally, then the income of the transient workers must be reduced by 50 percent ($2,000/$4,000)

in order to make it commensurate with income received by local (nonmover) workers. Once this adjustment has been made, multipliers appropriate to the local economy can be used to estimate nonbasic employment and income effects. The proportion of salary and wages spent by each type of worker in the study area was based upon estimates by key informants, including former construction workers. The average effective basic income for all 12 sites was over $10 million at peak construction. The range was from slightly less than $2.1 million for Surry to over $38.1 million for Diablo Canyon. Four of the stations generated between $10 million and $20 million in effective basic income while the remaining seven stations generated between $2.1 million and $6.7 million.

The nonbasic employment and income estimates for each study area were based on the Regional Industrial Multiplier System (RIMS) developed for the Regional Economic Analysis Division of the United States Department of Commerce, Bureau of Economic Analysis. The RIMS analysis of county-size economies accounted for the ability of small economies to provide goods and services and therefore produced specific multipliers for each study area. The ability of counties to capture local effective basic income varies depending upon each county's economic structure. For example, although the effective basic income for Oconee and Peach Bottom was almost identical ($5.9 million), there was a substantial difference in the nonbasic effects due to the very small size and limited commerical infrastructure of the Peach Bottom Study Area.

The average for all 12 sites was 332 nonbasic workers and $1.9 million in nonbasic income. These figures would be somewhat lower if the case of Diablo Canyon were deleted since it recorded more than twice as many workers and well over twice as much nonbasic income as did the second-place study area. At the bottom of the range are Peach Bottom, with 20 nonbasic workers and $106,000 in nonbasic income; Surry, with 36 nonbasic workers and $215,000 in nonbasic income; and Cook, with 42 nonbasic workers and $229,000 in nonbasic income.

The conclusions are interesting. For the 12 study areas investigated, effective basic income averaged 0.301 of direct basic income. This means that for every dollar paid out in direct basic income during the construction period, it had the effect on the average of $0.301 being paid to a resident of the study area. If local residents typically spent only 50 percent of their income in the study area economy, then the first-round stimulus to the study area's economy of one dollar of direct basic income would only be $0.15. Because of this dissipation of impact, it turns out that the average estimate of

nonbasic employment response is only 0.16 nonbasic jobs per 1.0 direct basic job at the construction peak.

Employment and income for the 12 sites during the operations year of 1978 were shown earlier (see Table 4-9). In several cases, the stations experienced large-scale construction or retrofitting during the operations period. This was true for Arkansas, Cook, Diablo Canyon, FitzPatrick/Nine Mile Point, St. Lucie, Surry, and Three Mile Island. The average direct basic employment for all 12 sites in 1978 was 853; average direct basic income was $15 million. The direct basic employment ranged from 273 at Crystal River to 1,920 at FitzPatrick/Nine Mile Point. The plants with continuing construction or retrofitting recorded higher direct basic income. Employment and income at both Diablo Canyon and FitzPatrick/Nine Mile Point were high due to the large numbers of nonoperations (construction and retrofitting) workers on site.

There was less indirect basic employment and income for the operations period than was the case for the construction period. All of the indirect basic employment and income for 1978 was recorded for stations with continuing construction or retrofitting work.

Four stations--Arkansas, Calvert Cliffs, Oconee, and Surry--recorded measurable "other" basic employment and income. This was due to substantially increased tax payments made by the utilities. The range of employment and income effects was from 130 workers and $1.2 million at Arkansas, to 217 workers and $1.5 million at Oconee. Calvert Cliffs, with fewer workers (200 "other" basic), recorded a greater income figure for the category due to the higher wage scale in Maryland as compared to South Carolina.

The effective basic income for 1978 was calculated for each study area based upon the residential location of the three categories of basic workers. The average effective basic income for all 12 sites in 1978 was almost $6.9 million. The Oconee, Peach Bottom, Cook, and Surry stations recorded the smallest amounts of effective basic income, each in the vicinity of $1 million. This was due to the small numbers of basic workers who lived in the study areas. Diablo Canyon, due to the high wage rate, the large proportion of workers living in the Study Area, and the large number of workers on site in 1978, recorded the highest effective basic income.

The average nonbasic employment for all 12 sites in 1978 was 200 workers; average nonbasic income was in excess of $1.1 million. As would be expected from the amounts of effective basic income recorded for each station, the RIMS multipliers estimated that the Study Area for the Diablo Canyon station received the greatest nonbasic employment and income effects in 1978. The fewest number was estimated for Peach Bottom and an additional 5 sites recorded fewer than 100 nonbasic employees and less than half a million dollars per year in nonbasic income. These figures were the result of the modest effective basic income available in the study areas and the small multipliers, which reflected the limited goods and services available in the economies of the study areas.

Because of the increased tendency of direct basic workers to reside near the station during the operations period relative to the construction period, the ratio of effective basic to direct basic income averaged 0.42 for the 12 sites in 1978 compared to 0.30 during the peak construction year. Similarly, the average for the 12 sites was 0.23 nonbasic jobs per 1.0 direct basic jobs during the operations period compared to 0.16 at the construction peak. These figures still suggest very modest effects relative to much of the impact literature, but they are significantly larger than during the construction period.

4.4.4 Total Employment by Place of Residence

Project-related employment of study area residents for each of the 12 stations is shown in Table 4-10. These totals include all the basic as well as nonbasic workers. The average study area employment by place of residence for all 12 sites at peak construction was 910 workers. The peak construction work force residing in the study area ranged from a low of 158 at Cook to a high of 1,595 at Calvert Cliffs. The major factors that determined the project-related employment effects were the number of nonmovers hired, the attractiveness of the study area as a place for movers accompanied by families, and the availability of housing for movers unaccompanied by families (or singles).

The representative operations year (1978) presents a complex picture of employment by study area residents. Several factors should be kept in mind in looking at the data. First, at a number of sites, operations and construction or retrofitting work were underway simultaneously. Second, four study areas—Arkansas, Calvert Cliffs, Oconee, and Surry—had substantial "other" basic employment due to large local tax

TABLE 4-10

EMPLOYMENT BY PLACE OF RESIDENCE — STUDY AREAS
(Peak Construction Year and 1978)

	Peak Construction Year	1978
Arkansas	1,425	1,100
Calvert Cliffs	1,595	707
Cook	158	89
Crystal River	625	267
Diablo Canyon	3,153	2,041
FitzPatrick/ Nine Mile Point	996	843
Oconee	716	687
Peach Bottom	435	51
Rancho Seco	169	57
St. Lucie	1,099	766
Surry	207	181
Three Mile Island	338	234
Average	910	586

Source: NRC Post Licensing Studies, Chapter 4, 1980/81.

revenues. These jobs were often filled by nonmovers. Third, study areas with more complex economies captured relatively larger shares of nonbasic employment and income that also tended to go to nonmovers. Fourth, few of the study areas could provide the required number of highly skilled operations and administrative personnel. These workers tended to make up a large proportion of the movers accompanied by families. The study areas were generally able to provide an ample number of unskilled and semi-skilled workers, and the proportion of such jobs has tended to rise with the noticeable increases in security personnel requirements.

The average employment in 1978 was 586 workers, about 64 percent of the number recorded for peak construction. The operations period employment ranged from 51 Study Area residents for the Peach Bottom project to 2,041 for Diablo Canyon. (Diablo Canyon was undergoing a major seismic retrofitting construction effort and was not actually in operation.)

4.4.5 Variation in Employment and Income Effects

4.4.5.1 Proximate Determinants of Variability in Employment and Income Effects

Direct basic employment and income

Some of the variability in the economic consequences of the twelve nuclear generating stations was due simply to differences in the scale of the projects. Differences in the number of units, in their design, and in retrofitting and repair activities affected direct basic activity both at the construction peak and in 1978. At the construction peak, direct basic income ranged from $21 million to $54 million with a mean of $35 million. In 1978, the variability was greater--direct basic income ranged from a low of $4 million to a high of $52 million with a mean of $15 million.

Ratio of effective basic income to total basic income

An even greater source of variability in the economic effects of the nuclear stations on the study area was due to variation in the ratio of effective basic income to total basic income. At the construction peak, it ranged from a low of 7 percent to a high of 71 percent with a mean of 30 percent. In 1978, the range was from 9 percent to 78 percent with a mean of 40 percent. The significance of this source of variation can not be understated. It implies that one dollar of direct basic income at one site may have an effective impact on the local economy that is as much as seven times that of another site.

Size of the nonbasic to effective basic income multiplier

The third major source of variability in the economic effects of the twelve nuclear stations was due to variation in the nonbasic to effective basic income multiplier. The multiplier ranges from a low of 0.02 to a high of 0.21 during the construction period with a mean of 0.16. In general, this was an important source of differential impact, but since most of the sites had values ranging from 0.10 to 0.20, it was not as important as were the two previously discussed factors—direct basic income and the ratio of effective basic income to total basic income.

Work force residence

The final variable that figures importantly in determining economic impact is the source of the work force—whether they are movers, nonmovers, or commuters. These three variables combine to determine total employment on a place of work basis. The final step is to determine employment on a place of residence basis. The source of variation here is the extent to which jobs are assumed by commuters who live outside the study area. During peak construction at one of the sites, 89 percent of the workers were residing in the study area; at another site only 6 percent of the workers were residing in the study area. Across sites, the mean at the construction peak was 37 percent. In 1978, the highest and lowest ratios were 89 percent and 9 percent, respectively, and the average was 46 percent.

Summary of Economic Impacts

Table 4-11 shows the four sources of variability in the economic impact of the twelve nuclear stations. These variables are appropriately thought of as the proximate determinants of variation in economic impact. The variables responsible for variation in these proximate determinants will be considered in the next section. It is important to note here, however, the relative importance of these variables in determining economic impact. The ratio of effective basic to total basic income, and the ratio of total employment by place of residence to total employment by place of work are the dominant variables in determining economic impact in the study area during the construction period. This conclusion is supported by noting that the effective basic to total income ratio, and the ratio of employment on a place of residence basis to employment on a place of work basis are almost identical. The ranking of these two variables must then be compared to the ranking of the twelve sites in terms of total employment by place of residence. The ranking in terms of economic impact on the study area (total employment) is nearly identical to the ranking of the sites by their

TABLE 4-11

PROXIMATE DETERMINANTS OF VARIABILITY IN THE ECONOMIC EFFECTS AT THE TWELVE CASE STUDY SITES

	Construction Peak										1978									
	Direct Basic Income		Effective Basic to Total Basic Income		Nonbasic to Effective Basic Income		Employment Place of Residence to Place of Work		Total Employment by Place of Residence		Direct Basic Income		Effective Basic to Total Basic Income		Nonbasic to Effective Basic Income		Employment Place of Residence to Place of Work		Total Employment by Place of Residence	
	Millions of Dollars	Rank	Percent	Rank	Percent	Rank	Percent	Rank	Persons	Rank	Millions of Dollars	Rank	Percent	Rank	Percent	Rank	Percent	Rank	Persons	Rank
Arkansas	21.0	12	61.2	2	16.2	5	75.1	2	1,425	3	13.5	5	64.0	4	15.9	6	77.4	2	1,100	2
Calvert Cliffs	33.1	6	55.3	3	19.1	3	73.2	3	1,595	2	5.6	9	78.0	1	21.9	1	69.7	4	707	5
Cook	44.4	3	6.8	12	7.7	11	6.1	12	158	12	10.2	6	10.8	11	16.5	5	31.5	11	89	10
Crystal River	26.6	10	24.9	6	14.9	7	33.6	6	625	7	3.7	12	70.3	3	15.3	7	77.2	3	267	7
Diablo Canyon	53.9	1	70.7	1	20.9	1	89.0	1	3,153	1	36.1	2	71.7	2	20.9	2	89.3	1	2,041	1
FitzPatrick/ Nine Mile Point	37.0	5	40.1	4	17.6	4	34.9	5	996	5	51.9	1	24.7	7	17.6	4	35.1	7	843	3
Oconee	24.6	11	24.0	7	12.4	8	28.9	7	716	6	7.8	8	57.7	5	12.4	9	61.4	5	687	6
Peach Bottom	39.2	4	15.1	8	1.8	12	19.3	8	435	8	5.5	10	14.6	10	5.4	12	12.2	10	51	12
Rancho Seco	27.2	9	10.2	9	11.1	9	13.2	9	169	11	9.1	7	8.8	12	11.1	10	9.3	12	57	11
St. Lucie	28.2	8	35.5	5	20.2	2	47.2	4	1,099	4	17.1	3	37.5	6	20.2	3	48.7	6	766	4
Surry	29.0	7	7.2	11	10.0	10	11.0	11	207	10	5.4	11	20.0	8	10.3	11	30.9	8	181	9
Three Mile Island	51.2	2	7.4	10	15.0	6	11.4	10	338	9	14.2	4	18.3	9	15.0	8	25.3	9	234	8
Mean	34.6		29.9		16.0		36.9		910		15.0		39.7		16.6		45.8		586	

Source: NRC Post-Licensing Studies, Chapter 4, 1980/81.

ratios of effective basic to total basic income. It is evident that this more than compensates for variation among the sites in terms of direct basic income. The Arkansas site, for example, ranked 12th with the smallest direct basic income ($21 million) of all the sites, yet ended up with the 3rd largest employment effect because of its high effective basic to total basic income ratio. Three Mile Island and Cook, on the other hand, had the 2nd and 3rd largest direct basic income but ended up with very small total employment by place of residence effects because of very low effective basic to total basic income ratios. Three Mile Island ranked 9th with a total employment effect of 338, and Cook ranked 12th with a study area employment effect of only 158.

The nonbasic to effective basic income ratios are highly correlated with the effective basic to total income ratios although they are less variable across the 12 sites than are the effective basic to total basic ratios. As such, they tend to reinforce the influence of the effective basic ratios in determining ultimate economic impact and to diminish the relative importance of the direct basic income injection associated with the station.

Similar conclusions are evident with respect to 1978 (see Table 4-11), but they need to be qualified. First, in 1978, there is much greater variability in terms of direct basic income across the 12 sites than was the case at peak construction. As a result, there are a couple of cases (Calvert Cliffs and Crystal River) where the direct basic income input is so low ($5.6 and $3.7 million, respectively) that the total employment effects (707 and 267, respectively) are less than their high effective basic to total basic income ratios would cause one to expect. FitzPatrick/Nine Mile Point is a similar exception working in the other direction. Despite an effective basic to total basic income ratio of 0.25 (ranked 7), its very large direct basic income input of $52 million resulted in a substantial employment impact of 843 persons which was the third largest among the 12 sites.

In sum, therefore, the major building blocks that translate a change in direct basic income into study area changes in income and employment have been presented (see Table 4-11). In general, the reinforcing variation of the effective basic to total basic income ratio, the nonbasic to effective basic income ratio, and the employment by place of residence to employment by place of work ratio, tended to dominate variation in direct basic income for the two points in time at which the 12 stations were studied in detail. As demonstrated by the evidence from 1978, however, it must be recognized that

these variables interact definitionally to determine local employment and income effects. Sufficiently large basic income inputs can, therefore, generate important local employment effects in spite of low values for the two key ratios and vice-versa. Thus, it is important to understand the underlying determinants of variability in these proximate determinants of economic impact.

4.4.5.2 Underlying causal factors determining variability in economic effects

Project-specific determinants

The principal input variable in generating local economic effects is the direct basic income and employment (place of work basis) associated with a project. Variability in direct basic employment and income occurred historically across the twelve case study sites and is obviously a project-specific variable that must be carefully anticipated if the local economic effects of building and operating a nuclear generating station are to be correctly foreseen. As summarized briefly in Section 4.2 of this report, there is more variability in these direct effects than might be expected. Related research by Denver Research Institute (Gilmore, 1981), which relies heavily on data from coal-fired generating stations, indicates that direct employment has historically been subject to significant forecasting errors. Thus, direct basic employment and income are both variable across sites and subject to revision as construction proceeds.

The only other major, project-specific determinant of variability in economic effects is company policies or initiatives that would influence the labor markets from which workers are hired or the residential patterns they assume once they are hired. A discussion follows of the significance of such policies in influencing the variables during construction and operation (see Table 4-11). It is sufficient to note here that across the twelve case study sites, company policies in these areas were not conspicuous as determinants of work force origin or residential patterns.

Site-specific determinants

The ratio of effective basic income to total basic income depends principally on:

1. The composition of the work force--movers, nonmovers, and commuters;
2. The family status of the movers; and
3. The availabilty of goods and services within the study area.

The ratio of nonbasic to effective basic income depends on:

4. The availability of goods and services within the study area.

The total employment response on a place of residence basis given total employment on a place of work basis depends on:

5. The number of commuters into the study area.

One of the first things to notice is that causal factor 4 is the same as 3, and that 5 is a subset of 1. This is the major reason for the high correlation of these variables (see Table 4-11). The composition of the work force between movers, nonmovers, and commuters can be thought of as being determined by three factors. First, it will be affected by the ability of the study area to supply nonmovers. This will depend on the number of workers residing in the study area, on their skills, and on the attractiveness of the jobs at the nuclear station relative to other local employment. Second, the composition of the work force will be affected by the availability of labor within daily commuting distance of the site. Finally, the number of movers who relocate into the study area will be influenced by housing availability, housing cost, and community amenities within the study area.

It is important to note that the composition of the work force is going to be influenced heavily by the definition of the study area. A large study area will tend to increase the number of movers and nonmovers and decrease the number of commuters, while a small study area would increase the number of commuters. A large part of the variation among the study areas (see Table 4-11), therefore, is due simply to the fact that the study areas vary both in population and in geographic size across the twelve sites. Standardization of the study areas with respect to either of these criteria would, however, have compromised other objectives of the study and created unsolvable data collection problems. It remains, nevertheless, that work force composition is a critical determinant of economic impact and that it is largely a function of site-specific factors pertaining to the size and location of labor markets relative to the site. The recent work by Malhotra (1981) on nuclear power stations directly addresses the question of the differential effect of various site-specific factors.

A related determinant of the ratio of effective basic income to total basic income is the family status of the movers. In particular, the extent to which married workers are accompanied by their families will cause the ratio of effective basic income to total basic income to be higher. Unfortunately, there was no way to reconstruct data for this variable in the absence of a survey of the construction work force and so its determinants cannot be examined based on the work carried out in this study.

The final site-specific source of variation in determining economic impact influences both the ratio of effective basic income to total income and the nonbasic employment multiplier. The availability of goods and services within the study area is the principal determinant of the nonbasic income to effective basic income ratio. Larger, more complex economies are able to supply more of the goods and services demanded by consumers with the result that the nonbasic income response to an increase in effective basic income will be larger. There was considerable variation in the size of the nonbasic income multiplier across the twelve sites (see Table 4-11).

The effect on the effective basic income to total basic income ratio of the local availability of goods and services is less intuitive. It must be remembered that the adjustment required to convert basic income to effective basic income has the result of making all income commensurate in terms of its effect on the local economy. In short, if the local residents spend very little locally, then a lesser adjustment is required for a transient construction worker who also spends little locally. On the other hand, if many goods and services are available locally, there will be a more significant difference between the local spending habits of residents and those of transient construction workers. This will necessitate a larger adjustment in order to convert total basic into effective basic income.

Other determinants

The economic effects of each of the twelve nuclear stations on its study area depended exclusively on project- and site-specific factors. The principal determinants were those site-specific factors influencing the composition of the work force, and the size of the nonbasic employment response in the local economy.

4.5 Demographic Effects

4.5.1 Population Change

The project-related demographic effects for each of the 12 sites are shown in Table 4-12. Two major categories of population change were analyzed in the case

TABLE 4-12

DEMOGRAPHIC EFFECTS IN STUDY AREAS
(Peak Construction Year and 1978)

	Peak Construction Year					1978				
	In-Migration	Reduced Out-Migration	Total Population Change	SA Population	Population Change % of SA	In-Migration	Reduced Out-Migration	Total Population Change	SA Population	Population Change % of SA
Arkansas	1,913	366	2,279	34,800	6.5	1,453	277	1,730	35,300	4.9
Calvert Cliffs	1,788	1,032	2,820	20,682	13.6	867	369	1,236	30,000	4.1
Cook	175	0	175	3,786	4.6	102	0	102	4,200	2.4
Crystal River	860	0	860	30,253	2.8	431	0	431	40,148	1.1
Diablo Canyon	3,308	0	3,308	132,529	2.5	2,212	0	2,212	144,744	1.5
FitzPatrick/Nine Mile Point	710	1,500	2,210	24,909	8.9	710	1,500	2,210	24,909	8.9
Oconee	540	161	701	41,800	1.7	153	230	383	44,800	0.9
Peach Bottom	314	106	420	2,202	19.1	78	0	78	2,302	3.4
Rancho Seco	146	0	146	8,612	1.7	28	0	28	11,418	0.2
St. Lucie	885	0	885	67,034	1.3	682	0	682	77,477	0.9
Surry	102	54	156	5,882	2.7	118	49	167	5,800	2.9
Three Mile Island	310	0	310	14,225	2.2	208	0	208	16,335	1.3
AVERAGE	929	268	1,197	32,291	3.7	643	202	845	36,453	2.7

SA: Study Area.

Source: NRC Post Licensing Studies, 1980/81.

studies--in-migration and diminished out-migration. The basis for making these population estimates was the basic and nonbasic employment which attracted or retained workers and their households.

The average in-migration for all 12 study areas at peak construction was 929 persons; diminished out-migration was 268 persons. The total population effect of 1,197 persons was about 3.7 percent of the average population for all study areas.

Population increases ranged from a low of 146 at Rancho Seco to a high of 3,308 at Diablo Canyon. Due to the different sizes of the study area populations, however, the site with the smallest percentage of increase was St. Lucie (1.3 percent), while the site with the largest percentage of increase was Peach Bottom (19.1 percent).

For every case except FitzPatrick/Nine Mile Point, in-migration was much larger than diminished out-migration; for all 12 sites together in-migration was more than three times larger than diminished out-migration. The FitzPatrick/Nine Mile Point case was substantially different because the project retained a large construction work force that otherwise would have left the study area to obtain work. In-migration also was affected by a number of factors. For areas where daily commuting was possible for the direct basic workers there was modest in-migration. The location of the work force, ease of transportation, whether the project was union or nonunion, availability of housing, and the general attractiveness of the area were all cited by key informants as major factors in determining the amount of in-migration during peak construction.

The estimates of diminished out-migration were seen as effects of employment opportunities, based upon past out-migration patterns and the responses of key informants. Both basic and nonbasic jobs were included in making these estimates of population increases. It should be noted that in 6 cases, no diminished out-migration was recorded. For the 6 study areas where diminished out-migration was considered to have occurred, the proportion ranged from 16 percent of the total population increase at Arkansas to 64.9 percent at FitzPatrick/Nine Mile Point. The local study area residents were generally very supportive of employment opportunities which allowed them to remain in the areas where they had strong family and social ties. The prospect of diminished out-migration through more jobs was seen as an important effect by several elderly key informants who wanted their family groups, especially the younger workers, to be able to stay in the study areas. This was particularly salient at the Peach Bottom and Calvert Cliffs site.

The project-related population effects for the operating period included workers and their households for all categories of basic and nonbasic employment. The "other" basic employment was important for those cases where substantial tax revenues were used to increase local public services or improve public facilities.

For the most part, the operations period population effects were smaller than was the case for the construction period. The average population increase for the 12 sites in 1978 was 845 persons, only about 71 percent of the peak construction increase. The percent of in-migration was quite similar for both periods, 77.6 percent at peak construction and 76.1 percent for 1978. The average population increase made up a greater proportion of the average study area population at peak construction (3.7 percent) than it did in 1978 (2.3 percent). This was due to the smaller population effects in 1978 and the general population growth of the study areas which increased an average of almost 13 percent. It also should be kept in mind that in a number of cases there was continuing construction or retrofitting work performed in 1978. Therefore, the population effects for Arkansas, Cook, Diablo Canyon, FitzPatrick/Nine Mile Point, St. Lucie, and Three Mile Island were not entirely due to station operations.

The population increases ranged from 28 at Rancho Seco to 2,212 at Diablo Canyon where a major retrofitting project was underway. Rancho Seco recorded the smallest percentage (0.2 percent) of population increase due to the project, and FitzPatrick/Nine Mile Point the highest (8.9 percent). Only one site, FitzPatrick/Nine Mile Point, was higher than 5 percent; the rest of the study areas were less than 5 percent. Overall, the operations period recorded smaller ratios of population effects in the study areas than was the case for the construction period.

4.5.2 Variation in Demographic Effects

4.5.2.1 Proximate determinants of variability in demographic effects

Employment change (place of residence basis)

In no case was there evidence of population change due to any factor except employment change. That is, the stations appear not to have attracted or displaced population except insofar as they affected employment opportunities in the study area. This means that the total change in employed persons living in the study area as a result of the station is the principal determining variable of population change. The variation in this variable, employment change on a place of residence basis, was explained in the previous section on economic effects. Thus, the conclusion is that the principal

determinant of variability in demographic effects is variability in economic impact across the twelve sites.

Migration

Once the number of employed persons living in the study area due to the project has been determined, population change occurs to the extent that these persons and their dependents would not have resided in the area in the absence of the project. This can happen in the case of movers under the assumption that they would not have in-migrated in the absence of the project. It can also happen with nonmovers if it is assumed that they would have out-migrated in the absence of the nuclear station. This effect is typically only relevant in situations in which out-migration is already occurring in response to poor employment opportunities. In these cases, it is reasonable to assume that some fraction of the jobs undertaken because of the nuclear station will allow individuals to remain in the study area who otherwise would have out-migrated in search of employment.

Summary

Table 4-13 summarized the proximate determinants of variability in demographic effects. The table shows that population change ranks almost identically with employment change for both the peak construction year and 1978. Thus, employment change is the dominant determinant of study area demographic changes. The table shows that there is some variability in the population change to employment change ratio, but not enough to alter the ranking of the sites with respect to population change.

4.5.2.2 Underlying Causal Factors

Employment change on a place of residence basis depends on the set of causal factors discussed at length in the previous section. Variability in the population change to employment change ratio depends on the following:

1. The composition of the employed residents in terms of movers and nonmovers and their family status; and
2. The migration behavior of the movers and nonmovers in the absence of the project.

In general, movers will have in-migrated to the study area in order to assume work on the project. Nonmovers, on the other hand, will only be assumed to have out-migrated in the absence of the project if employment in the area is declining and there has been an

TABLE 4-13

PROXIMATE DETERMINANTS OF VARIABILITY IN DEMOGRAPHIC EFFECTS

	Peak Construction Year						1978					
	Employment Change (Residence Basis)		Population Change		Population to Employment Ratio		Employment Change (Residence Basis)		Population Change		Population to Employment Ratio	
	Number	Rank	Number	Rank	Ratio	Rank	Number	Rank	Number	Rank	Ratio	Rank
Arkansas	1,425	3	2,279	3	1.60	3	1,100	2	1,730	3	1.57	4
Calvert Cliffs	1,595	2	2,820	2	1.77	2	707	5	1,236	4	1.75	2
Cook	158	12	175	10	1.11	5	89	10	102	10	1.15	6
Crystal River	625	7	860	6	1.38	4	267	7	431	6	1.61	3
Diablo Canyon	3,153	1	3,308	1	1.05	6	2,041	1	2,212	1	1.08	7
FitzPatrick/ Nine Mile Point	996	5	2,210	4	2.22	1	843	3	2,210	2	2.62	1
Oconee	716	6	701	7	0.98	7	687	6	383	7	0.56	11
Peach Bottom	435	8	420	8	0.97	8	51	12	78	11	1.53	5
Rancho Seco	169	11	146	12	0.86	10	57	11	28	12	0.49	12
St. Lucie	1,099	4	885	5	0.81	11	766	4	682	5	0.89	9
Surry	207	10	156	11	0.75	12	181	9	167	9	0.92	8
Three Mile Island	338	9	310	9	0.92	9	234	8	208	8	0.89	10
Average	910		1,197		1.20		586		845		1.44	

Source: NRC Post-Licensing Studies, 1980/81.

historical trend of out-migration. Thus, variation in the mover/nonmover composition of the work force or in its migration behavior can cause different projects to have different ratios of population change to employment change. In general, the underlying causal determinants of demographic change are largely site-specific as opposed to being project-specific.

Project-specific

Except for the influence of project-specific variables on employment change, the only other source of influence of project-specific variables on demographic change would occur if company policy influenced the mover/nonmover composition of the work force. The case study research did not show this to be an important effect, however.

Site-specific

The importance of site-specific factors in determining employment change has already been discussed. Beyond those effects, site specific variables are the principal determinants of variability in the population change to employment change ratio. Site-specific factors, already discussed, will determine the mover/nonmover composition of the work force. The movers will generally all have in-migrated in order to assume employment associated with the station and so become a component of population change. The nonmovers, on the other hand, become a component of population change only if it can be assumed they would have out-migrated in the absence of the project.

A comparison of data (see Table 4-12 and Table 4-13) shows that the three sites with significant reduced out-migration are the three sites with the highest population change to employment change ratio. Since the presence of diminished out-migration is very much a function of local labor market conditions, the underlying causal factors behind the population change to employment change ratio are site-specific.

Other determinants

The demographic effects of each of the twelve nuclear stations on its study area depended exclusively on project- and site-specific factors. The dominant role is played by employment change, with the site-specific factors that affect the population change to employment change ratio playing a more limited role.

4.6. Effects of the Nuclear Stations on Housing and Settlement Patterns

4.6.1 Housing

The housing effects for the 12 study areas are summarized in Table 4-14. The average size of the housing stock for all 12 study areas in 1970 was about 9,772 with almost 80 percent of these made up of single-family dwellings. The number varied widely between study areas, ranging from a low of 667 units for Peach Bottom to a high of 37,546 units for Diablo Canyon. Between 1970 and 1978, there was a rapid increase (5.6 percent average annual rate) in housing for the combined study areas . These rates of increase ranged from 3.3 percent for Three Mile Island to 10.4 percent for Crystal River.

Housing demand estimates were derived directly from the estimate of the population change due to the project. Thus, the demand equaled the requirements of in-migrants plus the requirements associated with diminished out-migration. Housing required for local workers who would have remained in the community even without the project was not identified as an incremental demand due to the project.

The peak construction housing demand ranged from a low of 58 units for Surry to a high of 1,297 units for Diablo Canyon. When demand was expressed as a percent of the 1970 housing stock in the Study Area, the lowest figure was 1.2 percent for Oconee. The highest figure was 25.3 percent for Peach Bottom. The Peach Bottom demand was almost exclusively for rooms and converted units which were used by movers unaccompanied by families (or singles). These workers tended to be weekly commuters and once the construction project was completed many of these rooms were no longer used as rentals. Thus, few new units were constructed to meet the temporary construction period demand.

The next highest demands for housing units were recorded for Arkansas at 8.7 percent and Calvert Cliffs at 8.9 percent. The remaining study areas showed considerably lower demands with five areas at 3.5 percent or less. In some cases, adjustments for the housing demand increase was comparatively easy. For the Calvert Cliffs Study Area, summer recreation units were upgraded for year-round use and rented to movers. Many of the workers on the Diablo Canyon project obtained housing in small hotels and motels during the off-season.

TABLE 4-14

HOUSING EFFECTS IN STUDY AREAS

	Study Area Housing Stock, 1970						Peak Construction Year Housing Demand		Operations (1978) Housing Demand		
	Single-Family	Multi-Family	Mobile Homes	1970 TOTAL	1978 Housing Stock TOTAL	Average Annual Increase 1970-1978 (%)	#	% 1970	#	% 1970	% 1978
Arkansas	8,098	1,086	691	9,875	14,215	4.7	858	8.7	656	6.6	4.6
Calvert Cliffs	7,503[a]	—	403	7,906	11,545	4.8	705	8.9	379	4.8	3.2
Cook	1,247	159	17	1,423	1,892	3.6	81	5.7	35	2.5	1.8
Crystal River	7,833	511	1,363	9,707	21,378	10.4	315	3.2	170	1.8	0.8
Diablo Canyon	28,600	5,632	3,754	37,546	57,976	5.6	1,297	3.5	807	2.1	1.4
FitzPatrick/Nine Mile Point	5,795	2,255	197	8,247	9,000	N/A	570	6.9	510	6.2	N/A
Oconee	12,424	175[c]	1,433	14,032	20,226	4.7	167	1.2	128	0.9	0.6
Peach Bottom	641	—	26	667	901	3.8	169[d]	25.3	22	3.2	2.4
Rancho Seco	1,947	240	183	2,370	3,706	5.7	140	5.9	50	2.1	1.3
St. Lucie	13,653	4,118	1,100	18,871	32,070	6.9	369	2.0	290	1.5	0.9
Surry	1,919	—	122	2,041	2,785	4.0	58	2.8	61	3.0	2.2
Three Mile Island	3,622[b]	961	—	4,583	5,956	3.3	146	3.2	51	1.1	0.9
AVERAGE	7,774	1,261	774	9,772	15,138	5.6	414	8.2	263	2.7	1.7

[a]Includes a small number of multi-family units.

[b]Includes mobile homes

[c]Four units per structure or more.

[d]Mostly rental rooms or conversions for weekly commuters.

Source: NRC Post-Licensing Studies, Chapter 6, 1980/81.

The housing demand for the operations period (1978) was smaller on the average, both in terms of the number of units (263) and as a proportion of the average study area housing stock (1.7 percent). The range of housing demand for 1978 was from 22 units at Peach Bottom to 807 units at Diablo Canyon. Only two study areas—Arkansas at 6.6 percent and FitzPatrick/Nine Mile Point at 6.2 percent—showed a housing demand greater than 5 percent of the 1970 Census housing stock count; and nine study areas were under 3 percent. The housing demand for the operations year was smaller than at peak construction for every case except Surry.

The increase in percentage for the Surry Study Area (from 2.8 percent at peak construction to 3.0 percent in 1978) was due to the very small number of in-migrants during construction and the effects of "other" basic employment during the operations period. Many of the "other" basic employees hired by the county were movers accompanied by families; generally they were people who held professional or administrative jobs in public services—education, social services, and county administration.

The effects of housing demand on the rental market were much more noticeable for the construction period than for the operations year, according to key informants. There was some permanent addition to the rental housing stock, but much of the demand was either unmet (resulting in more commuting) or produced only temporary rental facilities. The expansion of rental rooms at Peach Bottom resulted in the conversion of some of these facilities to permanent units for elderly and low-income residents. Most rooms were returned to the status of private, single-family use, however. At Calvert Cliffs, some summer recreational housing was weatherized for year-round use. Most of these units reverted to seasonal and/or retirement use after the extremely high demand of the construction period passed. In Surry, some mobile home units that were brought in to house construction workers remained as rentals during the operations period. However, the majority of mobile home units which were brought into the county for or by construction workers were removed after the construction period. The demand for rental housing was much less during the operations period, since the on-site work force was largely made up of permanent employees who wanted to own their own homes, or refueling/maintenance people who were only at the site for short periods and did not produce a consistent, economically feasible housing demand.

4.6.2 Settlement Patterns and Land Use

The 12 sites included in the case studies varied in size from 427 acres, the total land area of Three Mile Island, to 4,738 acres for Crystal River. In the case of Oconee, the 2,000 acres included the actual plant site and the surrounding "exclusion" area. The overall Keowee-Toxaway project, which included the Oconee Nuclear Station, comprised about 157,000 acres.

The location of the sites was mostly rural, where relatively low population densities existed. Agriculture, including farming, forestry, and grazing, was the most common land use prior to construction of the power plants. Several sites were also used for recreational purposes, most often because the cooling requirements for the plant resulted in siting at waterfront locations. Only Rancho Seco, where a relatively small reservoir was built (165 acres), was not located on a large, existing water supply source. Lake Keowee, the water source for Oconee, was built to provide cooling for the Oconee Nuclear Station, in addition to serving as a hydroelectric site. The Keowee-Toxaway complex had provisions for future steam generation stations and was rated by the utility as capable of carrying about 7,000 Mw of development. The changes in land uses to electric power production did not appear to have affected, by themselves, the social or economic patterns of the study areas. While the sites often involved substantial acreages, they were neither large enough nor so strategically placed that the changed use would effect, for example, the study area agricultural production.

The requirements for transmission line rights-of-way varied depending upon the distance from the existing power grid distribution system and the location of the station in regard to the service area. For example, Calvert Cliffs was located outside the Baltimore Gas and Electric Company service area, so it was possible to connect to the utility distribution system with a single transmission line corridor. An additional line was under consideration during the study period to complete the tie-in of the Calvert Cliffs plant to the regional power grid. Oconee, on the other hand, was located in the Duke Power Company service area and utilized 5 transmission line rights-of-way to distribute the electric production of the nuclear station and the hydroelectric plants. Generally, the rights-of-way were constructed rapidly and resulted in little change to the social or economic structure of the study areas. There was public concern in several cases about the visual and aesthetic effects of the rights-of-way, but they were not considered a source of significant land use change, nor were they the subject of unusually forceful opposition.

Other possible land use changes which might have resulted from the increased population and income effects of the plants were considered. Generally, the size of these effects was not considered large enough to change land use trends. Rather, key informants tended to feel that the plant-related effects strengthened overall patterns of change and development. Housing purchased by workers, for example, tended to follow the trends for other people in the study areas who had similar incomes, household characteristics, and local social ties. In some cases, such as Calvert Cliffs, operating personnel tended to locate quite near the site. However, even in the most noticeable case, the number of housing units involved was not considered large enough to have had an effect on land use patterns. Table 4-15 outlines the land use patterns in the various study areas.

4.6.3 Variation in Housing Effects

4.6.3.1 Proximate Determinants of Variability in Housing and Settlement Patterns

The proximate determinant of variability in housing demand was variability in population change due to the project. Projects with significant numbers of employees residing in the study area had an impact on the demand for housing to the extent that the workers in-migrated because of the project or would have out-migrated in its absence. Projects with smaller numbers of employees residing in the study area had less significant effects on the local housing stock.

4.6.3.2 Underlying Causal Factors

The underlying causal factors responsible for variability in housing demand effects across sites have to be traced back to the project- and site-specific factors responsible for variation in economic and demographic effects across sites. These have been discussed at length in previous sections and will not be reiterated here. Thus, the explanation for variability of housing effects lies principally in variation in employment and population effects. Today it is common for company housing or transportation to influence ultimate housing effects, but this was not the case at the twelve case study sites.

4.7 Public Sector Effects

4.7.1. Revenues

The data available for the fiscal and public service areas varied widely from one case to the other. This was due to the varied size of the study areas, their alignment with various taxing and public service jurisdictions, the complexity of the service demands, the condition of the historial records, and the numerous changes that were

TABLE 4-15

LAND USE EFFECTS IN STUDY AREAS

	Size of Site (Acres)	Former Land Use for Site	Transmission Line Rights-of-Way		Water Source
			Number	Acres	
Arkansas	1,164	Marginal farming and grazing land	2	3,700	Lake Dardanelle, Arkansas River
Calvert Cliffs	1,135	Woodlands, agriculture	1[b]	—	Chesapeake Bay
Cook	650	Recreational waterfront (zoned industrial)	3	3,300	Lake Michigan
Crystal River	4,738	Agriculture and undeveloped	2	—	Gulf of Mexico, between Crystal and Withlacoochee River
Diablo Canyon	750	Agriculture, grazing (zoned commercial-recreational)	3	—	Pacific Ocean
FitzPatrick/Nine Mile Point	1,602	Agriculture	3	—	Lake Ontario
Oconee	2,000[a]	Agriculture, woodlands	5	7,800	Lake Keowee, Keowee River
Peach Bottom	620	Agriculture, recreation	1[c]	—	Conowingo Pond, Susquehanna River
Rancho Seco	2,480	Agriculture, grazing	3	—	Utility-built reservoir (165 acres)
St. Lucie	1,132	Recreational waterfront	3	760	Atlantic Ocean
Surry	840	Woodlands	2	—	James River
Three Mile Island	427	Agriculture, recreation	1	—	Susquehanna River

[a]Exclusion area for Oconee Nuclear Station. Total Duke Power Company land holdings for the entire Keowee-Toxaway project were about 157,000 acres.

[b]Second line planned but not yet constructed.

[c]Existing ROW were built for Peach Bottom Unit 1.

Source: NRC Post-Licensing Studies, Chapter 6, 1980/81.

made in funding public services during the study period. Changes in the type of political control in some areas produced new goals, objectives, and programs and also contributed to the complexity of obtaining data for cross-site comparisons. This section discusses the overall revenue and expenditure patterns for the study areas. Education, transportation, public safety, and social services are considered separately.

The available information on direct revenues paid on behalf of the power plants, and the proportion that these revenues constituted of study area budgets, are shown in Table 4-16. The liability of the power plants for local property taxes depended upon tax laws which varied from state to state. At Cook, the plant contributed over 95 percent of the assessed value and taxes for the study area. The Rancho Seco plant did not pay local property taxes because it was built and operated by a tax-exempt municipal utility district. The Pennsylvania plants paid taxes to the state which then distributed the revenue throughout the state. This resulted in only minor property tax increases for the study areas at Three Mile Island and Peach Bottom.

Arkansas and Diablo Canyon paid substantial taxes during the construction period, based upon the assessed value of improvements made each year. For 1970, Arkansas paid about $242 thousand in local taxes while Diablo paid over $1 million. For 5 sites (Calvert Cliffs, Crystal River, Oconee, St Lucie, and Surry) the significant tax payments were made when the plants went into operation. The amount of taxes paid in 1978 varied across sites, from $1.5 million for Surry to $11.3 million for Calvert Cliffs. Typically, the assessed value of the plant was determined by the state, often with input from the utility and the local jurisdictions. The tax rate was determined by the local jurisdiction according to the requirements of the state tax law.

The proportion of the study area budgets produced by the power stations varied according to the tax base of the study area. Thus, while the taxes paid to Surry County were the smallest for a county-level study area, they accounted for almost 35 percent of the Surry County budget in 1978. Diablo Canyon, which paid over $12.4 million in taxes to San Luis Obispo County taxing jurisdictions in 1977, accounted for about 20.9 percent of the local budgets. The larger tax base of San Luis Obispo County modified the percentage effect of the plant's tax payments even though they were about 8 times as high as the dollar amounts paid to Surry County. The payments made on behalf of the Arkansas and Calvert Cliffs plants resulted in the greatest proportional contribution to study area revenues, close to 50 percent in both cases.

TABLE 4-16

REVENUE EFFECTS IN STUDY AREAS
(1969-1978)

	Project Revenues										Project Revenues as a percent of Study Area Budget[a]									
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Arkansas	—	242	646	1,652	2,521	3,830	5,059	5,934	6,772	—	—	32.9	21.7	41.1	46.1	51.5	52.9	51.2	50.5	—
Calvert Cliffs	—	—	—	—	—	—	—	6,852	7,431	11,267	—	—	—	—	—	—	—	46.4	46.2	47.7
Cook[b]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Crystal River	—	—	—	—	—	1,158	1,200	1,194	2,833	3,019	—	—	—	—	—	4.4	4.5	3.3	6.5	7.1
Diablo Canyon	211	1,053	2,254	3,400	5,297	6,378	7,645	9,695	12,413	7,981	0.8	3.5	9.6	9.6	12.7	15.6	17.1	18.7	20.9	—
FitzPatrick/ Nine Mile Point	—	3,075	—	3,634	—	3,585	—	6,264	—	8,118	—	26.8	—	26.9	—	21.0	—	25.8	—	28.8
Oconee	—	—	—	—	200	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Peach Bottom	29	68	60	142	126	186	58	41	31	30	37.0	48.4	50.0	67.2	57.0	61.4	34.4	25.5	17.6	16.7
Rancho Seco[c]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. Lucie	45	40	40	48	67	106	103	104	3,810	4,148	0.4	0.3	0.3	0.4	0.4	0.4	0.3	0.3	10.4	10.1
Surry	46	198	410	561	841	1,130	976	1,151	1,022	1,486	5.7	17.7	37.1	42.4	49.0	34.2	22.4	27.9	24.3	34.9
Three Mile Island[d]	—	—	—	126	—	—	—	—	—	16	—	—	—	—	—	—	—	—	—	—

[a]The Study Area budget includes the revenues of those taxing jurisdictions to which the utility paid taxes for the [illegible] plant.

[b]Station was estimated to have produced more than 95 percent of the Study Area revenues for period following 19[illegible] Exact calculations were not possible because the Study Area was not the same as several overlapping public service jurisdictions.

[c]Rancho Seco did not pay local taxes; the utility is a tax-exempt municipal entity.

[d]Income to Study Area from 1 percent earned income tax estimated for 1972 and 1978; no data were available for annual payments.

Source: NRC Post-Licensing Studies, Chapter 7, 1980/81.

The following sections look selectively at four areas of public services--education, transportation, public safety and social services--to determine whether the quantity, quality, availability, or cost of services was affected by the construction and operation of the nuclear stations.

4.7.2 Education

The estimated enrollment resulting from project-related population increases are shown in Table 4-17. These figures are based upon national ratios of school age population per household for the period 1971-1974 when most of the study areas experienced peak construction effects, and for 1978, the year designated as the operations period for these case studies. These education demands were somewhat larger than estimates made by local key informants because indirect basic, "other" basic, and nonbasic populations were included. These effects were seldom recognized by local key informants as being project-related since the link between such employment and the project work was not easily identified.

School enrollment demand at peak construction ranged from a low of 7 pupils (less than 0.1 percent) for Surry to 973 pupils (13.2 percent) for Diablo Canyon. The average enrollment was 302 students or about 5.8 percent of study area enrollment.

The enrollment figures were substantially less for the operations period (1978) for all study areas except Surry. Enrollment demand ranged from a low of 14 at Peach Bottom to a high of 426 at Arkansas. (Diablo Canyon with 525 was not actually operating in 1978 but was still under construction with upgrading and retrofitting projects.) The average project-related enrollment was 165, just a little more than half the average for the construction period. The percentage of study area enrollment due to the projects ranged from a low of 0.5 percent at Three Mile Island to 6.3 percent at Arkansas. (Diablo Canyon was 7.4 percent.) The average for all 12 sites was 2.9 percent, just half the percentage figure for peak construction.

The increased expenditures per pupil (in current dollars) were all positive and ranged from 0.9 percent at Three Mile Island to 24.5 pecent at Surry. The average per pupil expenditure increased at an annual rate of 10.0 percent for the 10-year period. The revenues contributed by the plants to the study area school districts varied widely—three plants made no significant tax payments (Peach Bottom, Rancho Seco, Three Mile Island) while the Cook plant paid over 90 percent of the school revenues in 1978. By 1978, the

TABLE 4-17

EDUCATION EFFECTS IN STUDY AREAS

	Peak Construction Year		Operations (1978)		Expenditures/ Pupil	Plant Generated School Revenue	
	Number	Percent of Enrollment	Number	Percent of Enrollment	1969-1978 Average Rate of Change[a]	Year Began	1978 Percent of Total
Arkansas	644	9.9	426	6.3	12.6	1969	65.7
Calvert Cliffs	529	8.4	246	3.2	12.4	1975	51.6
Cook	61	7.7	23	2.6	19.5	1969	90.8
Crystal River	236	3.8	111	1.5	1.3	1974	25.1
Diablo Canyon	973	13.2	525	7.4	8.2	1967	21.9
FitzPatrick/ Nine Mile Point	428	7.6	332	6.6	8.1	1964	27.4
Oconee	125	1.2	83	0.8	10.0	1973	19.1
Peach Bottom	127	6.6	14	0.7	3.1	No significant revenues	
Rancho Seco	105	7.2	33	2.2	N/A	No significant revenues	
St. Lucie	277	2.3	109	0.8	9.7	1970	18.8
Surry	7	0.1	40	2.7	24.5	1967	34.9
Three Mile Island	110	1.5	33	0.5	0.9	No significant revenues	
AVERAGE	302	5.8	165	2.9	10.0		29.6

[a]Dollars per pupil (current dollars).

N/A: Not available.

Source: NRC Post-Licensing Studies, Chapter 7.

tax-paying sites were contributing an average of almost 40 percent of the school district revenues. At the same time, project-related enrollment demand was 2.9 percent.

It appears likely that those school districts that received large increases in revenue elected to allocate some of it to increasing per capita expenditures. The 4 study areas in which plant generated revenues as a percent of total school revenues were the largest (Arkansas, Calvert Cliffs, Cook, and Surry) also had the most rapid increase in expenditures per pupil over the period 1969-1978 (see Table 4-17). At the same time, the 3 study areas with the smallest ratios of plant generated revenues to total school revenues (Peach Bottom, Rancho Seco, and Three Mile Island) had the smallest increases in expenditures per pupil.

In 5 of the case studies, overcrowding in the local school systems was evident. In these cases, however, the in-migration of workers and school-aged children was only a small proportion of the excess students. With one exception (Crystal River), the overcrowding problem was resolved. In general, although construction-related increases in school enrollment further strained educational systems, they were not the major cause of problems. In Crystal River, where school overcrowding persisted as an issue, the quality of education, according to key informants, was not impaired.

4.7.3 Transportation

The most important means of transportation for the 12 case study sites were the highway systems. Three sites utilized rail connections to their station locations, and another four sites had dock facilities. There was some commuting by boat to Three Mile Island, but most water access to the sites was used for shipping supplies and equipment, especially bulk items (e.g., sand and gravel) to the site.

The size of the work force needed to construct the 12 stations, the requirements of equipment, materials, and supplies, and the long-term duration of the construction effort, all greatly increased the use of the study area highway systems. Despite these abrupt increases in highway use, the road systems were able to accommodate the heavy use with minimal change as shown in Table 4-18. The construction of access roads to the sites was generally necessary and was undertaken either by the utility itself or through special arrangements with local and state officials. In the case of Rancho Seco, about 7.5 miles of roads were rebuilt and upgraded due to increased traffic during construction of the plant. This was funded by rearranging the local road construction priorities so

TABLE 4-18

TRANSPORTATION EFFECTS IN STUDY AREAS

	Transportation at Site			Highway Use Effects at Peak Demand						
	Rail	Water	Road	New Roads	Additional Maintenance	Highway Congestion	Safety	Public Issues	Highway Use Effects for Operations (1978)	Revenue Effects on Study Area Transportation
Arkansas	X	X	X	Access Road	Some	No	No	No	Use accommodated by existing capacity.	Significant expenditures of revenues on roads—blacktopped 75% of all county roads. Doubled highway maintenance personnel.
Calvert Cliffs	-	X	X	Access road built by utility.	None identified as direct project effect.	Yes, extreme at shift change.	Yes, many accidents involved workers.	Congestion, road access, safety.	Highway still considered overused.	Revenues were used for upgrading roads, providing lighting, adding new roads.
Cook	-	-	X	None.	Little maintenance reported.	Yes, traffic signals installed.	None reported.	Moderate concern.	Operations use is accommodated by current capacity.	Only small amounts of revenues went to roads due to limited response by road commission.
Crystal River	X	-	X	None.	No additional maintenance reported.	--	--	--	--	No major expenditure of revenues reported due to plant-related traffic or taxes.
Diablo Canyon	-	-	X	Upgrading needed due to traffic.	Yes, due to heavy loads to site.	Yes, roads improved.	None reported.	Congestion and access.	Construction effects continued.	Utility funded some road work, but no additional work was attributed to plant revenues.

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TABLE 4-18 (Continued)

TRANSPORTATION EFFECTS IN STUDY AREAS

	Transportation at Site			Highway Use Effects at Peak Demand						
	Rail	Water	Road	New Roads	Additional Maintenance	Highway Congestion	Safety	Public Issues	Highway Use Effects for Operations (1978)	Revenue Effects on Study Area Transportation
FitzPatrick/Nine Mile Point	-	-	X	Improved existing roads.	Yes, especially for winter use.	Yes.	None reported.	Road wear, congestion.	Continued heavy use due to continuing construction.	Increased revenues produced significant increases in transportation expenditures.
Oconee[a]	-	-	X	No.	None identified.	Yes.	None reported.	No issues for plant construction.	No adverse effects, new road system is considered good.	Extensive road improvement due to Keowee-Toxaway project and contribution to Northern County Scenic Highway (SC-11).
Peach Bottom	-	-	X	Increased funding for improvements.	Additional maintenance was funded.	Yes.	None reported.	Congestion was identified as No. 1 negative impact.	Roads adequate for operations period.	Earned income tax revenues were used mostly to improve roads.
Rancho Seco	-	-	X	Rebuilt 7.5 miles.	No.	Yes.	Slight increase in accidents.	Workers asked for improved roads (local congestion, etc.)	Roads considered adequate for current plant use.	No taxes paid by SMUD.
St. Lucie	-	-	X	None.	No increase reported.	Yes.	Some increase in accidents with volume.	Congestion, traffic control, speeding, etc.	Current capacity considered adequate.	None reported.

(Continued on Next Page)

TABLE 4-18 (Continued)

TRANSPORTATION EFFECTS IN STUDY AREAS

	Transportation at Site			Highway Use Effects at Peak Demand						
	Rail	Water	Road	New Roads	Additional Maintenance	Highway Congestion	Safety	Public Issues	Highway Use Effects for Operations (1978)	Revenue Effects on Study Area Transportation
Surry	-	X	X	New access road built: $600,000.	None reported.	Yes, most severe to neighboring county.	Slight increase in accidents and tickets.	Speeding, congestion at shift changes.	Roads are adequate for operations period use.	Roads do not require local tax expenditures.
Three Mile Island	X	X	X	No.	No.	Yes, near the site, but less than had been the case with local air force base.	No.	No.	Heavy use near site at shift change. Use was integrated into traffic patterns.	No revenue effects on roads.

[a]Oconee. Extensive road relocation, including 21.5 miles of highway and several bridges, was undertaken for the Keowee-Toxaway Lake projects.

Source: NRC Post-Licensing Case Studies, Chapter 7.

that the work was done much earlier than it would have been without the project-related traffic. In the case of Oconee, the extensive road reconstruction and relocation program (21.5 miles of new roads and bridges) that was undertaken as part of the formation of Lake Keowee also incorporated access to the plant site. Overall, however, there was little additional highway construction directly related to the construction and operation of the 12 stations.

Increased road maintenance in some degree was reported for 5 of the study areas, but no additional effort was estimated by key informants for the other 7 study areas. Diablo Canyon reported that there were effects due to heavy loads and FitzPatrick/Nine Mile Point recorded additional costs to maintain the roads for winter use.

In almost every case, local residents and officials reported that worker traffic to the site often resulted in extreme traffic congestion at the point where site access roads joined the local highway system. In several cases, traffic signals or traffic control personnel were required. There were some reported increases in accidents, but these cases did not appear to be greater than would be expected with the increased volume of traffic. In several cases, workers complained that local police wrote large numbers of tickets for construction workers. However, the police generally said that they had not made any special effort to single out construction workers and that they had only responded to the obvious traffic patterns. In many cases, congestion caused by worker traffic was considered a public issue and was one of the most commonly noticed effects in the local communities; however, it was often judged to be more of a nuisance than a serious problem.

The plant sites that had achieved a regular operations schedule by 1978 also had integrated their transportation requirements with the local highway system. Generally, the employment levels needed to operate the plants did not overtax the highways and the demand was only noticeable at shift changes. Even then it was only during such times as refueling and maintenance outages that congestion tended to be considered a major problem. FitzPatrick/Nine Mile Point and Diablo Canyon were still experiencing construction period effects. The main highway in Calvert County was only partly upgraded by 1978, and the remainder of the highway, including the section which joined the site access road, was inadequate and congested. This condition would have been the case with or without the traffic generated by the project, which had only added to an already overloaded section of highway.

Several study areas that realized large additional tax revenues from the station sitings spent considerable monies on upgrading local roads. This was true for Arkansas, Calvert Cliffs, FitzPatrick/Nine Mile Point, and Peach Bottom. The extensive work done by the utility in Oconee County was followed by the construction of a major new highway, South Carolina Route 11 (SC-11), which was funded primarily by state and federal funds but also included work financed by the Duke Power Company. In Surry, the county did not provide local funds for highways; such work was a state function. For those areas where work was done, it was generally completed for roads other than those directly linked to the station sites. This was because the access roads were directly connected to the nearest major highways where maintenance and upgrading were state rather than local responsibilities. Therefore, in the case of Calvert Cliffs, the county spent a considerable amount of money on local roads, but the state highway that provided the only major route to the site remained inadequate because state funding had not been adequate to complete the upgrading of the road.

4.7.4 Public Safety

Public safety was categorized in three areas of service: police, fire, and emergency preparedness as shown in Table 4-19. The utility companies that operated the stations provided extensive security, fire protection, and emergency services to the sites. At most, local public safety services were prepared to provide backup support for on-site occurrences.

The construction and operation of the stations also required some public safety capabilities in the study areas where the stations were located. Local police and fire services were responsive to the needs of plant-related workers and their households since they were either residents of the local communities or were travelers to the site who had to pass through the study area. Emergency preparedness dealt with the risk and treatment of possible accident victims, both on site and in the study area. The local police and fire department personnel typically had specific responsibilities assigned to them in the case of emergency situations. There was special training for the possibility of plant-related emergency events and, in some cases, special centers were designated for overseeing emergency period activities. However, these responsibilities were considered to involve only minor commitments of time and money by police and fire departments, and were not judged to be significant cost items to the local communities. In addition, contributions of equipment or other support by the utilities often compensated for any direct costs of emergency preparedness.

TABLE 4-19

PUBLIC SAFETY EFFECTS IN STUDY AREAS

	Project-Related Demand			Revenue Effects on Public Safety		
	Police	Fire	Emergency Preparedness	Police	Fire	Emergency Preparedness
Arkansas	Traffic	No recorded increased demand.	Extensive development on account of the station.	Police personnel doubled during Study Period.	Increased services from plant-related revenues.	Utility provided extensive communications equipment and substantial local revenues.
Calvert Cliffs	Traffic	None recorded as project effects.	Some expansion due to operations, especially post-TMI.	Project revenues helped fund increased services for expanding population.	Increased support for volunteer stations.	Increased responsibility for communications, planning, evacuation; director now full-time.
Cook	No direct effects identified.	None recorded.	SA did not handle emergency preparedness.	No direct revenue effects on police services were identified.	Equipment	County and state responded but no response was required by SA.
Crystal River	Traffic Control, Demonstration control.	None recorded.	About 20% of effort due to station.	Increased personnel.	Equipment, upgrading of department.	About 20% of expanded effort due to station.
Diablo Canyon	Traffic, demonstrations.	None recorded.	—	Increased resources, personnel and equipment.	Increased revenues, a new volunteer company.	—
FitzPatrick/Nine Mile Point	Traffic.	Some on-site fire calls.	Subcounty level did not provide emergency preparedness.	Increased personnel.	Equipment, some upgrading of departments.	County Office of Emergency Preparedness increased in size.

Continued on Next Page

TABLE 4-19 (Continued)

PUBLIC SAFETY EFFECTS IN STUDY AREAS

	Project-Related Demand			Revenue Effects on Public Safety		
	Police	Fire	Emergency Preparedness	Police	Fire	Emergency Preparedness
Oconee	Traffic control.	None recorded.	Emergency on-site and evacuation preparedness.	New law enforcement center ($41.9 million). Sheriff's office from 12 to 22, new equipment.	Two new volunteer fire stations, plus equipment.	New communications, increased expenditures at 10 percent per year.
Peach Bottom	None reported.	None reported.	Subcounty area did not handle emergency preparedness.	No additional revenues.	No increased revenues.	None reported for Study Area.
Rancho Seco	Traffic, demonstrations.	None recorded.	None reported.	No revenue effects; SMUD did not pay local taxes.	No revenue effects.	None reported.
St. Lucie	Traffic, labor strike control.	None reported.	Evacuation Preparedness undertaken.	Increased costs were not attributed to the station.	No increase due to station.	Increased costs were assumed by general revenue sources.
Surry	Moderate traffic increase.	None reported.	Recent evacuation preparedness undertaken by county.	Increased equipment, additional officer.	Some county funding for volunteer departments.	Director of Public Welfare is coordinator of county evacuation planning.
Three Mile Island	Traffic increase.	None reported.	Subcounty area did not handle emergency preparedness.	No increase in revenues.	No increase in revenues.	None reported for the Study Area prior to 1978.

Source: NRC Post-Licensing Studies, Chapter 7, 1980/81.

The study areas did not report any large increases in police and fire services in the local communities due to the construction or operation of the stations. Traffic control and crowd control at demonstrations or labor disputes were recorded by the police. Most of the fire departments did not record any additional on-site demand, although FitzPatrick/Nine Mile Point responded to several fire calls.

The project-related population was not judged to have made any unusual demands upon public safety in the study areas. On occasion, there were some references by police officials to rowdy behavior by construction workers, but this was not considered serious and these workers were often reported to have been less troublesome than some local people. Operations workers were generally considered to have been very good citizens who required little in the way of police or fire services.

The study areas that received significant additional revenues due to the operation of the plants spent some of these revenues on increased police and fire personnel and on new equipment. In several cases, there were also large increases in the support provided for emergency preparedness. There also were study areas of less than county size that were not responsible for emergency preparedness and consequently were not recorded as having increased personnel, facilities, or equipment in that area.

4.7.5 Social Services

The key informants in social services reported very little demand from project-related households in the study areas. A few informants, such as those in Surry, speculated that the employment and income effects may have reduced the long-term resident demand for services, but they also remarked that it was very difficult to evaluate such effects due to major changes in social service programs and staffing during the study period. In almost every case, however, the demand effects of the direct basic workers on the social services were reported to be very small. The income from jobs at the project was high enough so that project workers did not qualify for most social service programs. Changes in the social service programs applied mostly to children, the disabled, and the elderly. The project-related in-migrants almost never fell into these need categories. Also, there was no record of any significant influx of unqualified job seekers who might have become social service recipients due to unemployment, or of former project workers who "went on welfare" when employment declined.

The revenue effects on study area social services were limited to those jurisdictions that received significant additional taxes. Even then, the effects were mostly indirect: improved facilities for social service administration and a somewhat greater willingness to contribute a local share to state and federal programs. Support for the elderly was often mentioned.

During the study period, there was a general trend toward increased state and federal support for social services, with local jurisdictions relinquishing some of their control and reducing their financial responsibilities. In Oconee, key informants in the social services did not feel that the project-related revenues had any significant effects on programs although there had been significant changes. There were important changes in Surry, and a much greater willingness by the county to support social services. This was due mostly to the dramatic change in local government control and the subsequent changes in local policies regarding social service programs. For the most part, however, the trend in state and federal programs meant that the local jurisdictions had less control and responsibility in these areas. This meant, in turn, that the revenue effects were subsequently smaller for the social services area than for other local services.

4.7.6 Governmental Structure and Process

There was not a clear case in which the effects of the construction and operation of the nuclear stations by themselves produced significant changes in study area governmental structures and processes. There were several cases of expanded government spending, new facilities, increased employment, and new programs. These changes appeared to have taken place within the structural framework of the existing governmental structures, which were quite viable and flexible in most cases. In several cases, most notably Calvert Cliffs, the increased revenues seemed to have strengthened the control of long-term residents by providing officials with increased tax revenues with which they provided expanded levels of public services.

In other cases, such as Surry and Oconee, the tax revenues were used to support governmental change which took place because of complex social and political trends that were not caused by the projects. The change in governmental structure that took place for Oconee County was mandated by the state for all South Carolina counties. The dramatic shift of political and governmental control in Surry County that introduced extensive change in the administrative structure of the county resulted from the political organization of black voters. In both these cases, the project-related effects, especially

the additional revenues, appeared to have been used to solidify the changes that resulted from nonproject causes. There was some reason to believe that significant additional tax revenues served an essentially conservative function in regard to governmental structures. The tax revenues provided additional resources to whomever held political power and enabled these people to provide increased services without requiring the normal tax increases. As a result, the experience in Surry seemed to suggest that there was less conflict between political opponents than otherwise would have been the case.

4.7.7 Variation in Public Sector Effects

4.7.7.1 Proximate Determinants of Variability in Public Sector Effects

Effects of housing and population changes

A significant part of the variability in public sector impact is traceable to variation across the twelve sites in terms of the demand for public services and their associated facilities. Some study areas experienced only minor changes in population or housing, while others experienced substantial increases due to construction and operation of the nuclear generating stations.

Revenue effects

One of the most conspicuous sources of variation across the twelve sites was in the public revenue implications of the station. Some of the stations paid no taxes or were subject to state-wide equalization formulas such that local jurisdictions received little or no direct revenue from the station. In other cases, local jurisdictions received revenue windfalls that were often 50 percent and more of existing budgets. These differences in revenues were responsible for much of the variability in the effects of the nuclear stations on their study areas' public sectors.

4.7.7.2 Underlying Causal Factors

Project-specific

Project-specific variables influenced the economic and demographic effects of a station and so influenced the demand for public facilities and services associated with the plant. In general, however, the project-specific influences were small relative to the site-specific factors.

Site-specific

Site-specific factors substantially influenced economic and demographic effects. They were also responsible for the obvious variability in tax treatment that resulted in

such large differentials in the revenue consequences of the projects. Thus, characteristics of the sites, rather than characteristics of the projects, seem to be responsible for most of the variation in public sector effects across the twelve sites.

4.8 Social Organization Effects

4.8.1 Changes in Groups and Group Characteristics

Using the criteria described in Chapter 3, the twelve study areas contained between 3 and 7 major social groups. In all, the twelve case studies identified 8 types of groups in the vicinities of the nuclear stations: family farmers, agribusiness groups, elderly/retirees, ethnic groups (e.g., blacks and Hispanics), business and professional groups, suburbanites/newcomers, fishermen, and a residual group, variously identified as long-time residents, old-timers, etc.

Prior to the study period, the groups at each site were organized in a social structure with routinized interaction patterns. That is, there were established economic, political, and social interrelationships among the groups which formed the social system in the study area.

There are two basic ways that the social organization of a study area might change due to the project. First, the project may cause the introduction of new groups, which would then cause changes in the structural interrelationships among the larger set of groups. Second, the project may significantly change the characteristics (size, livelihood, demography, location, property ownership, attitudes and values, or cohesion) of existing groups. If these changes are large enough, the interrelationships among the groups may then change.

All sites had a comparatively large influx of workers during the construction period, and a more modest influx when plant operations began. In no case, however, did the new people form a separate, identifiable group. At all the sites, plant-related in-migrants were integrated into the existing group structure. In one case, Calvert Cliffs, the operations workers formed a subgroup of suburbanites due to their geographical concentration in a few residential developments. At the other sites, plant-related employees were not even distinguished as a separate subgroup.

Changes in group characteristics due to the plant occurred at all sites as will be discussed in Chapter 7. Most of these changes were not large enough to significantly

affect economic, political, or social interaction patterns. However, the following examples show some of the changes that were potentially large enough to alter group interaction patterns.

At Calvert Cliffs, a significant proportion of black agricultural laborers obtained basic jobs at the plant, which meant that the livelihood of the elite (landowners) was complicated by a shortage of labor. At Diablo Canyon, the construction of the power plant stabilized the tourist industry, and reduced turnover of such businesses. At Oconee, textile workers benefited from the new job opportunities, higher wages, and training programs at the station. At Peach Bottom, the income of the professional/business group was increased during construction, due both to the nonbasic spending and to the direct basic employment of younger members of the group. In addition, old-timers received significant rental income during the construction period. At Rancho Seco, newcomers and agriculturalists benefited economically by the reduced electrical rates due to the annexation of their area (some 100 square miles of land around the project site) into the electric service area of the nuclear plant. At St. Lucie, the workers benefited from the new, higher paying nonseasonal jobs, and the business community benefited from the workers' nonbasic spending. At Surry, there was a complete political reorganization, strongly motivated by the availability of tax dollars from the plant, such that the blacks gained control, and the white farmers lost control, of the Surry County government. Finally, at several sites there were groups that benefited significantly due to the tax payments, either in terms of lower millage rates or in increased services (especially the long-time residents at Cook; all groups at Oconee; the business/professional group at St. Lucie; and the blacks and elderly at Surry).

4.8.2 Changes in Group Interaction Patterns

At most sites, interaction patterns between the groups in the study area did not change over the study period. Changes were primarily associated with local growth trends or with changes at the national level (e.g., civil rights legislation, increases in franchised and chain stores, automation and mechanization). The construction and operation of the nuclear plants had only modest effect on changes in the social structures of the study areas. In general, the power plants played only a small role in shaping other ongoing social processes. There were, however, a few instances where changes in the social structure were attributable to the plant.

At a few sites, the effect of the plant on economic interaction patterns was noticeable. For instance, at Calvert Cliffs the system of using black intermediaries to broker black agricultural jobs was broken down. During construction, the employment market for black laborers became more competitive as blacks were hired as laborers at the nuclear plant. The high-paying union jobs provided an attractive alternative to agricultural employment, and the jobs could be obtained without going through the intermediary system. In addition, the increased income enabled many blacks to purchase homes and other consumer goods that had not been possible prior to the construction of Calvert Cliffs. When the plant began the operations phase, the smaller number of available jobs were filled by hiring out of Baltimore. Thus, the local employment opportunities for blacks were severely curtailed. Instead of returning to the preproject pattern of economic interaction, many blacks opted to out-migrate.

At Oconee, a somewhat similar situation occurred. Again, there was a significant segment of the work force that was dependent on a single, low-paying industry, in this case the textile industry. Again, construction of the nuclear power plant contributed to more open and competitive job opportunities. The emphasis of Duke Power Company on hiring and training local people, and on retraining them for operations jobs if necessary, tended to reinforce the new economic structure.

There were some temporary changes in the economic interaction patterns at Peach Bottom. There was a short-term boom in economic activity due to the presence of the construction workers, which tended to temporarily decelerate the rate of out-migration of the business/professional group. Also, there was a small component of agricultural workers who obtained work at the plant during construction. At all other sites, the structure of economic interaction did not change because of the nuclear plant.

Similarly, the political interaction patterns in most study areas were not affected by the plant. Where a political change attributable to the plant could be detected, the change took one of two forms: (1) some groups' concerns with the environmental effects of the plant (e.g., Cook and Peach Bottom) were associated with an increased concern over other local environmental issues and increased participation in local politics; and (2) increased friction between newer residents and farmers over the allocation of tax revenues from the plant (for example, Peach Bottom) created new conflict in political interactions. Suburbanites preferred improving the public services to lowering the tax rate, whereas farmers preferred the reverse. In addition, at one site (Calvert Cliffs)

there was evidence of direct involvement of the utility in state and local political decisions. At the other 9 sites, there was no evidence of a significant change in political interactions due to the plant.

Changes in social interaction patterns were even smaller and less common. In the Cook Study Area, there was some increase in social interaction between two groups that had united to oppose the project, and at Calvert Cliffs the plant contributed to the modernization of social interaction patterns as traditional barriers broke down. At most sites, however, any changes in patterns of socializing, formal and informal group membership, and intermarriage were due to factors other than the nuclear power plant.

In summary, changes in social organization due to the nuclear stations were small in magnitude and relatively uncommon. Typically, noticeable changes in economic, political, or social interaction patterns were primarily due to other factors.

4.8.3 Variation in Social Effects

There were few discernible changes in social organization due to the construction and operation of the nuclear power stations. To the extent that differential effects did occur, they were associated with the way in which the previously discussed economic and demographic effects were distributed among groups in the study area. The distribution of economic effects was most important in affecting study area groups, and this distribution seemed to reflect both project-specific and site-specific factors. The most important project-specific factors were those associated with the hiring and training policies of the construction contractor and of the utility operating the station. Site-specific factors relevant to the distribution of economic effects include the existing occupations and economic positions of groups in the area, and the availability of alternative economic opportunities.

CHAPTER 5: PUBLIC RESPONSE TO THE CONSTRUCTION AND OPERATION OF NUCLEAR GENERATING STATIONS

5.1 Introduction

One of the objectives of the socioeconomic assessment was to identify and describe the public response to each of the projects. The nature, saliency, and prevalence of plant-related issues and their articulation in the political process was considered an important aspect in measuring the social impacts attributable to the nuclear facilities. Thus, public response, with its underlying motivations in terms of public concerns and attitudes, constituted a social phenomenon to be addressed and explained. Further, public involvement of study area residents in the licensing hearing process and in political activities outside the public hearings was hypothesized to result in changes to the social structure or to patterns of group interaction. The degree of change, particularly in the areas of political interaction and in the process of decision-making, was viewed as being dependent on the nature (magnitude, saliency, and prevalence) of the study area response.

For each of the twelve facilities, the issues over the nuclear plant were identified, the political activities described, and the impact on the study areas assessed. Furthermore, it was important to ascertain the degree to which residents of the study area were concerned about the nuclear facilities and plant-related effects.

The public response to the construction and operation of the nuclear plants in the study areas took place over a relatively lengthy period of time, and the nature of the local response to the nuclear stations must be seen from a temporal perspective. For most of the nuclear plants in our sample, construction began in the mid-to-late 1960s and continued into the 1970s. Plant operations commenced during the mid-to-late 1970s, with construction and operations work overlapping in the case of sites with two or more units. Consequently, the response of the study area residents to the nuclear stations can be characterized in a context of evolving safety regulations, changing patterns of regional and national concerns over the development of nuclear energy, and site-specific events resulting from construction and operations activities.

This chapter describes findings with respect to public response up to the time of the accident at Three Mile Island. It was hypothesized that the accident at Three Mile Island would affect people living in the vicinity of all existing nuclear plants. The public

response to the twelve nuclear plants subsequent to the accident is treated, therefore, in the next chapter as part of the discussion of the socioeconomic consequences of the accident.

The description of the public response begins with a brief summary of the response at each site. Each summary concludes by a statement of the magnitude and prevalence of the public response in each study area. This is followed by a section which explicates the variation across sites. The research found that there were four determinants of variation. These included local values, national events, the pattern of political response, and the distribution of effects.

5.2 Summary of Public Response by Site

Arkansas Nuclear One (ANO)

During the pre-construction, construction, and operation phases of the plant, there was overwhelming community support for the nuclear power plant. This support can be exemplified by events occurring during the early planning phases of the project. When a number of landowners were reluctant to sell their land for the plant site, except at an inflated price, the business community, through the Chamber of Commerce, purchased the property for the utility. A dominant community value was the importance the community, and especially the business group, placed on industrial development. Historically, the business community in Russellville had taken the initiative to attract industry into the area and to aid the agricultural sector. Consequently, the business community had inherited leadership responsibility. The business community's active endorsement of the nuclear facility was an important catalyst for community-wide acceptance. Notwithstanding the importance of this role, the community consistently approved of the plant. The public hearings were uncontested, and only three individuals presented concerns through limited appearances. In spite of ANO's history of shutdowns, equipment failures, and a leak, no important opposition appeared in the region to raise safety or environmental issues. The nuclear facility was a "nonissue" for the community.

The positive community attitude toward the nuclear facility was found to be related to the following factors:

1. The historic relationship between the utility and the study region. Arkansas Power and Light (AP&L) was one of the earliest companies to locate in Arkansas and invest in industrial development. In addition, the company was a

major contributor to the recreational development of the state. Moreover, in a state that had lost population between 1940 and 1960, the company was viewed as a stabilizing and important economic asset.

2. The lack of any social problems or stress on facilities and services during the construction phase.

3. The visibly positive impact on the Russellville school system.

4. The value placed on industrial growth and economic expansion.

5. The general acceptance of the risks inherent in nuclear technology.

Calvert Cliffs

Opposition to Calvert Cliffs appeared during the late 1960s at the construction permit hearings. The Chesapeake Environmental Protection Association, comprising a number of Annapolis-based groups, expressed concern over the impact of thermal discharges on the Chesapeake Bay and the hazards of low level radiation. These concerns were parallel to those of the Chesapeake Bay Foundation. The concerns of the county's watermen for stringent water quality standards resulted in political activity which terminated with the imposition of state water resources department standards, which were 1.0 percent of AEC standards.

There was little organized opposition in Calvert County; county residents were supporters rather than opponents before 1973. However, a thermal standards issue surfaced during plant operations. The utility filed an amendment with the United States Department of Water Resources to allow discharges of up to 14 degrees higher than normal while the original permit allowed a 10-degree increase. The county asked for hearings over this amendment but was ultimately unsuccessful.

Cook

The construction permit hearings in 1969 for the D. C. Cook plant resulted in opposition to the plant by local area residents and environmentalists. The major area of contention was the cumulative effect of the D. C. Cook plant together with four other plants on Lake Michigan. This concern reflected a long-standing commitment of regional environmental groups to improve the quality of the lake.

The shoreline property owners, together with the regional environmental organizations, attempted to block the issuance of permits for plant construction. In 1969-1970, their principal interest in intervening was to replace the once-through cooling system by cooling towers. This particular concern was part of a much larger private interest concern with activities on the shoreline that might result in erosion problems. Historically, coastal dune erosion was a serious problem for this group, which resided, for the most part, in seasonal residences close to the beach. They argued that changes to the coast, necessitated by plant construction, would further aggravate the erosion problem. The problems continued into the mid-1970s with only limited resolution of the issues.

The groups continued to oppose the plant and in the 1977 operating license pre-hearing, arguments were presented concerning emergency plans, coastal changes, level of operator training, and safety of the emergency core-cooling system. The fact that the utility agreed to develop alternatives to once-through cooling in the event of ecological damages caused the interveners to drop their case, and the operating license was issued in 1974.

Two sets of activities were involved in the public response to the Cook project: (1) local governmental officials and long-time residents generally supported the plant; and (2) the lakeshore residents (many of whom were part-time residents) were opposed to the plant and worked closely with regional environmental groups in their opposition.

Crystal River

The 1967 announcement of the Crystal River plant was well supported by the community. Despite the fact that residents were concerned over the possible recreational damage that could result from thermal discharges, no intervention occurred at the hearings and no operation hearings were held. Support by local area residents continued, but environmental groups from outside the Study Area began actively opposing nuclear power in 1979. Thus, opposition to the Crystal River plant by state groups occurred late in the project's history. In general, the support was enhanced by the fact that the nuclear plant was part of a large complex that was, in sum, the largest employer in the county.

Diablo Canyon

The period prior to the construction permit hearings (1962 to 1968) represented a shift from a generally favorable climate, where the community supported the plans for a

nuclear station, to a less favorable climate where public concern over environmental questions engendered local opposition. During the 1964-1966 period, local government departments and the Sierra Club worked with the utility to find another coastal site for the plant. There was no outright opposition to the plant, but a concern to conserve a fragile and unique coastal area. By the late 1960s, opposition to the location of the site on the coast surfaced at the California Public Utility Commission hearings. The interveners were mostly from a neighboring county, with few representatives from the Study Area. Overall, the public and local government supported the station.

The NEPA hearings (post-1973) were accompanied by strong opposition to the plant, centered on the impacts of thermal emissions on the abalone population. Concern was also growing over seismic considerations, but these were outside the purview of the public hearings at the time. The growing opposition to the plant over environmental issues was a function of two situations: environmental problems due to construction, and a strong regional environmental awareness.

During the environmental hearings, a consensus was reached on the fact that the studies on the effects on marine life were incomplete. The fact that the AEC decided that construction could continue until the studies were carried out and that the AEC found an "unacceptable degree of harm" at the plant fueled the environmental opposition. In addition, concerns over environmental issues resulted from siltation problems and from the release of toxic copper, which killed much of the local abalone.

The fact that plant-related environmental issues surfaced as strongly as they did was not surprising. The protection of the environment was a long-time concern of Study Area residents and, by the early 1970s, environmental/conservation issues were the principal political interests of residents of the area. The nuclear power plant did not catalyze environmental concerns; rather, the plant was viewed as another example of industrial encroachment on a unique and valued coastline. Historically, moratoriums were placed on growth in a number of coastal communities in the area; an agricultural preserve program was implemented; and uranium mining in the county, as well as a proposal to build a harbor in the county, came under formidable opposition.

Between 1973 and 1981, during the operating permit evaluations, the principal contention was a prolonged debate concerning the seismic risk issue. The fact that the NRC could not reach a decision over the seismic hazard and the controversy surrounding

the issue seemingly altered public perception, and the level of active local opposition to the plant increased substantially. The past few years have witnessed a dramatic decline in local support for the plant, but in areas outside the City of San Luis Obispo and the coastal communities, support for the plant exists. Following the trend in national response, antinuclear organizations have grown in the local area and are well integrated into the larger regional nuclear movement. Public concern has shifted from the highly local interest in preserving environmental quality to a broad array of generic safety issues.

FitzPatrick/Nine Mile Point

The dominant issue when the FitzPatrick plant was announced was over the aggregate thermal effects of the two plants—FitzPatrick and Nine Mile Point. In 1969, the State of New York issued a new set of stringent standards for thermal discharges, and the debate centered around whether the FitzPatrick plant could meet these standards because of its proximity to the Nine Mile Point facility.

During the 1970 construction permit hearings, a number of limited appearances were made by Study Area residents, but on the whole, the local area provided support for the plant. The opposition to the plant was nonlocal and was spearheaded by the New York State Conservation Council, whose contentions included the potential for radiation release and the effect of thermal discharges on the Great Lakes system. However, subsequent to the issuance of the construction permit (1973), a local environmental group petitioned to intervene in the operating license hearings over the water quality concern. This university-based group remained active during permit hearings regarding the Nine Mile Point plant. Outside of this particular group involvement, Study Area residents on the whole did not oppose the plant. The one exception to this was the public responses to specific risk events. In 1978, plans to construct a radioactive waste incinerator at Nine Mile Point for low-level waste was opposed by local groups.

Oconee

When the plant was announced in 1965, it received widespread support from the community. The support reflected the need to diversify the economic base, which was exclusively based on textile manufacturing. The plant was viewed as an important investment that would help the economic base and reverse the trend of out-migration of the area's youth. Although the Department of the Interior expressed concern over

thermal discharges during the construction permit hearings, there was a noticeable lack of effective regional opposition.

Issues over the plant appeared in 1977 when there was a release of contaminated water into a local reservoir. A local interest group expressed the view that the health implications were not clearly specified. This issue, however, did not emerge as a community-wide issue and soon dissipated as a matter for concern. However, the utility's proposal to ship the nuclear waste from the Oconee plant to another plant for temporary storage received considerable opposition from a local city council which opposed shipment of wastes through its jurisdiction. Three state environmental groups intervened in the subsequent hearings over the shipment-of-waste issue. The Nuclear Regulatory Commission (NRC) ruled against the shipment of the waste, and the issue rapidly faded.

The evidence provided by the Oconee case history shows that the plant was generally accepted by the host area. Acceptability was heightened by the perceived benefits of the project in an area experiencing economic problems. Concern developed over specific operations events, which dissipated when the specific technical issues were resolved. Altogether, there was minimal local public concern and no apparent impact on the Study Area from any regional public response.

Peach Bottom

Strong public support for the construction of two additional units at the Peach Bottom site was evidenced during the 1966-1968 preconstruction period. There were two major factors to explain this support. First, the area was experiencing a serious downward economic trend, and the construction of two nuclear units was seen as the stimulus needed to reverse the trend. Second, Peach Bottom Unit 1, a small reactor, had already been established and accepted by the community, and this new project was viewed as an extension of the first unit. No residents of the Study Area expressed concern at the construction permit hearings but, prior to the hearings, the agriculturalists of the Study Area voiced concern that the cooling structures could have an adverse effect on the recreational uses of the Susquehanna River. There was also resentment by a number of farmers that the transmission lines would cross their properties.

In the early 1970s, at the time of the operating license hearings, the concerns had shifted, reflecting the growing opposition to nuclear power development in Pennsylvania. The regional concern focused on the critical contention of the cumulative impacts on the quality of the Susquehanna River since a number of nuclear plants were using the river for cooling purposes. The four interveners at the operating license hearings represented the larger regional interests—they were not from the Study Area and received only minimal support from Study Area residents. The major issue centered on thermal discharges. The controversy resulted in the adoption of a closed-cycle cooling system as a stipulation for the operating license. In addition, this result was the outcome of expressions of state environmental concerns.

Representatives of the agricultural community made limited appearances at the operating permit hearings. Their concern focused on the protection of milk products, and they demanded safeguards for the local dairy industry. The farmers also indicated that the rural township was the recipient of a great burden of risks and that the relatively high wages paid at the site contributed to difficulties in procuring seasonal farm laborers. While opposition to the plant was centered in the farming community, townspeople generally supported the plant. The prime value expressed by area farmers was the "agricultural way of life" and, as a group, they felt that the plant would result in rapid encroachment on their rural area. Furthermore, they were concerned over possible depreciation of land values because of the proximity of the plant and its possible effects on agricultural products. The fact that the utility proposed to build the Fulton plant across the river from Peach Bottom Township and to expropriate considerable farm land heightened the farmers' opposition to the Peach Bottom plant. The concerns by Study Area residents were over potential effects of the plant that were site specific; the hearing covered the generic safety issues represented by regional groups from the larger cities. There was a strong correlation between the traditional values held by the farmers and the predispositions toward growth and the public response to the plant. Delta residents expressed little concern over the plant.

The effect of the public response was evidenced in the expanded involvement of the township in political matters outside of the traditional parochial concerns with agriculture. This resulted in political affiliations with entities outside of the Study Area, which, in turn, reduced the area's geographic isolation.

Rancho Seco

Community support for the proposed plant during the construction permit hearing was evidenced by the fact that no formal intervention took place. Two limited appearances, however, included contentions over the risk analysis of the consequences of an accident and the effect of the plant's discharge on the local underground water system. The opposition was limited, as compared to other California plants at the time. The fact that the plant was located inland and would not pollute a natural water body mitigated against the forming of any sizable opposition. The coastal and water-related environmental issues pervasive in California were nullified because of the inland site.

By 1972, when the operation licensing hearings were held, a number of interveners had surfaced to protest the impending plant opening. The arguments presented included the inadequacy of the emergency core-cooling system and the danger posed by radiation leakages. These were generic safety issues that reflected national concerns over environmental health and safety. The interveners, by and large, were residents of Sacramento; none were from the Study Area. The proposal to build a second unit received substantial criticism, but little from the Study Area. Local officials, however, did attack the environmental report on Unit 2 as the report did not outline the steps to be taken to prevent development near the plant.

The case study points to a number of shifts in the nature of public response. By 1974, the state government did not support nuclear power as it had done a few years earlier. This was the result of the growth of the state concern over the safety of nuclear technology, and the poor quality of the environmental impact statement for Unit 2. The opposition to the plant was rooted in the colleges in the Sacramento area, while concern in the Study Area was limited.

Important factors that explain the limited opposition to the plant by local residents have been identified. They include: (1) the generally low level of involvement of residents in community social and political activities; (2) the inland site; and (3) the comparatively low electricity rates promised from the project.

St. Lucie

Public concern and opposition to the St. Lucie site paralleled the evolution of public concerns at the national level. During the early phase of public concern in the 1960s, the Martin County Taxpayers Association expressed concern that the thermal

discharge on a local water body would have a significant adverse impact on the tourist/recreational industry in the county. Consequently, the group argued that the discharge system be redesigned for an ocean intake or for cooling towers. The utility responded to this demand by designing an ocean discharge.

Environmental issues continued to be areas of contention during the subsequent construction permit hearings. Local area residents remained generally outside the hearings process. The prime actor was the Department of the Interior, which expressed concern over thermal pollution and potential problems over the migration of turtles. The utility responded by introducing a number of mitigating measures.

The case study found that a shift in the nature of the public response occurred during the 1973 NEPA hearings. The focus of concern shifted from local issues to national issues related to technological safety. The neighboring county to the Study Area took an active part in the opposition. The Martin County Conservation Alliance was a long-established environmental interest group that had taken positions on growth policy, coastline problems, and open space.

During the 1974 to 1979 period, the goals of the interveners shifted. During the earlier confrontations between local groups and the AEC, the groups' goals were to settle for the mitigation of localized adverse environmental impacts. By 1979, the goals were to permanently curtail construction of additional nuclear plants in the area. At the same time, the number of intervening groups and their geographic extent had expanded. Only two of the six interveners were from Martin County, and no group represented the Study Area itself. The issues were of two types: generic safety concerns (consequences of low-level radiation, thermal discharges, evacuation procedures) and locationally specific concerns. The two site-specific issues dealt with the accuracy of population projections and the need for protection against hurricane damage. The controversy resulted in the NRC deciding that the utility had to revise its population projection, which according to the NRC, had been underestimated. In addition, the NRC stipulated that additional storm surge barriers be installed for erosion protection.

In St. Lucie County, the opposition to the St. Lucie plant was limited. Although there was some involvement by the St. Lucie County Conservation Alliance, it was primarily Martin County residents who were politically active in opposing the plant. The evidence, however, shows that the level of political participation was moderate. Overall,

environmental awareness was low, and few environmental issues surfaced in the Study Area. In contrast, the population in Martin County was older and more affluent, with a tendency to participate actively in environmental/conservation organizations. Membership in the Martin County Conservation Alliance constituted a large proportion of the county's population, but only a few members were politically active in opposing the plant. Once the permit hearings ended, the level of public concern dissipated dramatically.

Surry

The 1966 announcement of the Surry plant received enthusiastic support by Study Area residents and county officials. The support, as was gauged by key informant interviews and secondary data, was largely based on the economic gains that would be generated by the construction of the plant. There is no recorded opposition to the plant. A number of local fishermen expressed some concern over thermal discharges, but this concern did not materialize into opposition. Factors given for the acceptability of the plant also included: a local sense of security because many residents had worked with nuclear energy in nearby shipyards; the lack of regional opposition; and the utility's excellent public relations efforts. During the construction period, there were no active organizations to oppose the plant, and public support continued.

Once operations began on the two units (1973), two issues emerged as a consequence of a series of events involving steam accidents. These issues emerged at the hearings for licensing Units 3 and 4. During the hearings, two environmental groups opposed four units being built on the river. Although the permits were issued, the plans for building two additional units were canceled.

There was very little opposition to the plant. One reason for this was that the plant was in a remote rural location. In addition, the regional tendency was to rely on established governmental procedures for regulating business, and the plant was generally considered a business venture. There was also very strong faith expressed in the plant's safety, and traditional regional values tended to devalue protest and opposition to employment-related developments.

Three Mile Island (TMI)

The 1968 construction permit for Three Mile Island was not contested and was supported by all groups and organizations in the Study Area. Two factors stand out to

explain this high level of acceptance. First, the plant was viewed as counterbalancing the closing of a large air base in the area. Second, the nuclear facility was seen as a nonpolluting generator of electricity.

The NEPA hearings in 1972, however, witnessed the emergence of environmental groups as interveners. The Citizens for a Safe Environment argued that the AEC did not adequately calculate the probability of a flood on the island, and that the health hazards of low-level radiation were not properly assessed. The interveners were part of a regional interest group that was actively opposing nuclear plants in the region, including the Peach Bottom facility. Active local opposition was lacking.

5.3 Proximate Determinants of Variation Across Sites

5.3.1 Local Values

Existing research on community conflict and public response to nuclear facilities have noted that a major explanatory factor of the prevalence and duration of the response was related to local values. Areas that hold "traditional" values have been hypothesized to be more likely to support nuclear generating facilities than "modern" areas where concerns over environmental impacts may prevail and where public participation in the decision-making process may be prevalent. The post-licensing findings support the view that local values are a strong determinant of the nature of public response to nuclear generating stations.

At those sites where a local pro-growth/pro-industry value prevails, it is likely that the construction of a nuclear station will be strongly supported. Support will be heightened in those areas that have historically experienced economic decline and out-migration. Nuclear facilities are generally perceived as a valuable community element--they tend to induce growth and to aid in stabilizing the economy. Thus, the Oconee Plant and the Arkansas Nuclear One plant became symbolic of renewal and economic prosperity. In such cases, visible economic gains, such as employment opportunities for local residents or major fiscal benefits, seem to heighten the perceived economic importance of the plant.

A community's value system may be described by the values held by the community's social groups. The Post-Licensing Studies found that, although variations existed in response to nuclear plants within a study area, community conflict did not emerge because of a nuclear facility. While disagreements may occur in the political

sector (e.g., Diablo Canyon), it is rare that the controversy over a nuclear plant will result in significant changes in political structure and organization. Rather, controversy over nuclear plants may reinforce, heighten, and polarize values and political positions. Thus, where active nuclear opposition exists, there is also a tendency for involvement in other environmental issues.

The Post-Licensing Studies also found that while support for a plant may be extensive in a study area due to prevailing pro-growth community norms, opposition is seldom universal in the host areas. In all 12 study areas, active political opposition was undertaken by one or a few small organizations. The dominant concerns were motivated by environmental issues, parochial/self-interest issues (economic pacts), issues over technology and decentralization, and questions over safety. In areas where active environmentalism occurred, there was a strong likelihood that opposition to nuclear plants would emerge. In many of the study areas, conservation and environmental organizations were the nucleus for the formation of an antinuclear group or constituency.

Where social groups have a strong political base, their values with respect to nuclear plants will tend to be expressed in the political arena. Thus, in Pope County, Arkansas, and Calvert County, Maryland, the business community took political action in support of the nuclear plants. In contrast, the farmers of Peach Bottom, Pennsylvania, who perceived potential detrimental harm to agriculture and their way of life, actively opposed the plant at the licensing hearings and subsequently passed resolutions to improve emergency response planning.

A lower level of opposition to nuclear plants may be more likely in areas that have the following combination of characteristics: reliance on established government procedures; political values which belittle protest; a prevailing pro-growth attitude; an important community leadership role played by the business community; and perceived economic benefits from plant construction and operation.

The study results also suggest that the response of social groups at the most general level has been fairly consistent. Business groups, on the whole, favor nuclear plants as do industrial agriculturalists. Agricultural areas characterized by family farms and by strong historical/cultural links have an inconsistent record of support. Minority groups generally have supported nuclear plants because of the perceived economic gains that will result from their construction.

5.3.2 National Events as a Determinant of Variation in Public Response

The public response at each of the twelve study areas varied over time and often reflected the pattern of concern at the national level. A number of studies have attempted to describe the temporal pattern of concerns over the development of nuclear power and, consequently, there has been a general recognition that the response to nuclear power can be defined by four historical phases.

The first distinct historical phase of public response to nuclear power occurred during the late 1950s and early 1960s. The period was marked by the general acceptance of nuclear power at both national and local levels. Development of both Peach Bottom Unit 1 and the FitzPatrick/Nine Mile Point stations began during this period. The evidence provided by the FitzPatrick case study indicates that when the plant was announced in the early 1960s, residents focused on the potential economic benefits of the plant. Typical of the early 1960s, there were many questions about the technology and some limited concerns expressed over thermal discharges, but there was a basic confidence that the utilities and the Atomic Energy Commission (AEC) were diligent and competent in fulfilling their responsibilities.

The Diablo Canyon and Peach Bottom case studies also found that in the early 1960s, when decisions were made to locate these plants, there was the conviction that the development of nuclear power was economically and environmentally preferable to fossil-fueled facilities. The national scientific consensus and political climate favored the development of nuclear power. These factors reinforced the predisposition toward these two plants. Further, the Peach Bottom area, as a rural, generally isolated community with a historical record of economic instability, made project-related employment and income look particularly beneficial.

Although there was general acceptance of nuclear technology in this early phase, there was nevertheless substantial governmental concern over safety, including the first major safety report by the AEC (Wash 740) and the congressional debate over nuclear insurance. In the early 1960s, the first opposition to nuclear plants surfaced. A number of studies have related this early concern to the debate over atomic fallout.

The second stage is less well defined but extended over the period from the mid-1960s to 1970. During the 1960s, the nuclear industry grew rapidly: in 1968, 14 plants were in operation and another 39 were under construction. At the national level, concern

over nuclear technology had waned, but was characterized by local opposition to specific projects. The subject of much of the concern was thermal discharges. Of particular visibility was the opposition to the Diablo Canyon facility, proposed to be sited on the California coast. The opposition argued that the plant would result in irreversible damage to a unique natural coastline and that a serious safety question existed because of the proximity to an earthquake fault.

During the late 1960s, opposition and concern over local siting decisions were focused on the potential environmental impacts of power plant construction and operation. Moreover, the historical evidence suggests that opposition to local plants included individuals motivated by self-interest and individual concern over the general quality of their respective communities. However, the dominant concern of the late 1960s was over the thermal and radiation contamination of water bodies next to the plants.

The specific environmental concerns that characterized these local issues have continued, despite the fact that the opposition has, in general, shifted to more generic safety issues. This is a reflection of the strong linkage of nuclear opposition to the national environmental movement. The sociological evidence indicates that of all the groups sampled with respect to attitudes toward the development of nuclear power plants, environmentalists opposed this development by a factor of 4:1 (1975) as compared to support of nuclear power by 2:1 for the other social groups. The earlier intent of the opposition was to force a change in design, to apply greater safety standards, and to alleviate adverse environmental consequences. Thus, opposition often dissipated when the utility acquiesced on a particular demand (e.g., Peach Bottom and St. Lucie). There also has been a shift in the scope of the opposition's goals--from attempts at design adjustments to a commitment to end the development of nuclear plants. This is a reflection of the growth of concern over safety problems and waste disposal and not just thermal discharges, and the fact that local opposition has developed associations with national antinuclear organizations.

The third phase of public concern began in the early 1970s as a result of two occurrences. The Calvert Cliffs decision resulted in the institutionalization of environmental protection in licensing decisions. Consequently, public concern shifted from environmental to safety issues in the early 1970s. The rule-making hearings on the Emergency Core Cooling System in 1972-1973 demonstrated widespread disagreement

among AEC safety experts and focused attention on the question of nuclear safety and the adequacy of safety systems. In 1974, the national antinuclear movement emerged through the activities of Critical Mass '74, a coalition of major environmental and antinuclear organizations. Thus, the third phase of public concern, the period of National Environmental Protection Agency (NEPA) hearings of the early 1970s witnessed public contentions over thermal and radiation effects, an increase in the number of interveners, and the representation of more broad-based interests--ranging from environmental to ideological/nuclear issues.

The fourth stage of public concern occurred between 1975 and 1981 when the issues focused on nuclear safety and waste disposal. This period has been characterized by more stringent standards being instituted by local, state, and federal agencies; by the growth and solidification of national antinuclear interest groups; and by major protests and opposition by citizens. The concern over nuclear safety has been heightened, in large measure, because of the accident at the Three Mile Island nuclear plant.

Although the opposition to nuclear plants has grown, survey data consistently note that a large majority of people favor the development of nuclear power, and nearly all of the state antinuclear referenda have failed to pass. However, we also know that public support declines as nuclear power moves from general policy issues at the national level to actual local siting decisions. Even at local levels, we found that there exists a broad variety of public responses, and at some sites there is full community support for nuclear plants. Today, site-specific concerns are becoming increasingly reflective of ideological positions.

5.3.3 Underlying Causal Factors

Analyses of public response at the 12 sites found that underlying causal factors in the variation in the level and type of response can be explained by project-specific and site-specific factors. Projects that have a high level of uncertainty with respect to either specific events (leaks at Peach Bottom and Arkansas Nuclear One) or general risk phenomena (earthquake risk at Diablo Canyon and reliability of welds at Oconee) will have a high likelihood of generating public concern and possible political response. Such concerns were found to be heightened in situations where other risk events have occurred at about the same time, such as the closing of a plant, an accident at a plant, or the disclosure of improper procedures at a plant. Major visible economic benefits were found to temper concerns over risks. The fact that Arkansas Nuclear One provided substantial tax revenues to the local school district was viewed by residents as the major positive

effect of the plant, while the effects of a leak of radiated water was viewed as more remote and thus of lower significance. Where the utility and plant were major employers in a local area and generated large revenues, local public response was consistently in favor of the nuclear station, as in the case of Crystal River.

With respect to site-specific factors, examination of the 12 sites showed that the most enthusiastic support for the nuclear plants came from host communities that were experiencing, or had experienced, economic problems and that placed a high value on industrial growth. Opposition to the plants came from areas where environmental concerns over specific or unique areas became important values for a particular group.

5.4 Effects of Public Response on the Study Areas

In most of the case studies, local opponents who challenged the nuclear stations did so through the legally instituted channels of the hearings process. Once a decision had been made about the plant, particularly regarding a construction or operations permit, public activity and opposition dissipated to a large degree. In only two of the case studies, Diablo Canyon and Peach Bottom, did local political activity have lasting effects on the decision-making structure. At the Diablo Canyon site, the controversy over the nuclear plant resulted in the reinforcement and enhancement of political differences between the environmentalists and the pro-growth advocates. Moreover, the controversy heightened both environmental awareness and the level of public concern. Consequently, the concern over nonnuclear environmental problems also increased.

At the Peach Bottom site, the political involvement by the agricultural families in the township strengthened their overall political position and this resulted in a higher level of professionalism in political and planning matters. Earlier, the locus of political involvement was characterized by an ad hoc approach to small problems that were agricultural in orientation. More recently, the township has become concerned with comprehensive planning and contingency preparedness.

In areas where local opposition to plant sitings developed, the opposition was generally in the minority in terms of its population size. In Diablo Canyon, where the nuclear controversy was most intensive compared to the other case studies, the controversy did not universally affect local politics, nor was its intensity consistent. A majority of the study area's population continued to support the plant. Thus, the effect of public response on social organization and social processes in the sample cases was minimal.

CHAPTER 6: SOCIOECONOMIC CONSEQUENCES OF THE ACCIDENT AT THREE MILE ISLAND

6.1 Introduction

The general purpose of the Post-Licensing Studies is to describe the social and economic effects of siting, constructing, and operating nuclear power plants in the United States. Field work for the research described in the previous chapters of this report began in late 1978. Because of variable availability of data for the 12 sites, a decision was made to end the study period for each site in 1978, and to focus the operations period discussion on the most recent year (1978) for which common data were available, although field work continued at some sites through early 1980. Thus, the analysis in the case studies focuses on the peak construction year, whenever that may have been for each individual project, and on 1978 as a common operations year.

The accident at Three Mile Island (TMI) occurred on 28 March 1979. Since TMI was one of the case study sites, the scope of the Post-Licensing Studies was expanded to include an analysis of the social and economic effects of the accident on the residents of southcentral Pennsylvania. Because a reliable data base was necessary to support this effort, the NRC Telephone Survey of 1,500 households was conducted in late July of 1979 (Flynn, 1979). Since that time an additional report has been prepared that described the social and economic consequences of the accident during the six-month period from the end of March through September 1979 (Flynn and Chalmers, 1980). Because of the unique circumstances surrounding the accident, the TMI Case Study was expanded to summarize the analysis of both the emergency and the post-accident periods.

In addition to the direct effects of the accident on the area surrounding the TMI station, it was immediately apparent that the effects of the accident would not be confined to the TMI area. In particular, Peach Bottom Nuclear Generating Station (one of the twelve case study sites) is located just 35 miles downstream from TMI on the Susquehanna River. Further, 4 of the remaining 11 sites have Babcock and Wilcox units which are similar in design to the damaged unit at TMI. In addition, given the national significance of the accident, along with NRC regulatory revisions associated with TMI, every nuclear station in the country was affected by the accident. Each of the other eleven case study sites were examined, therefore, for consequences of the TMI accident. The purpose of this chapter is to summarize the effects of the accident both at TMI and at the other case study sites and to examine the reasons for variability in these effects.

6.2 Effects of the Accident on South-Central Pennsylvania

6.2.1 Introduction

The effects of the accident at Three Mile Island can be grouped into three categories: (1) the regional economy, (2) local institutions, and (3) private individuals. The time periods of this analysis covered the two-week emergency period immediately following the accident, the short-term effects over the next six months, and the long-term effects through the two years following the accident. The major events associated with the accident are shown in Table 6-1. Because court cases are still pending and because clean-up of Unit 2 and preparation for the restart of Unit 1 are incomplete, direct effects of the accident are still occurring. Thus, the description of the effects of the accident which are included in this analysis are necessarily limited.

6.2.2 Economic Effects

The direct economic effects experienced during the emergency period following the accident included interrupted local production and reduced local income and employment (Flynn and Chalmers, 1980; Commonwealth of Pennsylvania, n.d.). The losses were conspicuous during the first week of April but very minor subsequent to that time. The estimate of residents' total accident-related income losses (and gains) derived from the NRC Telephone Survey is probably the best measure of short-term economic disruption (Flynn, 1979). Net losses within fifteen miles of the site are estimated to be about $9 million. When expressed relative to annual income in the area, the income loss amounts to about 0.25 percent of annual personal income; employment losses were estimated to be of the same order of magnitude.

Evacuation costs were estimated to be of a similar order of magnitude—about $9 million (Flynn and Chalmers, 1980, p. 45). Because almost one-third of the population residing within 15 miles of the plant had evacuated, sales were down, production was disrupted, schools were closed, and conventions canceled. Yet, by 6 April 1979, one week following the accident, economic conditions in the region had largely returned to normal.

Economic losses to business firms are being considered in various class action lawsuits. The sectoral composition of these claims has recently been summarized by the Commonwealth of Pennsylvania. Within an approximate 20-mile radius of TMI, manufacturing firms are estimated to have lost $7.7 million in value of production. Only one-third of the firms reported having been affected, and of these, two-thirds reported

TABLE 6-1

THREE MILE ISLAND UNITS 1 AND 2
CHRONOLOGY

PRECONSTRUCTION PERIOD

November 1966: Public Announcement of Unit 1

February 1967: Public Announcement of Unit 2

CONSTRUCTION PERIOD

May 1968: Construction Permit for Unit 1 issued

November 1969: Construction Permit for Unit 2 issued

April 1974: Operating License for Unit 1 issued

OPERATING PERIOD

September 1974: Unit 1 begins commercial operation

February 1978: Operating License for Unit 2 issued

December 1978: Unit 2 begins commercial operation

17 February 1979: Unit 1 shut down for refueling

EMERGENCY PERIOD

Wednesday, 28 March 1979, 4:00 a.m.: Feedwater pumps supplying Unit 2 shut down.

Friday, 30 March 1979, 12:30 p.m.: Governor issues advisory that pregnant women and preschool children leave the region within a 5-mile radius of the plant and that all schools in the area be closed.

Saturday, 31 March 1979, 8:23 p.m.: AP reports story from NRC that hydrogen bubble could explode.

Monday, 2 April 1979, morning: Denton announces decrease in size of bubble and implies danger of explosion is less than originally thought.

Wednesday, 4 April 1979: Schools outside 5-mile radius reopen, but those within a 5-mile radius remain closed and the governor's advisory remains in effect.

Monday, 9 April 1979: Governor's advisory withdrawn.

Wednesday, 11 April 1979: Middletown area schools reopen.

POST EMERGENCY PERIOD

April 1979: EPICOR-I used to begin decontaminating water containing low levels of radioactivity stored in auxiliary building.

June 1979: Pennsylvania Public Utility Commission (PUC) refuses to allow TMI-Unit 2 to be included in Met Ed rate base.

August 1979: Petitions filed to intervene in federal hearings on start-up of TMI-Unit 1 (hearings scheduled for February 1980).

September 1979: Release of Kemeny Commission Report.

January 1980: Release of the Rogovin Report.

(Continued on Next Page)

TABLE 6-1 (Continued)

THREE MILE ISLAND UNITS 1 AND 2
CHRONOLOGY

March 1980: TMI accident anniversary.

10 May 1980: PUC grants interim rate increase; Unit 1 removed from rate base.

July 1980: First successful entry into Unit 2 reactor building.

29 October 1980: Unit 1 restart hearings begin.

9 December 1980: GPU files $4 billion suit against the NRC.

June 1981: Unit 1 restart hearings end; submerged demineralizer system begins processing high-level waste water.

January 1982: Federal Court rules that the issue of psychological stress must be included in the Unit 1 restart considerations.

that the effect was confined to the week immediately following the accident. Nonmanufacturing firms claim lost sales and services of about $74 million.

The agriculture and tourism sectors of the local economy were particularly vulnerable to the accident period effects. The tourist industry in southcentral Pennsylvania placed their TMI-related losses at $5 million. (Commonwealth of Pennsylvania, n.d..) These losses were generally confined to the one-month period immediately following the accident. Although there were a few conspicuous claims of adverse impact on agriculture, the farm community as a whole reported minimal losses due to the TMI accident. Ninety-six percent of farmers within a 25-mile radius of TMI reported no economic losses due to the accident.

The effects of the accident on real estate were studied both by the Commonwealth of Pennsylvania and by the NRC (Gamble, 1981). The Commonwealth of Pennsylvania concluded that housing and property values were not, in general, significantly or negatively affected by the accident. Further, no pattern of disinvestment related to the accident was discovered. The Gamble study came to similar conclusions. It states that there is no evidence that the accident at TMI had measurable effects on the value of single-family residential properties within a 25-mile radius of the plant (Gamble, 1981; p. 104). It reports that, although there was a sharp decline in sales within 10 miles of the plant for a 4-8 week period after the accident, the market then returned to normal. It is their judgment that properties on the market during this period subsequently sold at prices that would have prevailed in the absence of the accident.

Against this apparent backdrop of "return to normalcy," there is concern within the business community about the effect of the accident on the continued growth and development of the area—particularly the Metropolitan Edison Company's service area. Upon investigation, it appears that the concern is based not so much on abstract dimensions of the area's image, but rather on the potential effect of the accident on the cost of power. There is presently much confusion about the extent to which recent increases in the price of electricity are due to the accident. A study of the Metropolitan Edison service area conducted by Weston, Inc. showed that the cost of keeping Unit 1 idle is $95 million per year. The average residential customer has experienced a 50 percent increase in electricity costs over March 1979 levels, which is at least twice as great as residential increases in nearby areas over the same period. Rates for industrial uses have

increased even faster. There is a clear appreciation of the extent to which future prices depend on a complex set of future political/regulatory decisions. There is apprehension that the uncertainty of future electricity rates may significantly affect relocation and expansion plans, even if higher prices (relative to what they would have been) never occur.

6.2.3 Institutional Effects

The accident at Three Mile Island strained existing institutions in several respects. First, because a formal emergency was not declared, the role of the Civil Defense coordinators was ambiguous. Given the already fragmented responsibility for public safety in most of the municipalities in the area, this ambiguity was quite difficult to handle in some cases. Even in municipalities that were able to handle the structural problems smoothly, the potential exists for future difficulties should other actors occupy the roles.

It appears that interinstitutional friction was much less common during the 1972 Hurricane Agnes emergency than during the accident at TMI. The major difference appears to be that a formal emergency was declared in the case of the hurricane, but not in the case of the TMI accident. Consequently, for the hurricane emergency, there was less ambiguity about what needed to be done, who should do it, and when it should be done.

Second, it is clear that the lack of a specific evacuation plan prior to the accident complicated the work of local emergency agencies. Besides having responsibility for pre-operations planning and handling requests for information from the public, personnel at the emergency operations centers had to develop ad hoc plans that normally require months of input. In fact, although it is now more than two years since the accident and all of the local municipalities have invested considerable time in preparing better plans, many people believe that local authorities still have not completed satisfactory, integrated plans. In most instances, further refinements to the plans are ongoing.

Institutions other than emergency agencies were equally unprepared for the accident. Prior to the accident, those with responsibility for special populations, such as prisoners and hospital patients, had no plans for evacuating them. Furthermore, there was no procedure for identifying and evacuating the institutions' necessary records and equipment.

Third, the expansion of the antinuclear movement in the TMI area has affected, and will continue to affect, federal, state, and local decision making. At the local levels, antinuclear groups were instrumental in the passage of resolutions that opposed the reopening of TMI. The various groups have worked out affiliation interrelationships and have intervened in NRC and other regulatory hearings regarding restarting TMI Unit 1 and the recovery of Unit 2. They have also provided information to the public on the class-action suits.

Relationships among and within agencies at the federal level have been clarified or changed because of the accident. For instance, the NRC is now responsible for assessing on-site hazards, while the Federal Emergency Management Administration (FEMA) is responsible for coordination among all other federal agencies with support roles. The NRC itself has undergone a series of reorganizations in response to the accident and the findings of the various investigatory commissions.

The nuclear industry has funded three new organizations in response to the accident. These deal with training programs, analysis of incident reports from the plants and dissemination of their findings, and an insurance pool to cover the cost of replacement power in the event of an accident.

6.2.4 Individual Effects

The most significant effect of the accident on the people in the region was the evacuation experience. From newspaper accounts and interviews, it appears that the general public was not unduly alarmed during the first two days of the accident. However, on Friday, 30 March, some areas were scenes of chaos, with whole neighborhoods evacuating. Information regarding the plant was both threatening and confusing. Surveys show that much of the public was stressed and upset during the accident period. Approximately a third of the population of 370,000 within fifteen miles of the plant evacuated (Flynn, 1979). Those who evacuated traveled an average distance of 100 miles, were gone from home an average of five days, and spent an average of about $300 in additional expenses. Many in the area lost work and/or pay. On the other hand, some residents appear to have been affected very little by the accident; they remained calm and did not alter their daily routines.

The short-term effect on area households comprised both income losses and extraordinary expenses. About $1.2 million in insurance has been paid to area residents.

Those households having some members who evacuated incurred substantially greater costs than did other households. For instance, in the 15-mile ring, costs per household with evacuees averaged $296, while for nonevacuating households costs averaged $41. Assuming that the average annual family income in the area was about $17,000 (Flynn, 1979), these costs amount to losses on an annual basis of 1.75 percent of income for evacuating households and 0.24 percent for nonevacuating households.

For most people, the effects of the accident were short lived. Unobtrustive measures of stress (e.g., alcohol consumption) rose early in the accident period, but quickly returned to normal levels. Relative to the accident period, fewer people are worried today about emissions from Three Mile Island, fewer continue to see the station as a serious threat, and fewer show behavioral stress symptoms. To date, studies by the Pennsylvania Department of Health have failed to provide evidence of a measurable health effect due to the accident. But for some residents, the accident has caused a permanent change in their day-to-day activities and levels of stress. This is particularly true of those who are active in antinuclear groups. In addition, a small proportion of the general public has continued to experience economic effects or has made definite plans to move or to change jobs. These represent significant personal effects.

Opposition to the TMI station remains high; recent surveys indicate that about 50 percent of the people in the local area oppose the restart of Unit 1. There are several reasons for the opposition, including mistrust of Met-Ed and the NRC, concern about the stress effects of the restart, and continuing concern about the health effects of the accident.

While the most immediate effects of the accident have clearly been transitory, residents of the area recognize the potential for continuing effects as decisions are made with respect to the future of the generating facility. Their continuing vulnerability is a cause for both concern and resentment. The extent of their continuing anxiety will depend on their participation in the decision-making process, on their ability to recognize the logic of the decisions that are made, and on the credibility of the decision-making bodies.

6.3 Effects of the Accident on the Other Eleven Case Study Sites

6.3.1 Direct Economic Effects

6.3.1.1 Retrofitting

In the aftermath of the accident and the findings of the Kemeny, Rogovin, and congressional committees, the NRC revised several of its regulations (see especially NUREGs 660 and 0737). In order to comply with the new standards, substantial retrofitting was required for most operating reactors. For instance, the new regulations required an off-site technical center capable of monitoring the core at all times. In addition, the NRC ordered a brief outage for all Babcock and Wilcox reactors while additional safety modifications were made. In most cases, the required retrofitting was not complete by summer 1981. Some utilities estimated that it would take as much as two additional years to reach full compliance. The cost of the retrofitting varied depending on the design of the plant, but generally exceeded $15 million and was considerably higher at some sites ($40 million for Calvert Cliffs). The plants averaged some 1,000 person-months of effort to make the changes.

6.3.1.2 Training Programs

The new NRC regulations require that each control room operator spend at least one week per year training with a simulator. Many utilities already had such programs, but some did not. Calvert Cliffs bought its own simulator, at a cost of about $10 million, for the use of its operators. At a minimum, the utilities in the Post-Licensing Studies held one special training session for their operators to communicate the new NRC requirements. However, several utilities added personnel to their training staffs, increased the training period for new operators, or otherwise made major modifications in their training programs.

6.3.1.3 Emergency Planning

Evacuation plans were modified at all sites. In some cases the new plans are still being developed or reviewed by the NRC. Prior to the accident, the planning radius for evacuation at most sites was 2 to 5 miles; most utilities increased this radius to at least 10 miles after the accident. Another change common to most sites was the installation of additional sirens and/or communications equipment in the local communities. Some utilities have instituted ongoing public information programs. These programs use public meetings, the press, and leaflets to describe the new emergency plans. The costs to date for these programs range from about $400,000 to $10 million, with a median cost of $4 million.

6.3.1.4 Conclusions

To date, the cost of the TMI accident to utilities other than Metropolitan Edison has been substantial; most of the expenditures have not occurred in the local study areas and few of the extra personnel required were locally hired. Thus, the economic effects of the accident on the study areas have been minimal, except as the costs to the utilities may be reflected in future rate increases.

6.3.2 Issues Raised at Other Locations

During and immediately following the accident, all of the utilities involved in the Post-Licensing Studies issued statements to the press. Nearly all of the plants that had a design different from TMI emphasized this fact. At Oconee, which had a similar design, the good operating history of the plants was cited, and the safety modifications that were made to the plant were described. The new training programs for operators were also cited at Oconee. Given these factors, the owners of the Oconee plant pointed out that the risk of an accident occurring at that site was much lower than at TMI.

After the accident, the NRC required a review, and in most cases a revision, of the utilities' evacuation plans. Modifications of the plans usually took several months, and many are not yet complete. At most sites, evacuation planning was a public concern and improvements in the plans were heavily covered in the press. In some locations, there was public participation in the process of plan revision.

At most sites there was evidence of heightened and increased concern over existing nuclear stations. Public concern appears to have been short lived and minimal at some sites (Cook, Oconee, Surry, St. Lucie, Crystal River) and serious at others.

Residing 35 miles from TMI, residents of the Peach Bottom Study Area were not far removed from the uncertainty and trauma precipitated by the threatening events during the two-week emergency period. A telephone survey of 250 households in the Study Area five months after the accident showed that a majority of households in the Study Area prepared for a possible evacuation, though none of those interviewed actually evacuated (Pijawka, 1980). The survey showed that the TMI accident had minimal impact on the individual household's economic situation. The major consequences of the TMI accident on the Peach Bottom Study Area included: problems concerning the effect on local institutions; the emergence of public issues over the safety of the Peach Bottom

plant; the emergence of an environmental antinuclear interest group; and the initiation of independent planning efforts to mitigate the potential hazards of the Peach Bottom station. The latter included a set of rules to govern the shipment of low-level wastes from the Peach Bottom plant.

At the Diablo Canyon site, there was evidence to associate the heightened public concern with the Three Mile Island event. Interviews with antinuclear activists indicated renewed efforts because of TMI and a growing antinuclear constituency. Regional antinuclear organizations grew in size and commitment subsequent to TMI, and those that opposed Diablo Canyon also opposed Rancho Seco.

While public opposition to the Arkansas Nuclear One plant remained consistently low throughout its history, a small antinuclear group surfaced as a result of TMI. Although the group did not receive much public support, the fact that an opposition group had surfaced in Pope County was a noticeable event.

Examination of the 12 sites in terms of public response subsequent to TMI suggest a number of themes. At nearly all sites, concern over plant safety was heightened--at least this was reflected in available public attitude polls. However, expressions of concern manifested in the political arena varied by site. At those sites where active antinuclear opposition had previously occurred and where organizations were still intact and functioning, post-TMI activities expanded. At sites where operating problems had recently occurred and where environmental political organizations existed, concerns surfaced over evacuation plans and transportation of radioactive waste. The prime concern of nuclear host communities immediately after TMI involved the issue of evacuation plans. Except for those areas where licensing processing was on-going, the level of concern expressed soon after TMI declined appreciably after a few months.

In areas where little opposition to nuclear generating plants had historically occurred, there was minimal public activity as a consequence of TMI. At these sites, the accident at TMI was perceived to have resulted in additional regulatory safeguards for existing plants that resulted in increased safety for communities where plants are operating.

CHAPTER 7. THE SIGNIFICANCE OF SOCIOECONOMIC CHANGE DUE TO THE CONSTRUCTION AND OPERATION OF NUCLEAR GENERATING STATIONS

7.1 Introduction

The significance attributed to the nuclear plants represents the study team's overall estimate of the impacts of the plants and their effects. The criteria to determine significance include: (1) the magnitude of the effects; (2) the duration of the effects; (3) the distribution of the effects among social groups; (4) the evaluation of the effects by social groups; and (5) the relationship of the nuclear power plant and its effects to the other changes and issues occurring in the host areas.

7.2 Significance of Socioeconomic Change Across the Twelve Sites

7.2.1 Arkansas

7.2.1.1 Economic

Magnitude and duration

The economic changes attributable to the construction of the Arkansas nuclear plant were relatively large and important. Total employment by place of residence was estimated to be about 1,450 persons and this constituted about 14 percent of the labor force (place of residence) in the Study Area. The changes brought about by the plant occurred at a very critical time in the economic history of the area. During the 1960s, substantial in-migration had occurred to reverse a long and serious historical out-migration. This in-migration resulted from major public work efforts on the Arkansas River and the location of a number of industries in the area. The decision to construct a nuclear power plant near Russellville, the building of which was to last a decade, resulted in the stabilization of the economic and demographic base. Many construction workers remained in the area permanently because of the plant; in fact, over 70 percent of the work force were noncommuters.

In 1977, the year of peak construction, there were 951 direct basic jobs and 125 "other" basic jobs (public service jobs and school-related) from plant tax revenues. Together with nonbasic employment, the total employment of over 1,400 jobs generated an increase of over $17 million, much of which remained in the Study Area. From a historical perspective, the construction of the nuclear plant was an important stabilizing element, coming as it did at the start of a period of industrial growth in the Study Area.

Although the number of workers fluctuated at the site during the construction period, the economic changes were long-lasting ones. There is a sizable operations work force, and TMI-related changes to the plant have presently resulted in the construction of a large ancillary emergency building that employs a sizable work force. Moreover, there are currently an estimated 125 teachers and administrator positions in the Russellville School District that are attributable to plant revenues.

The industrial and urban growth of Russellville that took place at the same time as the construction of the nuclear facility reduced the relative importance of the plant's economic effects and level of perceived impacts. Yet, as a result of plant expenditures, a number of individual firms were able to expand and diversify their inventory. Consequently, these firms were placed in a strong competitive position and their market area expanded. Russellville became a more important regional center of economic activity. In the context of the substantial development that had taken place in the Study Area over the study period, the importance of the plant's economic effects, in terms of both duration and magnitude of effects, should not be underestimated; it was an important project for the community.

Distribution/evaluation

The overall evaluation by Study Area groups of the economic effects was mixed. With respect to the importance of these effects on the particular groups, the blacks, for example, assessed the economic changes as very unimportant to them. The business community and the wage and salary workers, on the other hand, expressed the view that the economic effects were generally important. These assessments were also strongly related to the groups' awareness of the magnitude of the economic impacts and their duration. Key informants representing the black community indicated that they did not obtain plant-related jobs or income nor did they regard the economic effects as particularly relevant to their group. Although the business community was the recipient of worker and construction-related plant expenditures, the economic gains to the group were evaluated as small, positive, and short-term. There were a number of reasons given for this evaluation. The Russellville area was expanding rapidly during the period of construction and operation of Arkansas Nuclear One, and as the interviews with commercial retailers pointed out, it was difficult to assign changes in the volume of retail business to the nuclear power plant. Moreover, the introduction of large department stores on the periphery of the central business district resulted in the dispersion of economic activity away from the downtown area where the Study Area's

traditional business community was located. This further diminished the potential for a major economic stimulus to the business group residing in the area prior to construction. At present, the downtown area is experiencing some economic difficulties as the suburban areas of the city are expanding. This fact has reinforced the evaluation of the plant's economic effects as being generally short-term.

A large proportion of the farmers in the Study Area supplemented their farming income with industrial employment and a number of farmers subsequently obtained construction employment at the nuclear site. The key informants accurately assessed the degree to which members of the farming community worked on the plant, evaluating the economic changes as limited but positive and short-term. However, the overall importance of the economic changes to the group was evaluated as unimportant. The effects of the plant were underplayed partly as a response to the availability of alternative and long-term employment opportunities. While only two groups perceived economic effects to be important to their respective group, all groups in the Study Area indicated that the effects were important to the Study Area as a whole.

Overall

The overall significance of the economic effects of construction and operation of the Arkansas nuclear station was rated as high. The labor force effects were well in excess of 10 percent, the economic effects were long lasting, and the effects were perceived to be important by two groups in the Study Area.

7.2.1.2 Demographic

Magnitude/duration

Demographic effects of the project on the Study Area were relatively large. These effects included: (1) the prevention of the out-migration of a sizable indigenous construction work force and their families, and the in-migration of over 2,500 persons during the peak construction year. Over 150 construction workers and their families who in-migrated into the area to work on the plant permanently relocated at the end of construction. The population increase due to the facility ranged from 1.5 percent in 1969, when construction began, to 8.5 percent in 1977, the peak year of construction.

Distribution/evalution

Project-related in-migration was viewed as important by each group except the black group which did not experience additional in-migration as a result of plant construction.

Overall

The overall significance of the demographic effects of construction and operation of Arkansas Nuclear One was rated as moderate. Population changes at peak construction were between 5 and 10 percent of the resident population and were evaluated by local groups as being important.

7.2.1.3 Housing

Magnitude/duration

The growth in housing was significant during the study period; in 1977, the peak year, the estimated project-related housing demand accounted for 6.2 percent of the total county housing stock. The large demand for housing did not result in housing shortages: the in-migrants were readily accommodated in new homes, expanded mobile home parks, and apartment buildings. Once construction ended, there were no major housing problems because the demand for housing continued through non-plant-related in-migration.

Distribution/evaluation

The study found that the construction and operation of the nuclear plant was a catalyst for the expansion of the housing sector. For the business community, the growth in housing was considered to be a significant benefit to the group and the Study Area. The blacks were not affected by plant-related changes to the housing sector and, consequently, they did not perceive such effects to be particularly important to the community per se.

Housing availability was not considered to be a problem for the construction and operations workers, nor for non-plant-related in-migrants. A number of farmers however, viewed the expansion of the housing sector as an encroachment into the rural areas, resulting in land use conflicts. Consequently, the farmers' general assessment of housing changes due to the plant was somewhat negative.

Overall

The overall significance of the housing effects of the project was rated as moderate. The demands on local housing were significant although there appear to have been no shortages.

7.2.1.4 Public Sector

Magnitude/duration

All groups evaluated the revenue effects of the plant on the Russellville School District as the most significant positive and permanent impact. Prior to construction of the plant, the existing level of tax revenues and state and federal revenue sharing were not sufficient to provide the operating basis of the local school system. Today, the school district is one of the leading districts in the state.

Distribution/evaluation

The revenues paid by the utility for the Arkansas Nuclear One facility were assessed by all groups in the Study Area to be important both to their group and to the Study Area. The effects were evaluated as very large, positive, and permanent. Of particular importance was the revenue effect on the Russellville School District. Farmers who resided outside the jurisdiction of the school district, however, evaluated the revenue effects of the plant as less important than did those farmers or other groups who resided within the district. The changes in the school district were identified as the most significant and positive effects of the nuclear plant. The expansion, upgrading, and improvement of the quality of education in the school district, viewed as a direct result of plant revenues, was also considered to have important secondary effects. Thus, the nuclear plant was seen as an important factor that contributed both to the stabilization of the community and to the in-migration of professional and affluent families. This attitude was generally shared by all social groups.

Overall

The overall significance of the fiscal effects of Arkansas Nuclear One was rated as high. The effects were very large and significant and judged as such by area groups.

7.2.1.5 Social

The in-migration of both construction workers and their families and nonbasic workers did not have any negative social effects. The plant-related in-migrants were not conspicuous as a distinct group and were readily integrated into the established community social patterns. The fact that in-migration to the Study Area was occurring at a very rapid rate during the study period and that the area had experienced a major population turnover, diminished the likelihood of a strong traditional/newcomer social split. In terms of demographic characteristics, the in-migrants did not markedly differ from the established residents. The social indicators examined to measure social change

found no adverse impact. Social structure and social process changes attributable to the plant were not apparent; the study period was a period of major socioeconomic transition that had little to do with the nuclear plant. Overall, the social effects of the project were rated as having low significance.

7.2.1.6 Overall Significance

Although concern over the risks of the nuclear plant increased following the Three Mile Island (TMI) accident, and became somewhat heightened during a leak of cooling water, the groups in the Study Area generally discounted the probability of a major accident and the risks inherent in normal plant operations. The facility was accepted as an important element of the community and symbolic of the industrial development that had taken place during the last 15 years. It is important to note that growth in industrial employment and in-migration to the Study Area were regarded as salient community values and historical objectives. The fact that Pope County had experienced two decades of out-migration and economic instability reinforced the importance of growth as a community norm. The economic and fiscal effects resulting from plant construction and operation were evaluated within a larger historical and value-laden context. As such, the effects of the plant generally were viewed as positive, outweighing perceived risks.

Based on the highly significant economic and fiscal effects, the moderately significant demographic and housing effects, and the social effects of low significance, the overall significance of the Arkansas Nuclear One station has been rated as being from moderate to highly significant to the Study Area in which it was constructed and is operating.

7.2.2 Calvert Cliffs

7.2.2.1 Economic

Magnitude/duration

According to Study Area key informants, the economic effects of the Calvert Cliffs nuclear plant were evaluated as very important. During the construction period, project-related employment reduced the county's unemployment rate, increased occupational mobility and labor force participation rates, and upgraded skills of local crafts workers. Project-related employment of Study Area residents (both movers and nonmovers) was significant—approximately 1,600 persons during the peak construction year. This represented about 20 percent of the total Study Area labor force.

Of the various Study Area groups, the construction workers, native countians, blacks, and newcomers received the majority of the jobs. By 1978, the total number of project-related jobs had decreased to about 650 workers (5 percent of the total Study Area labor force); the same groups (minus the construction workers) were the recipients of the employment and income.

Distribution/evaluation

In Calvert County, three groups indicated that they did not receive any economic benefits from plant construction and operation. These groups were the elite (owners of large land estates), the watermen, and the retirees. However, except for the watermen, all the groups considered the economic effects to be a significantly important factor for the county. The area's blacks obtained a large share of the construction jobs, and interviews with key informants representing the black community indicated that construction jobs were considered to be very important to the well being of the group. However, the jobs were not permanent and, as construction ended, so did many of the economic gains resulting from the jobs at the plant site.

Overall

Due to the relatively short duration of the majority of the project-related economic effects, their overall significance was rated as moderate.

7.2.2.2 Demographic

Magnitude/duration

Together, the in-migration of project-related workers and the reduced out-migration of Study Area residents resulted in large numbers of project-related persons in Calvert County: over 1,500 workers and their families between 1970 and 1974. During the peak project years (1971-1973), this population change was approximately 2,800 persons, or about 10 percent of Calvert County's total population. By 1978, however, the population change declined to about 1,240 (or 4 percent of the county's total population).

Distribution/evaluation

The Study Area groups were differentially affected by this population change. The construction worker group (by definition) was the recipient of the greatest number of project-related people. The native countians and blacks also received a significant portion (principally due to reduced out-migration). The elite and the watermen were largely unaffected by the project, while the business and professional group grew as a

result of nonbasic project-related employment and income. The number of suburbanites and retirees rapidly increased; however, their growth was not a result of the Calvert Cliffs plant. Key informants for each group indicated that the project-related demographic effects were important to the Study Area.

The black community assessed demographic effects to be more important than did the other groups. This was the result of the sizable diminished out-migration in this group which enhanced social stability. The reduced out-migration, especially of young persons, was evaluated as especially important to the black community.

Overall

The overall significance of the demographic effects of the project was noted as moderate.

7.2.2.3 Housing

Magnitude/duration

The large number of in-migrating project-related workers and their families resulted in significant demands being placed on Calvert County housing. As a result, rents and property values rose, new dwelling units were constructed, seasonal units were converted to year-round use, and rooms were rented. Most of the increased rental costs were paid by new in-migrants (particularly construction workers, new business and professional people, and other newcomers).

Distribution/evalution

Two groups indicated that they were not affected by changes in the housing sector—the elite and the watermen, who owned homes. Both these groups did not consider housing as an important effect to the county. The business group, however, included owners and managers of the construction and realty industries, which benefited from the plant-related expansion of the housing sector; thus they evaluated the housing impacts as very positive and significantly important to both themselves and the community. The beneficial aspects of the growth in the housing sector were nevertheless viewed as temporary. For the blacks in the Study Area, the increased level of employment at the construction site resulted in the upgrading of existing homes and the buying of new homes. For the blacks as a group, this was an extremely important development. Following the end of construction, and the disappearance of black

employment on the project, problems in upkeep and home ownership emerged to a limited degree.

For the newcomers/suburbanites (including construction workers), the construction of the nuclear station resulted in high rents and problems in housing availability. Consequently, members of this group evaluated the housing effects as negative. Availability improved after construction ended. Native countians, of whom 25 percent were renters, also assessed housing effects as negative. This was a reflection of the escalation in prices of rental housing as a direct consequence of increased demand for housing by construction workers.

The retirees in the Study Area were cognizant of few housing effects because of the nuclear plant. They were affected in both positive and negative ways, depending on length of residence. To illustrate, rentals by construction workers aided in upgrading seasonal homes to year-round housing for those retirees who already owned seasonal homes. In-migrating retirees found home purchase prices either high or not available due to competitive demand.

Overall

The overall significance of the housing effects of the project was rated as moderate.

7.2.2.4 Public Sector

Magnitude/duration

The revenue effects were the most obvious and significant impacts on the Study Area. Project-related revenues began to accrue to the local area in 1975 when Unit 1 went into commercial operation. By 1978, taxes paid on the nuclear plant accounted for about 50 percent of Calvert County's total revenues.

The project-related revenue was used to upgrade and expand public services, establish new programs, make capital improvements, and lower the tax rates for both property taxes and the local share of state income taxes.

Distribution/evaluation

The facilities and services benefits of the tax revenues were shared equally by the Study Area groups in most cases. However, property owners and persons liable for the

largest income tax payments were the most affected by tax reductions. While members of each group benefited, the elite, the large landowners among the native countians, the business and professional group, and the suburbanites were most positively affected. Key informants for each group evaluated these effects as either important or very important.

Overall

The overall effect of the Calvert Cliffs station on the public sector of the Study Area was unquestionably high. There were significant effects on both the revenue and the expenditure sides of local government budgets. Not only were revenue flows increased, but the tax burden on local residents was reduced. These effects were recognized by local residents and considered very significant.

7.2.2.5 Social

Generally, the nuclear power plant did not induce major changes in social structure or processes. The elite and watermen were outside the locus of activities that could be impacted by plant-related changes. However, there is evidence that leadership roles were modified. As business expanded and diversified, the local power base of the business/professional group expanded while the traditional power base of the elite/agriculturists declined. The black group became more independent through increased levels of income and employment, with renewed community spirit. To the blacks, this change was recognized and evaluated as positive and important. To other groups, the shift in leadership roles was not a critical factor nor was this shift evaluated as important. To many, this shift was viewed in a context of modernization, and only partially as a result of the plant. Overall, the significance of social effects due to the plant was rated as low.

7.2.2.6 Overall Significance

Construction and operation of the Calvert Cliffs nuclear station produced economic, demographic, and housing effects that were all rated as being of moderate significance. The most significant changes were those experienced in the local public sector as a result of increased revenues. These were rated as being of high significance. There were some social effects of the project, but they were rated as being of low significance. In sum, the effects of the Calvert Cliffs nuclear station on the Study Area were judged to be of moderate overall significance.

7.2.3 Cook

7.2.3.1 Economic

Magnitude/duration

In general, Study Area residents considered the economic effects of the D. C. Cook nuclear plant as short-term and beneficial, but not critical to local employment activities. During the peak construction year, approximately 165 Study Area residents obtained project-related employment: 140 in basic jobs (50 nonmovers and 90 movers), and 25 in indirect and nonbasic jobs. By 1978, the number of jobs had decreased to 90. Although the project-related jobs represented a substantial proportion of the total number of jobs located in the Study Area, they accounted for less than 6 percent of the total number of jobs held by Study Area residents during the peak construction year. Moreover, the relatively dense settlement pattern, scattered industrial locations, and the high rate of commuting diffused the effects of changes in employment opportunities.

Distribution/evaluation

Of the employment created by the D. C. Cook nuclear station, approximately two-thirds was obtained by long-term residents and one-third by Lakeshore property owners. The "other newcomers" groups was not generally a recipient of project-related jobs. In general, these three major social groups considered the economic effects to be of a relatively small magnitude. While the "other newcomers" and "long-time residents" viewed the effects as positive, the Lakeshore property owners, who were relatively affluent and/or seasonal residents, expressed the view that the economic changes were neither positive nor negative.

Overall

The economic effects of the D. C. Cook station were rated as being of low significance.

7.2.3.2 Demographic

Magnitude/duration

While the total project-related population increase reached 175 persons in the peak construction year, this accounted for only about 5 percent of the total Study Area population.

Distribution/evaluation

Within the Study Area, the other newcomers group consistently received almost all of these people. Nevertheless, the in-migration of project-related people to the Study Area was only one of a number of factors causing changes in the area's demographic characteristics. The other newcomers and the lakeshore property owners groups also increased in size due to non project-related in-migration. In general, members of Study Area groups evaluated the demographic effects as unimportant.

Overall

The overall significance of the demographic effects of the D. C. Cook station was rated low.

7.2.3.3 Housing

Magnitude/duration

Due to the region's dense settlement patterns, good road network, and numerous alternatives for residential locations, only minimal project-related housing effects were discerned. The project-related demand generally accounted for only a fraction of the new residential units constructed.

Distribution/evaluation

While the longtime residents were the major landowners, developers, and realtors who benefited from increased real estate activity, key informants from each Study Area group evaluated the project's housing effects as unimportant.

Overall

The overall significance of housing effects was rated as low.

7.2.3.4 Public Sector

Magnitude/duration

In terms of project-related effects on the Study Area government and on public services and facilities, the construction and operation of the D. C. Cook nuclear plant increased tax revenues to Berrien County, Lake Township, and the Bridgman School System, while the project-related increase in the demand for public services and facilities was small. Both the township and the school district expanded the scope and improved the quality of the services they provided as a result of the project-related

increase in the resource base. In addition, the school system reduced their millage rates throughout the Study Area.

Distribution/evaluation

The effects of the increased provision of services and the reduced property tax rates were not evenly distributed among the Study Area groups because of differential property ownership characteristics and because Bridgman did not share equally in the property tax revenues. In general, the lower taxes resulting from the plant revenues were not perceived as particularly important to the groups, particularly the lakeshore property owners who, on the whole, perceived few benefits. Their perception was strongly associated with their view of the health and environmental problems that would result from the plant. This group most actively opposed the establishment and operation of the plant and perceived that the risks of the plant outweighed any of the benefits.

Overall

Even though public sector effects were not uniformly perceived as important by area residents, they were rated as of moderate significance because of the substantive changes they effected in the scope and quality of public services.

7.2.3.5 Social

In terms of social characteristics, the construction and operation of the D. C. Cook nuclear plant was the catalyst for several changes, primarily in group intra-action and interaction patterns. For example, opposition to nuclear power and to construction practices at the D. C. Cook plant prompted the lakeshore property owners to organize and participate in the legal opposition to the project. Moreover, the project precipitated a marked change in the political and social relationships among the groups in the Study Area. Overall, these social effects were rated moderately significant.

7.2.3.6 Overall Significance

While the public sector and social effects of the D. C. Cook station were evaluated as being of moderate significance, the economic, demographic, and housing effects were all rated as being of low significance. On this basis, the overall significance of the D. C. Cook station to the Study Area was rated from low to moderate.

7.2.4 Crystal River

7.2.4.1 Economic

Magnitude/duration

The primary plant-related economic effects in Citrus County were basic and nonbasic jobs and income for Study Area residents: 625 county residents held project-related jobs in 1973; 267 in 1978. This represented approximately 5 percent of the county's total labor force during the peak construction year. Thus, the number of project-related jobs was small compared to the total work force, and most were short-term in duration.

Distribution/evaluation

The majority of the project-related jobs and income were distributed to the wage and salary workers, while the business community benefited primarily through the expenditure of project-related income. Nonetheless, all five Study Area groups evaluated the economic effects as positive and important to the county.

Overall

The rapid growth and economic development which occurred in the county during the study period, including the construction of Crystal River Units 1, 2, 4, and 5, make an overall evaluation of the significance of the economic effects of Unit 3 difficult. It was nonetheless determined that the significance was low to moderate.

7.2.4.2 Demographic

Magnitude/duration

The distance from a major metropolitan center, the lack of stringent mobile home regulations, and the construction of new dwelling units, prompted a large number of project-related workers and their families to move to Citrus County. During peak construction, an estimated 860 persons in-migrated to the Study Area. Of these, approximately two-thirds were classified in the wage and salary workers group, and one-third became members of the business community. (This represented approximately 8 to 10 percent of both groups' total population.) While the project-related in-migration continued to be several hundred people (430 in 1978), its share of the total population decreased due to the rapid growth of the Study Area population. At no time was the project-related in-migration large enough to significantly affect the Study Area's demographic characteristics.

Distribution/evaluation

The demographic effects were concentrated in only two groups: the business community and the wage and salary workers. The groups' evaluation of the importance of those effects corresponded to the distribution of effects; that is, those groups not receiving project-related workers viewed the demographic effects as unimportant to themselves and to the Study Area, while the business community and the wage and salary workers evaluated the in-migration of project related workers as important.

Overall

The overall evaluation of the significance of the demographic effects was rated as low due to the large in-migration of non-project-related persons.

7.2.4.3 Housing

Magnitude/duration

While the project did play an identifiable role in the area's increased residential and commercial development, settlement patterns in the county were not significantly affected. However, the construction and operation of the nuclear plant did contribute to the increased number of dwelling units in the county (particularly during construction). Moreover, the demand for housing by project-related workers contributed to an overall increase in the price of housing in Citrus County. While the nuclear plant played a role in these changes, an equally important factor was the in-migration of non-project-related people, notably retirees.

Distribution/evaluation

The in-migration of construction and operation workers increased the demand for housing and resulted in an increase in single-family homes (primarily for operation workers) and mobile homes (primarily for construction workers). Members of the business community were the primary benefactors of the increased real estate development and rental activities. Not surprisingly, group members evaluated the housing effects as very positive and as important to their group and to the Study Area. While key informants of the remaining groups also considered the housing effects as important to the Study Area (even if they were not seen as important to group members), the primary effects of concern to them were perceived as increased rental prices and shortages of rental units.

Overall

The overall evaluation of significance of housing effects was low to moderate.

7.2.4.4 Public Sector

Magnitude/duration

The major project-related government and public services effects were the increased assessed valuation of property in Citrus County with the resulting increase in property tax revenues and concomitant decrease in millage rates. The majority of the increased project-related tax revenues went to the county and to the Citrus County School District. These revenues accounted for approximately 12 percent of the total revenues for both districts, but not until FY 1977/1978. The presence of Crystal River Units 1, 2, 4, and 5 was important to the county's tax base as was the non-project-related growth. While there were no significant project-related effects on public services and facilities during the study period, the non-project-related growth required continued upgrading and improvement of the public infrastructure.

Distribution/evaluation

The significance of the project-related effects on public facilities/services and property taxes was evaluated in a similar manner by each of the Study Area groups. The plant-related increased tax revenues and improved public services and facilities were generally perceived as being long-term, positive, and important to each group and to Citrus County. The Unit 3 effects were typically not separated from the effects of the coal-fired generating plants

Overall

The project-related public sector effects were rated as being of moderate significance to the Study Area.

7.2.4.5 Social

While the Study Area experienced a rapid in-migration of people during the study period, there were relatively few changes in group profiles or interaction patterns. Of those changes, none could be directly attributable to the construction and operation of Crystal River Unit 3. The Crystal River plant was rated, therefore, as having no social effects on the Study Area.

7.2.4.6 Overall Significance

The construction and operation of Crystal River Unit 3 in Citrus County resulted in minimal to moderate impacts to the Study Area for each of the effects examined except social where it was determined there were no effects. In terms of the entire population of Citrus County, the collective significance of the effects due to the presence of the nuclear plant was evaluated as being from low to moderate significance when compared to the total socioeconomic changes that occurred in the county during the study period.

7.2.5 Diablo Canyon

7.2.5.1 Economic

Magnitude/duration

The construction of the plant has taken place over a ten-year period and major retrofitting activity is currently taking place. Construction activity increased steadily over this time period and, therefore, no economic "boom" evident. At construction peak, the 3,500 persons at the site comprised 8 percent of the county's jobs. This decreased to 4 percent during 1978, but the increase in the in-migrant labor force amounted to only 1.3 percent of the Study Area's labor force. The relative importance of the plant was reduced due to the expansion of economic activities and the growth in population and housing during the study period. The diversification of the economic base of the area reduced the economic significance of the plant. The plant had two secondary effects--stabilizing the tourist industry and stimulating construction activity during a period of low demand. Both effects, however, were temporary and would have taken place, although perhaps more gradually, without the construction of the plant.

Distribution/evaluation

The business group placed moderate importance on the secondary effects of the station, but generally did not perceive the plant to have played a major role in the economic development of the area. San Luis Obispo County was a growth area without the plant. In fact, the agricultural, the elderly, and the Hispanic groups rated the plant as unimportant to the economic well being of their groups and to that of the area as a whole. The effects were largely concentrated in the Pismo Beach area, a transient/recreational area. Proprietors indicated that, when the tourist industry had finally become viable, they could not strongly differentiate between construction workers and other groups. Outside of the Five Cities area, the economic effects were diffused and

were not considered to be significant. The Hispanic community, which had the most to gain from direct employment at the site, did not directly benefit.

The direct effects of the plant were generally viewed as being of limited importance and primarily affecting members of the business community. The general perception was that the benefits of the plant were geographically concentrated and even these had diminished because of the substantial nonplant economic growth.

Overall

The economic effects of the Diablo Canyon station have been rated as of low significance to the Study Area in the context of the other changes characterizing the region.

7.2.5.2 Demographic

Magnitude/duration

The demographic increases associated with the plant were not important. In 1975, the peak construction year, the total plant-related population increase was 2.5 percent of the total population; in 1978, it was 1.5 percent. These increases represented but a small fraction of the substantial in-migration during the study period. The plant-related in-migrants were not conspicuous, nor did they alter social structure and process in any noticeable way.

Distribution/evaluation

Population effects were evaluated as unimportant by all Study Area groups.

Overall

The significance of the demographic effects was rated as low.

7.2.5.3 Housing

Magnitude/duration

The demand for housing units was estimated at 2.6 percent of housing stock and this was easily met. In terms of the relative magnitude of project-related housing growth, the geographical extent of housing demands, and the impact on housing and rent values, the effects due to the plant were minimal.

Distribution/evaluation

Overall, the in-migration of construction workers and their families was evaluated as unimportant to the groups or to the area. This was also true of the housing effects on the groups; the construction workers primarily rented apartments or motel rooms in the Pismo Beach area and consequently did not exert any pressure on housing availability or rental prices. The fact that this area was oriented to transients and catered to the tourist market mitigated adverse impacts that may have resulted from accommodating such a large construction work force.

Overall

The housing effects of the Diablo Canyon station were rated as being of low significance to the Study Area.

7.2.5.4 Public Sector

Magnitude/duration

The revenues generated by the plant were viewed as positive by most groups and as moderately important. However, no major improvement in public facilities, social programs, or reductions in the tax rate could be attributed to the plant. The fiscal changes were dispersed throughout the county budget.

Distribution/evaluation

All groups in the area except the Hispanics evaluated the tax revenues from the Diablo Canyon plant as important to their group and to the Study Area, although these effects were not felt to be particularly large relative to concerns with environmental impact and safety associated with the plant.

Overall

The overall significance of the public sector effects was rated low.

7.2.5.5 Social

Overall, the project had little effect on the size or characteristics of the social groups. The farming community, the elderly, and the Hispanics were not affected by plant effects. Little interaction occurred between the construction workers and the indigenous social groups, thus minimizing any social conflict and change in social interaction pattern. The controversy over the plant, however, reinforced and amplified the polarity of value positions in the area and it was concluded that the plant was an

indirect but contributing factor to increased group participation in environmental concerns. Overall, the significance of the social effects on the Study Area was rated as low.

7.2.5.6 Overall Significance

The overall significance of the Diablo Canyon station must be considered in the context of the public debate over the safety of the station. According to key informants, the nuclear plant is not a major political issue in terms of requiring local level decisions; rather, the consensus is that the controversy over the plant has fluctuated over time. With the exception of those who actively oppose the plant or are strongly concerned about its safety, local key informants indicated that the Diablo Canyon plant often was not identified as the major problem in the county and, in a few cases, was not mentioned at all. However, a recent, partially released poll suggests that most residents may harbor deep-seated concerns about the safety of the plant, particularly over the seismic hazard.

Each of the key informants indicated a high level of satisfaction with their residence in the county. Mention was made of the small town quality of the urban centers, the invigorating yet mild climate, the importance of the coastal environment, and the favorable social milieu. The special environmental qualities of the Study Area attracted and are continuing to attract a substantial in-migration of affluent elderly and professional people despite proximity to the Diablo Canyon plant. The existence of a nuclear plant and the possibility of its operation have not detracted from the general benefits of living in the area: the value of homes and property has escalated sharply during the study period.

Thus, based both on this evaluation and on the detailed consideration of the plant's economic, demographic, housing, public sector, and social effects—all of which have been rated as of low significance—the overall significance of the Diablo Canyon station to the Study Area is rated as low.

7.2.6 FitzPatrick/Nine Mile Point

7.2.6.1 Economic

Magnitude/duration

While many changes occurred in the economies of the Study Area (Oswego City and Scriba Town) and in Oswego County, including the effects related to the construction

of the Nine Mile Point nuclear plant, the overall character of the economy in both the Study Area and the county remained unchanged. The size and diversity of the Study Area economy prevented it from being overwhelmed by the project-related economic effects. Moreover, the prior presence in the area of the Niagara Mohawk Power Corporation as a major employer meant that the presence of the nuclear plant introduced neither a new type of employment nor a new employer.

During the peak construction period, project-related employment accounted for 6 to 8 percent of the jobs held by Study Area residents. Even though a large proportion of the project-related economic effects were temporary in nature, the employment and income enhanced the relative economic position of skilled craftworkers and some entrepreneurs, and also provided jobs for a variety of other wage and salary workers and contributed to the local economy.

Distribution/evaluation

Of the three major social groups, only the business community and the wage and salary workers identified major economic effects of the plant; the university group was not aware of any major effects. The business community viewed the economic effects as important for their group specifically, and for the community in general, because the plant-related effects injected jobs and income into the economy at a particularly critical time when revitalization was needed. The wage and salary workers benefited from the jobs made available by the project and, like the business group, evaluated the economic effects as large, very positive, and very important for their group's well being and that of the community. The university community was removed from experiencing any employment effects, and thus considered the economic effects of lesser importance.

Overall

In general, the Study Area residents evaluated the economic effects as very positive and the overall significance was considered moderate.

7.2.6.2 Demographic

Magnitude/duration

The demographic effects of the Nine Mile Point nuclear plant were closely tied to project-related employment and Study Area housing conditions. During the study period, the project-related population accounted for a varying percentage of the Study Area population, ranging from 1.6 percent to 10.7 percent (when the population increase

reached 2,590). Because of the diverse characteristics of the existing Study Area population and the presence of people with attributes similar to those of the project-related population, the project did not cause major changes in the area's demographic characteristics.

Distribution/evaluation

Of the Study Area groups, the wage and salary workers and the entrepreneurs received almost all of the population effects (which included the retention of potential out-migrants as well as the in-migration of project-related workers and their families). Not surprisingly, the affected groups evaluated the demographic changes as important.

Overall

The overall significance of the demographic effects was rated as low to moderate.

7.2.6.3 Housing

Magnitude/duration

The total demand for project-related housing ranged from 210 to 890 units, almost half of which was demanded by nonmovers. Although the demand represented less than 10 percent of the Study Area's total housing stock, when combined with other pressures on the housing market, it contributed to the increased costs and the decreased availability of housing in the Study Area.

Distribution/evaluation

Housing effects were experienced in diverse ways by each of the three social groups: the entrepreneurs benefited from increased real estate activity; long time members of the wage and salary workers obtained rental income; and newcomers to the wage and salary group and the university group competed for housing and were affected by increased housing costs. In general, group members evaluated these housing effects as important.

Overall

The overall evaluation of significance indicated that the housing effects were considered moderate.

7.2.6.4 Public Sector

Magnitude/duration

Four governmental jurisdictions—Oswego County, Scriba Town, Oswego City, and the Oswego City Consolidated School District—received substantial increases in tax revenues due to the Niagara Mohawk nuclear plants. For example, in 1978, plant-related property taxes represented 5.4 percent of the total county revenues; 73.6 percent of Scriba Town's total property tax revenues; 27.4 percent of the school district's total property tax levy; and 9 percent of Oswego City's total sales tax revenues. In general, the increased revenues were deemed adequate to meet the project's associated demands on public services and facilities. Several public facilities were upgraded as a result of project-related demand and resources. These included schools, roads, recreational facilities, and Scriba Town's local governmental facilities.

Distribution/evaluation

Tax revenues from the plant were generally viewed as positive and moderately important to the Study Area; the university group, however, did not feel that the tax revenues aided their group, but did benefit the community at large.

Overall

The significance of project-related public sector effects was rated as moderate.

7.2.6.5 Social

Changes in the characteristics of the functional groups in the Study Area were the result of a combination of economic, political, and social processes in which the Nine Mile Point stations did not play a dominant role. This was particularly true of the changes that occurred in the interaction and intraaction patterns of the groups in the Study Area during the project period. The opportunities and challenges presented by the nuclear plant increased the dynamics of the social processes in the Study Area. However, the project did not introduce a major new social group into the Study Area, nor effectively alter the characteristics of the existing population. Since the effects on the Study Area's social structure were minimal, social effects of the plant are rated as not significant.

7.2.6.6 Overall Significance

The FitzPatrick/Nine Mile Point nuclear station had economic, demographic, housing, and public sector effects which were all judged to be of moderate significance

(demographic was actually rated low to moderate). Social effects were judged to be of no significance. On this basis, the overall conclusion is that the station was of moderate significance to the Study Area.

7.2.7 Oconee

7.2.7.1 Economic

Magnitude/duration

The employment effects of the Oconee plant were moderate and were focused on the construction period; Study Area residents hired for plant operations were few in number and tended to fill the less skilled jobs. Employment and income effects during construction were diffused throughout a larger region and only about 25 percent of the effects occurred in the Study Area, with most workers commuting outside the area. On-site employment at peak construction was estimated to be only 1.8 percent of the total employment in the Study Area. While increases in the area's per capita income and in male labor force participation rates were associated with the building of the station, these were short-run changes.

Distribution/evaluation

The analysis of group evaluation of the effects of the Oconee nuclear station showed that the groups generally did not experience any large economic impacts. The retirees felt that employment and income from building the plant were irrelevant and unimportant to them, yet they indicated that economic effects were moderately important to the Study Area as a whole. The remaining Study Area groups assessed the economic effects as generally important to them. No one group, however, indicated that the income effects were significant and long lasting.

Overall

The overall significance of economic changes due to the plant was low.

7.2.7.2 Demographic

Magnitude/duration

Two components of population increase due to the Oconee Nuclear Station were in-migration and diminished out-migration. The in-migration effects were greatest at peak construction when an estimated 540 persons in-migrated (1.3 percent of Study Area population). This effect declined sharply when construction was completed, but increased slightly during operations as the on-site work force increased. Diminished out-migration was due to direct basic employment, and to the large proportion of local

residents who obtained the "other" basic and nonbasic jobs. Due to the "other" basic and nonbasic employment, diminished out-migration recorded a steadily increasing trend throughout the study period. The total population effects were greatest at peak construction, equalling 1.7 percent of the Study Area population. The total population effects for the 1978 operations year were 0.9 percent.

Distribution/evaluation

Demographic effects were regarded by all groups as minimal or nonexistent. Project-related in-migration was not associated with the business, retiree, and textile worker groups. To these three groups, in-migration was neither positive nor negative. For the black community, the availability of basic and nonbasic jobs resulted in reduced out-migration. The increased social stability of this group was evaluated as an important occurrence, given the historical out-migration of black families from the Study Area.

Overall

Although in relative terms the population increase attributable to the plant was small, the fact that the black community benefited from the plant was evaluated as important, and consequently demographic effects were rated as moderately significant.

7.2.7.3 Housing

Magnitude/duration

The effects of the construction and operation of the Oconee Nuclear Station on housing in the Study Area were relatively modest. The project-related population accounted for only 1.2 percent of the housing demand at peak construction, and 0.7 percent for the 1978 operations year. Construction period demand was modified substantially since Duke Power Company provided on-site housing for 150 movers unaccompanied by families (or singles). These units were removed at the conclusion of the construction period.

There was an increase in rental rates over the study period, due to the increased demands (not all due to the Oconee Nuclear Station project) and costs associated with the construction of new multifamily units. There was also a rapid increase in the use of mobile home units during the study period and much of the project-related housing need was filled by these units.

Distribution/evaluation

Housing sector effects were not found to be strongly differentiated by social group.

Overall

Study Area groups placed little importance on housing effects due to the Oconee plant and their significance was thus rated as low.

7.2.7.4 Public Sector

Magnitude/duration

The construction and operation of the Oconee Nuclear Station made few demands on Oconee County public services. The increased demands for public services that did occur resulted primarily from the project-related population increases. The county received revenues to offset these increases from two main sources: from the workers through normal taxing channels, and from the utility due to the increased tax assessments which were levied against the station. The tax payments made by Duke Power Company on behalf of the Oconee Nuclear Station constituted one of the major effects of the project on Oconee County public services. The tax payments made on behalf of the station accounted for about 55 percent of county property taxes in the peak year.

Distribution/evaluation

The increases in public services and the slight decrease in the tax rate affected each group differently. The primary beneficiaries of the service increases were the worker groups and the blacks. For the business/professional group and retiree group, the tax rate effects were also very important. Many retired people cited the low property tax rate as a main reason for selecting the area as a place to live.

Overall

The fiscal impact was evaluated, by far, as the most important positive aspect of the Oconee plant compared to all other plant effects. All five groups assessed the revenue effects to be positive (there were no adverse effects on the level and provision of public services due to in-migration) and important to the groups and to the Study Area. The importance of the fiscal effects reflected the area's rural and poor tax base prior to plant construction and the profound contrast in the level of public services instituted after plant construction. Lacking a strong industrial tax base, the importance of the revenues from the nuclear plant became a highly valued source of county income. Thus, the significance of the public sector impacts was rated as high.

7.2.7.5 Social

The study found that the social structure and group interrelationships existing prior to the nuclear plant remained intact during the study period. Major permanent changes were not discerned. Although the black community directly benefited, the overall effects on social structure were rated as of little significance.

7.2.7.6 Overall Significance

The socioeconomic assessment of the Oconee plant showed that the plant was moderately significant in overall impacts. Of particular importance were the positive effects on the black community because of expanded employment opportunities and the significant tax revenues generated by the plant.

7.2.8 Peach Bottom

7.2.8.1 Economic

Magnitude/duration

The Peach Bottom Nuclear Generating Station was constructed in an area that was considered rural and isolated. There was little industrial activity; agriculture remained as the leading industry. Prior to project construction, Delta experienced a serious economic and population decline resulting from increasingly limited employment opportunities in the Study Area. Peach Bottom Township, on the other hand, had begun to experience substantial rural nonfarm development.

During project construction, a significant number of Study Area residents were employed at the site. For example, during the peak construction year, 415 workers (or 20 percent of the local population) had direct basic jobs. The income of those workers (an estimated $6.7 million in 1973) resulted in economic gains. The nuclear plant did have important labor force effects on the Study Area during construction. For example, the 7 percent preproject unemployment rate fell to 2.1 percent by 1970, and approximately 25 percent of the Study Area labor force was employed at the site. However, the economic effects were temporary in nature and were not large enough to transform the economic base of the area or to have other long-term effects.

Distribution/evaluation

The four groups comprising the Study Area accurately assessed the impact of the plant-related effects. The business/professional group and the "old-time" residents indicated that employment and income effects were not large. For the old-time

residents, a few construction and operations jobs were available in addition to supplemental income from rental housing. However, these effects were assessed to be short-term effects and not sufficiently large to be of significance. The business community in the Study Area at the time of construction was small, experiencing out-migration and economic instability. To them, the construction of the plant resulted in some economic gains but, due to the high level of income leakage from the Study Area concomitant with a small resident work force, the economic change was not sufficiently large to change the economic base. Further, according to key informants, only a few of the business families benefited from economic changes. To a large extent, the economic situation in the Study Area was similar to the one preceding construction: high levels of unemployment, noticeable out-migration, and economic instability. From a long-term perspective, the economic impacts of the plant to the groups and to the area were evaluated as unimportant.

The agriculturalists in the Study Area judged the construction of the nuclear station at Peach Bottom to have little economic importance to their group or the community as a whole. From an economic perspective, the availability of employment at the construction site resulted in fewer agricultural workers because many workers obtained construction jobs at the nuclear plant. Although this loss in agricultural employment did not result in long-term problems for the farmers, it was nevertheless perceived as an adverse consequence of plant construction. Thus, the economic effects of the plant were viewed as generally positive during the construction phase, but as unimportant to the individual social groups or the community.

Overall

The significance of the economic effects was rated as low.

7.2.8.2 Demographic

The construction and operation of the Peach Bottom plant resulted in an in-migration of project-related workers and a reduced out-migration of local residents. Between 1970 and 1974, the project-related population accounted for more than 14 percent of the total Study Area population. During project operations, the project-related effects were much smaller. For example, in 1978, the population due to the project represented 3.5 percent of the Study Area population.

Distribution/Evaluation

The construction period was characterized by a short-term shift in the demographic characteristics of the Study Area residents because of the influx of young, single, male workers at the project. Following the end of construction, a marked decline in population occurred. However, even though the nuclear plant did affect the demographic characteristics of the Study Area groups, these changes were less dramatic when compared to the demographic changes which occurred in the Study Area as a result of suburbanization. The overall evaluation of the project-related demographic changes, as viewed by group members, was that the changes were unimportant to the Study Area.

Overall

The significance of these demographic changes was determined as low.

7.2.8.3 Housing

Magnitude/duration

Except for creating a small shift in the Study Area housing stock from single-family to multiple-family structures in Delta, the impact of the nuclear plant on housing and settlement patterns (which primarily affected the old time residents) was temporary and minimal. Because of the low vacancy rates, the relatively small number of housing units, and the plant's proximity to urban centers, the Study Area could accommodate only a small percentage of the total number of construction workers who moved to the region to work on the project. While Peach Bottom Township experienced an increase in housing construction activity and an escalation of real estate values during the study period, the principal factor in those changes was surburbanization.

Distribution/evaluation

Interviews with farmers indicated that the growth of rural suburbanization during the study period was viewed as an encroachment on their way of life. Although those that were interviewed were cognizant of the fact that the plant was only in a small way responsible for the growth in the housing sector in the rural township, they nevertheless saw the plant as symbolic of the change and as partially responsible. The fact that developers' activities for residential property investments began soon after project announcement reinforced such a predisposition. The growth in population and housing in the rural areas of the township was viewed as being inconsistent with the value placed on the preservation of a rural lifestyle.

The magnitude of housing sector effects was assessed as being relatively large by old-time residents of the area, despite the fact that few real changes occurred in the housing market. On the one hand, this reflected the income received through rentals which was evaluated as an important supplemental income, particularly to elderly residents. On the other hand, old-time residents pointed out that a number of large homes were bought by developers, subdivided into apartment units for construction workers, and fell into disrepair following the end of construction. While the rental income was evaluated as important and positive in the short run, the change in the quality of some homes was evaluated as a negative effect of the plant but was not considered as large or pervasive across groups.

Overall

Even though some group members evaluated housing effects as important, the actual plant-related changes were judged to be of low significance.

7.2.8.4 Public Sector

Magnitude/duration

The only significant project-related tax revenue was a 1.0 percent earned-income tax imposed by Peach Bottom Township on persons employed within its jurisdiction. During the construction period, annual township revenues increased at an average of 55 percent each year. The revenue from the earned income tax represented one-third or more of the total township revenues during construction; by 1978, the plant taxes contributed only 17 percent of the total. These revenues were used to reduce the township's millage rate and to help finance existing public services. However, the in-migration of workers did not result in excess demands on the local infrastructure.

Distribution/evaluation

The revenue effects accrued only to township residents (the suburbanites and the agriculturalists) and were not recognized as being important by any of the four Study Area groups.

Overall

Due to the short-term nature of the effects, the distribution to only two groups, the groups' evaluation of the effects as very unimportant, and the significant government-related effects resulting from suburbanization, the overall evaluation of the significance of the project-related public sector effects was rated as low.

7.2.8.5 Social

The construction and operation of the Peach Bottom nuclear plant had little effect on the social groups in the Study Area and only a moderate effect on social processes. The agricultural community increased their political involvement in the project licensing hearings and through initiatives on growth and policy issues that were indirectly attributable to the plant. Moreover, the presence of the Peach Bottom plant and the accident at Three Mile Island were catalysts for the formation of a small environmental interest group of suburbanites, which was instrumental in changing the behavior and scope of the political activities in the township. Nonetheless, the collective effects were minimal. The significance of the plant in affecting social change was rated low.

7.2.8.6 Overall Significance

The significance of the collective effects of the plant on the Peach Bottom Study Area was evaluated as minimal. On that basis, the overall significance of the plant on the Study Area was also rated as low.

7.2.9 Rancho Seco

7.2.9.1 Economic

Magnitude/duration

Total employment by Study Area residents was relatively small, amounting to only 169 persons during the peak construction year. This represented slightly over 2 percent of the population of the Study Area. The small number of workers residing in the area was the result of the proportionately large number of workers who commuted to the site and the lack of housing available to accommodate a greater number of workers. The economic impacts, overall, were of low magnitude and were temporary. There is no evidence that unemployment levels were affected by plant construction, nor was the preconstruction economic base changed to any noticeable degree.

Distribution/evaluation

Overall, the four groups in the Galt County Census Division (CCD) evaluated the socioeconomic effects of the construction and operation of the Rancho Seco Nuclear Generating Station as unimportant. The presence of the nuclear plant resulted in only minimal effects to the groups. The economic effects were viewed as unimportant by each group because of the small number of Study Area residents employed at the plant and the small number of project-related workers who in-migrated to the Galt CCD.

Moreover, the minimal amount of utility, contractor, and worker purchases in the local area resulted in few induced economic effects benefiting the townspeople.

Overall

The significance of the economic effects was rated as low.

7.2.9.2 Demographic

Magnitude/duration

At peak construction, only 146 persons in-migrated as a result of the plant, representing 0.02 percent of the Study Area population. In 1978, the operations year, even fewer persons had in-migrated. The demographic characteristics of the Study Area did not change as a direct result of plant-related in-migration nor was there any noticeable effect on social interaction patterns. The rapid growth of rural suburbanization in the area concomitant with the construction of the plant further reduced any demographic impact that may have occurred.

Distribution/evaluation

The in-migrants were part of the "newcomer" group and the townspeople group and were generally not conspicuous as would have been the case with more traditional or cultural groups. Further, the groups themselves did not ascribe any importance to demographic changes attributed to the plant.

Overall

The overall significance of demographic effects were judged to be low.

7.2.9.3 Housing

Magnitude/duration

No adjustments were made in the housing stock to accommodate greater numbers of workers and there were a number of local constraints that mitigated against expanding the housing sector. Changes in the housing sector as a result of the plant were minimal. This fact is buttressed by the evaluation of all groups as to the unimportance of this effect to the groups and to the area as a whole.

Distribution/evaluation

Due to stringent zoning ordinances, low vacancy rates, and a lack of response by developers to project-related demand, housing effects were identified only by one group,

the townspeople. Overall, the groups evaluated the effects of the project on housing as unimportant.

Overall

The effects of the Rancho Seco plant on housing in the Study Area was deemed of low significance.

7.2.9.4 Public Sector

Magnitude/duration

The low number of workers residing in the area precluded any large or excessive demand on public facilities and services. Further, the utility that operated Rancho Seco was municipally owned, and consequently did not pay taxes on the plant. Fiscal effects, therefore, were not significant either in a positive or negative dimension.

Distribution/evaluation

While the construction and operation of the Rancho Seco plant resulted in a variety of government-related direct and indirect effects—such as increased traffic, the construction of a park, and the upgrading of a secondary road—and while each of the groups were affected, the magnitude and type of the effects were not considered to be important.

Overall

There were few significant project-related public sector effects because of the small number of in-migrating project-related workers and because the nuclear plant did not generate any property tax revenues. Revenue and expenditure impacts were minimal, and public sector impacts were thus generallyu not significant.

7.2.9.5 Social

In terms of effects on social groups and interaction, the construction and operation of the plant did not result in any noticeable changes. Group changes over the study period were the result of social changes (rural suburbanization) not related to the plant. There was some evidence that a number of plant-related in-migrants took up leadership positions in the community, however, such change was individualistic, rather than group specific, and the cumulative effect was minimal. The growth of population in the area, which was substantial during the study period and not associated with the nuclear facility, overshadowed the effects of the plant. Moreover, the public response to

the plant that occurred subsequent to Three Mile Island was not characteristic of a major political change in the orientation of public involvement. The significance of social impacts of the Rancho Seco plant was rated as low.

7.2.9.6 Overall Significance

The Study Area in which the Rancho Seco plant was located was undergoing major changes during the study period. The construction of the nuclear station was not an important factor in these changes. Public sector impacts and changes in social structure and process were not discernible. Economic, demographic, and housing changes were small and temporary. The major factor explaining the lack of appreciable change due to the plant was the close driving distance to a major metropolitan center from which most of the workers commuted to the site. The plant's impacts on the Study Area were thus rated of low significance.

7.2.10 St. Lucie

7.2.10.1 Economic

Magnitude/duration

While the construction and operation of the St. Lucie nuclear plant provided jobs and income for county residents (over 1,000 jobs during the peak construction year and over 750 in 1978), within the context of the general county employment growth, the nuclear plant had relatively little effect. Throughout the study period, less than 5 percent of the county's total labor force held project-related jobs. Because the construction of the plant occurred concomitantly with the rapid growth in the Study Area, the economic impacts of the plant were not conspicuous. Within the context of the general growth in the county, the nuclear plant had relatively little effect on the standard-of-living of county residents overall. Unemployment rates did not appear to have been affected by construction employment at the plant.

Distribution/evaluation

Economic effects of plant construction and operation were evaluated as large and significantly positive by the business community and by the wage and salary workers. The key informants argued that plant construction resulted in increased income to the business group and stabilized the local economy. However, these impacts were considered to be short-term and of only moderate importance to the group and to the Study Area. The prevailing assessment among business leaders was that the construction

of the plant occurred concomitantly with the rapid growth in the Study Area which diminished the impacts of the plant as a singular impacting agent.

Few blacks obtained construction-related employment and the magnitude of black employment was accurately assessed by the group. Therefore, economic effects were perceived as neither negative nor positive and were considered generally to be an unimportant factor in the black community's economic well being. Similarly, the retirees, who comprised a large proportion of the Study Area population, perceived the plant to be unimportant to them and to the Study Area as a whole.

Overall

Because less than 5 percent of the plant's work force were nonmovers and because secondary economic effects never materialized due to the plant, the economic significance of the St. Lucie plant was rated as low. Although purchases for construction aided a number of individual merchants, these gains were temporary and became hidden relative to the rapid growth of the local economy during the study period.

7.2.10.2 Demographic

Magnitude/duration

The population effects of the nuclear plant on the Study Area were relatively small since a large proportion of the project-related work force commuted daily to work from outside St. Lucie County. Nevertheless, during the peak construction year, an estimated 885 project-related workers and their family members in-migrated to the Study Area. However, they constituted only 5 percent of the total study area population. In all but three years of the study period, the project-related population increase accounted for less than 1 percent of the Study Area population. The population change was not a dominant element in the overall population changes in the Study Area.

Distribution/evaluation

On the whole, the groups did not perceive any large demographic effects due to plant construction and no importance was attributed to this socioeconomic variable as affecting social groups. The large commutation work force coupled with the rapid population growth taking place in the county resulted in the reduction of the importance of this impact agent.

Overall

The overall significance of demographic impacts was rated as low.

7.2.10.3 Housing

Magnitude/duration

The project-related housing demand (370 units in the peak year) did not represent a significant percentage of the total housing stock (less than 1.5 percent in 1974). While it was impossible to disaggregate the effects of the project-related workers on the characteristics of the housing stock and on the housing market within the context of the area's rapid growth, there is no evidence that they were significantly affected by the project. Key informants' perceptions of the overall importance of the project's effects on housing was that it was unimportant.

Distribution/evaluation

Few housing effects were noticeable, and because the St. Lucie site attracted a large commuter work force, the importance of housing effects was not apparent.

Overall

The overall significance of the housing effects were low.

7.2.10.4 Public Sector

Magnitude/duration

The St. Lucie nuclear plant was an important contributor to property tax revenues for taxing jurisdictions in St. Lucie County (especially the St. Lucie County Government and the St. Lucie County-Fort Pierce Fire District), while demanding few services in return. (The tax revenues did not begin accruing until the plant's operation period.) While the county's non-project-related growth had major government and public services and facilities effects, key informants (except retirees) indicated that the St. Lucie nuclear plant had resulted in very important government and services and facilities effects. Once operation of the plant began, approximately 20 percent of the total county taxes were paid by the utility for the St. Lucie plant. This was moderately important and constituted about 9 percent of total county revenues.

Distribution/evaluation

None of the groups were aware of any negative effects on public facilities and services. The business community and the wage and salary workers were aware of tax

revenues accruing to the area because of the siting of the St. Lucie plant. The revenue effects were considered very positive, long-term impacts, and generally important to the area. As to the importance of taxes to themselves as groups, the business community and the wage and salary workers discounted the importance of tax benefits. Tax revenues were considered positive by the blacks and moderately important to the area. However, tax revenues were not considered especially important to the blacks as a group.

Overall

Because the plant's revenues constituted about 9 percent of the total revenues in the Study Area and were evaluated as generally important, the significance of public sector impacts was rated as moderate.

7.2.10.5 Social

The construction and operation of the St. Lucie nuclear plant had little effect on social structure in St. Lucie County. Project-related workers neither attained leadership positions nor contributed to changes in group interaction patterns. In general, project-related workers were viewed as indistinguishable from the rest of the population, particularly since the population had grown so rapidly during the study period. Effects on the social structure were evaluated by all groups as not appreciable. The effects of the St. Lucie plant on the social structure of the Study Area were noted as not being significant.

7.2.10.6 Overall Significance

The study period in St. Lucie County was distinguished by very rapid population growth rates and urbanization. The construction of the nuclear plant was not a major factor in this growth. The overall significance of the plant's impacts was rated as low.

7.2.11 Surry

7.2.11.1 Economic

Magnitude/duration

The employment and income benefits to Study Area residents were only a small proportion of the project's total economic effects. The large number of commuters and the small retail and service capabilities in the county minimized the plant's employment and income effects. Nevertheless, during project construction, as many as 10 percent of the county residents worked in project-related jobs. The workers and business professional groups benefited most from the project's economic effects. Unemployment

declined during the construction period, but returned to preconstruction rates during plant operation. Although job mobility increased as a direct result of the plant, this was not a pervasive economic factor in the Study Area.

Distribution/evaluation

The economic effects of the Surry plant were evaluated as either small or nonexistent by Study Area groups. Both the farmers and elderly were outside the locus of plant impacts, indicating that to them there were no economic advantages of hosting the nuclear plant. Although they viewed the economic effects to their respective groups as unimportant, key informants viewed the economic effects to the Study Area as moderately important. To the three other groups in the Study Area, the economic effects were small and short-lived, although moderately important as a job-generator for the workers and as an income-generator for the business group.

Overall

The significance of the economic effects was rated as moderate.

7.2.11.2 Demographic

The demographic effects of the Surry nuclear plant were a function of project-related in-migration and reduced out-migration. Overall, these were small (less than 3 percent of the county's total population); however, they were noticeable in a county that had experienced a decreasing population trend prior to project construction.

Distribution/evaluation

Aside from the workers group, the majority of the population change was attributed to the newcomers group and the business/professional group. Nonetheless, key informants evaluated the project-related demographic changes as of overall importance.

Overall

Although the demographic changes were relatively small, the retention of residents in the community and the reversal of the traditional out-migration were viewed as important by Study Area residents. Demographic changes attributed to the project were thus rated as moderately significant.

7.2.11.3 Housing

Magnitude/duration

The lack of housing for workers who wanted to relocate to Surry County was the principal factor accounting for the small proportion of Study Area residents employed in project-related jobs. While the project-related population had a measurable effect on the quantity and quality of housing, the extent of those impacts were modest and primarily affected only the workers group (who sought housing) and the business/professional group (who benefited from increased construction and rental activity). However, during peak construction, only 58 dwellings were associated with plant-related workers. This accounted for under 3 percent of the county's housing stock.

Distribution/evaluation

Housing effects were considered to be minimal or nonexistent and, overall, little importance was placed on this effect. The business group viewed housing effects as somewhat important and positive to the group because this group gained through increased demands for housing and the establishment of new mobile homes. In contrast to this evaluation, the newcomers/suburbanites who were in-migrating to the Study Area found housing costs high and in many cases not available. This problem was attributed to the heightened competition for housing created because of plant construction. Housing availability improved with the completion of the nuclear station.

Overall

The significance of the housing effects of the Surry project was determined to be low.

7.2.11.4 Public Sector

Magnitude/duration

The construction and operation of the Surry nuclear plant resulted in increased tax revenues due to the plant-related increase in the county's assessed valuation. By the mid-1970s, approximately 35 percent of Surry County's total revenues were from taxes paid on the nuclear project. The effects of the large increases in county revenues due to the plant were important in development of county programs, in capital investments (especially in schools), in county employment, and in the moderating of tax rate increases.

Distribution/evaluation

In contrast to the demographic impacts, which were evaluated as minimal by all groups and temporary in nature, the fiscal impacts were evaluated as positive, long-term and important to the groups. No adverse impacts to facilities and public services attributable to the plant were identified.

Overall

While each of the Study Area groups were affected by fiscal changes, group representatives indicated that changes in tax revenues and in public services and facilities were very important. The overall significance was considered to be high.

7.2.11.5 Social

The profile characteristics and interaction patterns of Study Area groups changed during the study period. However, one of the most important changes, the transfer of political power from white to black control, was the result of long-term social conditions which involved the weakening of the traditional caste system, rather than project-related effects. The presence of the nuclear plant primarily resulted in indirect effects on the Study Area's functional social groups. For example, a major change for the elderly was the availability of expanded public services due, in part, to project-related tax revenues. The overall significance of the social effects was estimated to be moderate.

7.2.11.6 Overall Significance

The examination of the five impact dimensions--economic, population, housing, public sector, and social--resulted in an overall determination of moderate significance of the Surry plant.

7.2.12 Three Mile Island

7.2.12.1 Economic

Magnitude/duration

At the beginning of the study period, the Study Area was comprised of a rural agricultural area and a local trading and industrial center. During the study period, total non-project-related employment increased substantially as the trade and services sector became more diversified.

Although the construction and operation of the Three Mile Island nuclear plant had a dramatic effect on the Study Area in terms of employment and income by place of work and the economic structure of the local economy was temporarily transformed

during the peak construction years, the effect of the project on the resident Study Area labor force was much less pronounced. For example, during the peak construction year, 90 nonmovers received basic jobs, 170 movers obtained basic jobs, and 80 Study Area residents worked in project-related indirect and nonbasic jobs. Nonetheless, these jobs accounted for less than 6 percent of the total number of jobs held by Study Area residents. Of these jobs, the largest proportion was obtained by the newer residents.

Distribution/evaluation

Prior to the March 1979 accident, the general consensus of the Study Area residents was that the cumulative socioeconomic effects of the construction and operation of the Three Mile Island Nuclear Generating Station on the Study Area were unimportant. In general, the magnitude of the economic and demographic effects was considered to be small and the majority of those effects were short-term, construction impacts. Group representatives, including blacks, consistently evaluated the economic and demographic effects as unimportant to both their group and the Study Area as a whole.

Overall

The effects of increased employment and income due to the plant was small because of the high level of commutation to the site. The area was growing rapidly in economic development during the study period, and the impacts of the plant were not conspicuous. The significance of the economic effects was rated low.

7.2.12.2 Demographic

Potential project-related demographic effects were moderated by the availability of labor within commuting distance and the urban nature of the region. Project-related in-migration was too small to dominate population change in the area during the study period. As with the economic effects, the majority of the demographic changes were attributed to the same three social groups who evaluated the effects as unimportant.

Overall

The overall significance of demographic impacts was determined to be low.

7.2.12.3 Housing

Magnitude/duration

The construction and operation of the Three Mile Island nuclear plant resulted in only minimal effects to Study Area housing. The large supply of affordable housing

within easy commuting distance of the project site and the lack of response in the local area to supply additional housing, combined to reduce the number of project-related workers relocating to the Study Area.

Overall

The plant's effects on housing in the TMI Study Area were considered as not of significance.

Distribution/evaluation

The minimal housing effects were distributed throughout each group. In the groups' overall evaluation of these effects, key informants considered the housing effects as of little concern.

7.2.12.4 Public Sector

Magnitude/duration

Because the number of project-related movers was small, only minimal demands were made on existing public services and facilities. Moreover, because of the Pennsylvania tax laws, there were no perceptible project-related tax benefits to local taxing jurisdictions.

Distribution/evaluation

The public sector effects were distributed throughout each group and all groups considered the impacts of little importance.

Overall

The plant's impacts on the public sector were considered as being not significant.

7.2.12.5 Social

The important social structure changes that occurred during the study period were due to increasing urbanization and suburbanization of the Study Area in addition to the area's population growth. There was no evidence that the project-related workers had any discernible effect on intergroup interactions, nor was the construction and operation of the TMI nuclear plant a salient issue for most Study Area residents. The impacts of the plant on the social structure were considered as not being significant.

7.2.12.6 Overall Significance

Unlike the public sector impacts of most of the other plants in the study, TMI did not generate any meaningful tax revenues for the host area. In addition, the few impacts that did occur in the economic and demographic areas became "lost" in the general growth that was taking place in the Study Area during the construction/operations phases prior to the TMI accident. The perception of Study Area residents was that the plant's effects were generally of low importance.

7.3 Summary and Analysis of Variation

The significance of each effect was determined by evaluating the individual effect along five dimensions. These included measurements of the magnitude and duration of the effect. The degree to which these effects were distributed among the various social groups in the study area was another value dimension. The evaluation by social group of the importance of the effect to the group and to the study area as a whole was another unit of measuring significance. Finally, the relative importance of the impact was weighed against other changes in the study area. For each dimension (economic, demographic, housing, public service, and social), then, an overall rating of impact significance was assigned. The significance of the individual effects on the study areas is shown in Table 7-1. At five of the twelve sites, the overall measure of significance of the plant was rated as low; at two the rating was low to moderately significant; at four sites the effects were considered moderately significant; and at one site the overall significance of the plant was rated between moderately and highly significant.

Of the five dimensions of impacts that were examined for their significance, the least significant changes resulting from constructing a nuclear plant were found in effects to the social structure. This was followed by changes to the housing sector. In eight cases no significance or low significance was associated with housing effects.

The economic effects were usually of low to moderate significance. The fact that the plants were often located in rural areas with little economic capability to provide construction equipment or a trained labor pool reduced the potential for larger impacts. The nature of the economic changes were such that they were often short term and not distributed to all sectors of the population. Compared to the effects of nonnuclear energy development in the West (boom towns), the impacts of nuclear power plants have been modest. The fact that plants are located close to large metropolitan centers with large labor pools and that other communities are dispersed around them to meet housing

TABLE 7-1

SIGNIFICANCE OF SOCIOECONOMIC EFFECTS

	EFFECTS					
	Economic	Demo-graphic	Housing	Public Sector	Social	Overall Significance
Arkansas	H	M	M	H	L	M-H
Calvert Cliffs	M	M	M	H	L	M
Cook	L	L	L	M	M	L-M
Crystal River	L-M	L	L-M	M	N	L-M
Diablo Canyon	L	L	L	L	L	L
FitzPatrick/ Nine Mile Point	M	L-M	M	M	N	M
Oconee	L	M	L	H	L	M
Peach Bottom	L	L	L	L	L	L
Rancho Seco	L	L	L	N	N	L
St. Lucie	L	L	L	M	N	L
Surry	M	M	L	H	M	M
Three Mile Island	L	L	N	N	N	L

N - None

L - Low

M - Moderate

H - High

demands, has lessened the economic/demographic impacts associated with more geographically isolated communities.

The stress placed on public services due to plant-related changes, particularly worker in-migration, has been minimal. What has been rated as significant, however, has been the substantial revenues that have accrued to the local taxing jurisdictions in which the plants are located. The fiscal impacts from five plants were rated as highly significant and from another four plants as moderately significant. The Rancho Seco plant is publicly owned and a property tax is not levied, while the taxes paid by the utility on two plants in Pennsylvania are distributed statewide.

Those sites experiencing economic gains of moderate to high significance were sites where a large portion of the work force was represented by a local labor force (Arkansas), or where significant purchases of construction materials were made (FitzPatrick). Economic effects were important at those sites where the economic effects of the plant were conspicuous and highly visible. This occurred in rural places where the construction of the nuclear plant marked a turning point in the local area's economy.

Those sites experiencing demographic effects of moderate significance were generally areas in which the construction of the plant resulted in expanded employment opportunities which had the effect of reversing out-migration. Where this occurred, the resident populations evaluated the effect as very important and as a stabilizing element.

There was wide variability in the significance of public sector impacts among the sites. Those sites experiencing highly significant effects were rural areas where the revenues from the plant constituted a large percentage of the local jurisdiction revenues. In these cases, residents could point to actual improvements and expansion of public facilities and services. In a number of cases, large absolute levels of revenues were only moderately significant given the large size of the existing tax base.

CHAPTER 8: FINDINGS OF THE POST-LICENSING STUDIES RELATIVE TO THE NUCLEAR STATION IMPACT LITERATURE

The purpose of this chapter is to identify the major findings of the Post-Licensing Studies and to provide information on the relevance of the findings to the available research on the impacts of nuclear generating facilities. Over thirty studies that assessed the impacts of nuclear plants were examined. These included reviews of research on impacts of nuclear plants, ex post facto case studies, projective case studies, and theoretical or methodological discussions on measuring socioeconomic consequences of siting and constructing nuclear plants.

8.1 Findings and Relevance to the Literature

8.1.1 Settlement Pattern of the Work Force

The Post-Licensing Studies found that the nearest city in excess of a population of 50,000 was usually located less than 50 miles from the nuclear sites, and that even in rural areas a number of residential alternatives near the sites were available for workers. In most cases, a relatively high level of commuting occurred. Additionally, because residential alternatives were available, a dispersed settlement pattern of movers was observed. Moreover, most of the plants were found to be located within commuting range of large labor sheds. Such locational characteristics would have the effect of reducing mover in-migration, thus reducing potential adverse effects on the provision and level of public services and the social structure of the host community. Further, a large commuter work force and a generally dispersed residential pattern also resulted in a dispersed pattern of economic benefits and income leakages from the study areas.

The available research on socioeconomic impacts of energy projects has found that the degree of geographic isolation of a host community was generally a critical factor in explaining the magnitude of socioeconomic effects. The major socioeconomic impacts occurring in energy "boom towns," for example, have been attributed to the concentration of in-migration of project-related workers and their dependents into one community. The impacts would result from the lack of absorptive capacity of the community to accommodate the population influx. Pressures exerted on existing public services would not develop to the same degree if the movers were geographically dispersed.

A major 1977 review of the state of knowledge of socioeconomic effects of nuclear developments criticized the applicability of energy boom town studies to nuclear plant effects. The study argued that the knowledge of energy "boom town" impacts was irrelevant for the study of nuclear power plants. (Policy Research Associates, 1977.) A major factor that was identified in explaining the difference in the magnitude of impacts between energy resources projects and those of nuclear plants was the difference in siting patterns: nuclear power plants, in contrast to areas where energy resources tend to be developed, were generally located close to large metropolitan areas and in areas with well developed infrastructures that could accommodate a nuclear facility without excessive strain on existing community services. In fact, the study examined 93 nuclear sites and found that 85 percent of the sites were located within 60 miles of a large metropolitan area. This would result, it was argued, in substantial worker commutation rather than worker in-migration, and would thus reduce the project effects on local areas. Moreover, preliminary assessments of existing nuclear plants in the study indicated that the settlement pattern of the nuclear plant labor force was geographically dispersed. Consequently, the impacts, both positive and negative, would also be dispersed.

Applying the findings from the energy resource development literature to the development of nuclear power plants was found to be problematic, and parallelisms with the effects of rural industrialization were suggested as an alternative. The impacts to local rural areas from industrialization were viewed as being comparable to those of nuclear power plants. The rural industrialization literature is consistent in its contention that the high level of commuting associated with rural industrialization resulted in sizeable income leakages from areas in which rural factories were sited. In addition, the demands for housing, community services, and education were found to be small. Furthermore, because commuters make up a substantial part of the rural factory employment, the multiplicative income and employment effects were generally low—an employment multiplier usually less than 0.4 jobs per basic job.

The fact that the impacts of nuclear power plants have been tempered by proximity to their load centers (large metropolitan areas) has been suggested by a number of other studies. In his review of the impact experiences of TVA nuclear plants and the Pilgrim Plant in Massachussetts, Bjornstad (1976) concluded that because nuclear plants are located near areas having large labor pools, mass in-migration to the host community was avoided and, consequently, few adverse effects occurred on community

services. In the Pilgrim case, a large, union-qualified commuter work force resided in Boston: workers in the local area were generally not qualified for union jobs. Consequently, although the large commutation pattern resulted in income being taken out of the local area, there was also minimal stress on public services. Krannich (1976), in his ex post facto investigation of 17 nuclear plants, found that although some impacts occur, a "boom-town" phenomenon was universally absent. He found that the size and distance of a plant to a metropolitan area correlated with specific impact levels.

The fact that work force commutation is a significant factor in reducing potential project impacts received empirical support in two other studies. Shurdiff (1977), in her description of the impacts of the nuclear plant in Plymouth, Massachussetts, indicated that the local economic impacts through employment were small because of the large worker commutation to the local area. The study found that high local unemployment levels continued throughout the construction period. In addition, in this case, the local work force was not sufficiently skilled at construction-related jobs and, consequently, local people were generally not hired. Again, because of the significant commuter work force, there was little impact on community services attributable to the nuclear plant in Hartsville, Tennessee (Wilkerson, 1978).

In his survey of 98 nuclear plants that are currently operating or under construction, Myrha found that these plants were located in areas having between 280 thousand and 300 thousand people within a 50-mile radius. The author argued that because a large proportion of the plant's work force was within commuting distance of most plants, nuclear stations created the "least adverse socioeconomic impacts of any energy development project." The study identified three factors that minimized adverse impacts: (1) proximity to large centers; (2) the size of nonagricultural labor force within commuting distance; and, (3) prevailing pro-growth community attitudes. (Myrha, 1980.)

8.1.2 Study Area Definition

The Post-Licensing Studies developed a methodology that would result in the delineation of a "study area" for detailed assessment of the impacts. The delineation of the study area was determined on the basis of the spatial allocation of workers and the distribution of purchases and taxes. In addition, the study areas were defined on the basis of the areas constituting integrated functional social and economic units. The study found that purchases in the region were usually too small to be significant in selecting the study area. Moreover, the process of estimating the boundaries of the

study areas resulted in both large and small study areas. Consequently, study area size is acknowledged as an important determinant in the variation of the proportion of plant workers residing in the study area. In the Post-Licensing Studies, seven of the study areas comprised entire counties and five were subcounty study areas.

Few of the studies that were examined specifically dealt with the problem of study area definition. Usually, the study arbitrarily selected either the nearest host community (especially if the focus of the study was the impact on public services), or the county in which the plant was sited.

Gilmore et al. (1981), in a study of the economic impacts of power-generating plants, attempted to discern an outer boundary of the impacted areas based on an examination of commuting times, population concentrations, labor union jurisdiction, and the indigenous regional labor force. However, it was difficult to gauge how these factors were used as criteria for determining specific study areas. Nonetheless, the study areas represented either the entire county or a subcounty area.

In 8 of the 12 cases examined in the Post-Licensing Studies, more than 25 percent of the direct work force resided in the selected study areas. The percentage of the work force residing in the study areas varied within a wide range—from 5.4 percent to 85.0 percent. In addition, the study found that during the operations period the percent of workers residing closer to the plant site was higher than it was during the construction period. This reflected the decline in the size of the labor force after construction and the availability of housing closer to the site during the operations phase.

8.1.3 Labor Force at Peak Construction

The Post-Licensing Studies found that the size of the labor force at peak construction ranged between 1,227 and 2,872 workers. Although the size of the work force may be related to the number of units being constructed, other modifying factors (such as project scheduling and worker strikes) were also important. However, there was no clear relationship between size of the plants in terms of capacity and the size of the labor force.

The size of the peak construction work force in the twelve cases agrees with the information on labor force size found in the literature on nuclear power plants. However, the literature search found that little emphasis was given to an examination of

the determinants of labor force size and an explanation for variation across sites. It was generally assumed that the size of the work force was related to the number of units simultaneously under construction at the site. In his survey of 28 nuclear plants, Krannich (1979) found that the "characteristics of the facility" was a major impact determinant. He argued that, in general, the greater the size of the project, the greater the size of the labor force and, consequently, the greater the magnitude of the impact. Wilkerson (1978) found that at the plant at Hartsville, Tennessee, 4,400 construction workers were employed two years into construction and that the size of the labor force would increase to over 6,000 workers during the peak construction year. This large labor force—larger than the usual work force—is attributed to the extraordinary scale of the project. He also found that, despite the large work force size, the impacts of construction were small due to the gradual, rather than sudden, build-up in the construction labor force. This finding is supported by the Post-Licensing Studies: the gradual increase in the size of the work force and the termination of the construction activity allowed ample time for local decision-making regarding planning and the development of mitigation strategies.

8.1.4 The Mover/Nonmover Breakdown

The study found that, as a percent of the total work force, nonmovers ranged from 2 percent to 30 percent. In general, the number of workers employed from the host communities during both the construction period and operations period was small compared to the total work force in the community. In most of the rural areas, the number of skilled workers available was small and the hiring of local workers was lower than had been expected. Union halls were often located in the large metropolitan areas outside the study areas, and worker commutation to the site was a significant factor. Local hiring increased when the utility instituted training programs to upgrade local skills. In the four cases studies that experienced the largest shares of nonmover workers, the study areas had been experiencing rapid growth and, as a result, had large indigenous construction work forces.

The work force consists of three types of workers--nonmovers, movers, and daily commuters. The meaning of these terms depends directly on the definition of the study area. Movers and nonmovers are both residents of the study area. Anyone living outside the study area is defined as a daily commuter. Thus, the larger the study area, the larger the proportion of movers and nonmovers relative to daily commuters. The Post-Licensing Studies found that the percent of movers ranged from 3.5 percent to 61.6

percent of the total work force, with a mean of 17.6 percent. Malhotra (1980), in his analysis of 28 construction worker surveys at 13 nuclear plant sites, estimated that the mover proportion ranged from 14 percent to 50 percent of the total work force. The percent of movers residing in the local area ranged from 8 percent to 88 percent. Malhotra further noted that extreme values in mover proportions were rare. However, in the Post-Licensing Studies, low extreme values were found. A closer examination of those cases indicates that these low mover-proportion values were usually associated with subcounty study areas. As the study area becomes smaller, workers who in-migrate to the study region but not to the defined study area are not considered as movers; they are counted as commuters who drive daily to the site to work. The difference between the findings can be accounted for by differences in the definition of "mover." Malhotra defined a mover as a worker who changed residence to work at the site and he estimated the number of movers through a survey of workers taken at the sites. If we factor out the extreme low values represented by the subcounty areas, the mover proportions resemble those found in the 1980 Malhotra study.

The Post-Licensing Studies found that the percentages of both nonmovers and movers during the operations period increased compared to the percentages during the construction period. This simply means that the operating work force tends to live closer to the station (i.e., fewer daily commuters from outside the study area) than does the construction force.

A number of factors have been suggested in the Post-Licensing Studies that explain the variation across sites in mover proportions. These include: (1) the location of large metropolitan centers within commuting distance of the site; (2) the level of skilled manpower in the local areas; and (3) availability of housing. In a number of cases, the percentage of movers in the study area would have increased if a greater number of workers could have been accommodated by the housing sector or through housing sector adjustments.

Malhotra's (1980) findings support these conclusions. Of the total number of movers, 50-60 percent considered in-migration as temporary. He found that the majority of workers "want to minimize the distance to work, and attractiveness of the community or future employment are less important factors." Malhotra also noted that housing availability was an important factor in the residential location of workers. The variation in the proportion of movers within the local area reflected the ability of communities

near the site to accommodate workers and this ability varied across sites. The proportion of movers and nonmovers in local areas was found to be lower among the more rural sites that were characterized by low population levels. This reflected the low number of available skilled construction workers in the rural areas, the nearness to a metropolitan center, and the alternative housing centers within commuting distance to the site.

8.1.5 Employment and Income

The direct basic income averaged $35 million for all sites for the peak construction year. The range in income generated across the twelve sites was large and was due to differences in both work force size and regional wage rates. In contrast to the direct basic income and employment effects, indirect basic effects can be effectively ignored in assessing economic impacts from nuclear power plants. The rural local areas did not supply substantial amounts of equipment and supplies, and the effects of such purchases on the study area economies were insignificant. Even in the few cases where local purchases were perceived as important, indirect basic employment was less than 2 percent of basic employment. The fact that nuclear plants are located in somewhat rural areas adjacent to small communities has meant that these places have had neither the capacity nor the skills to support the construction of nuclear generating facilities. Several studies support our findings that indirect basic employment and income effects have been insignificant.

In his assessment of the Turkey Point facility in Florida, Johnson (1977) estimated that most of the technical equipment and materials were purchased outside the region, and that only 1.3 percent of building materials for construction was purchased in the local county. A projective study of the impacts of nuclear plants on four Maryland counties concluded that "small counties without large communities will not be able to respond quickly to large, rapid change and not be able to capture a large share of new business potential." This was attributed to the areas' business structures being comprised of firms that were small in size. Moreover, it was also projected that these firms could be adversely affected by competition from new businesses that may enter the local economy because of plant-induced economic activity (Maryland Power Siting Program, 1978). In two of the twelve Post-Licensing Studies, this factor was observable, and in one case, the new competition did adversely affect the viability of existing firms.

In Salem County, Pennsylvania, the Susquehanna Steam Electric Station produced an average of $40 million in direct basic income, but produced little in terms of material purchases: construction materials were purchased from nonlocal suppliers because these goods were not available locally. (Pennsylvania Power and Light Company, 1976.)

"Other" basic employment and income effects were also examined but were not found to be a significant factor during the construction period. The term "other" basic activity was used to refer to changes in the economic base of an area due to the construction and operation of a nuclear station beyond the direct labor effects and the indirect purchases of materials and supplies. Examples of this would be a decline in agricultural activity due to increased competition for labor, or an increased size of the government sector (beyond that occasioned by population growth) due to increased availability of revenues. In only one case was there evidence of fiscally induced basic employment and this was not assessed to be significant. There was also no evidence of any significant or long-term problems with respect to wage competition.

The study conducted by the Maryland Power Siting Commission (1978) to assess the socioeconomic impacts of nuclear plants on four counties argued that the construction of the Calvert Cliffs facility adversely affected a number of industries in the host community. Because construction jobs at the site paid relatively high wages, a substantial number of farm workers and other laborers left their places of employment and obtained jobs at the site. The purported result of this employment shift was that a number of local firms and farms either had difficulty in procuring workers or had to obtain workers at inflated wages. Consequently, some firms which were dependent on low-wage labor went out of business. However, the attribution of this to the nuclear power plant was not supported by the Post-Licensing Studies research findings for Calvert Cliffs. Moreover, Policy Research Association, in its 1977 review of nuclear plant impacts, cautioned against reliance on existing ex post facto case studies of nuclear plant effects because changes in study areas were readily associated with the development of nuclear facilities without careful assessment of attribution. For example, with respect to the 1977 Calvert Cliffs case study undertaken by the Federal Energy Agency (FEA), Policy Research Association claimed that the FEA erroneously attributed the closing of a lumber mill to the fact that workers left for better paying positions at the nuclear construction site.

The average number of nonbasic jobs at all twelve sites during the peak construction year was estimated to be 332 and nonbasic income to be $1.9 million. These estimates were for the study areas and were based on determinations of effective basic income. The average of effective basic income to direct basic income for the twelve sites was 0.286; that is, the income paid out to the work force as a whole only had about 29 percent of the effect on the local economy that would have occurred had the income been paid to local residents. The nonbasic employment response was determined to be only 0.16 nonbasic jobs per one direct basic job. This is a generally small multiplier effect but it is not unexpected. Although nuclear plants are located in rural areas, they are nonetheless located near large metropolitan centers. Given the generally dispersed geographic location of workers and the substantial amount of commutation, it was not unexpected that significant income leakages from the study areas would result.

During the operations period, the Post-Licensing Studies found an average of 200 nonbasic workers in the study areas. The ratio of effective basic income to direct basic income during operations averaged 0.46 for the twelve sites compared to 0.29 during peak construction. The induced jobs averaged 0.23 nonbasic jobs for each basic job during operations compared to 0.16 during peak construction.

The number of nonbasic jobs generated during the operations phase were approximately 50 percent more than those generated during construction. This reflects the proportionately greater number of movers into the study area during operations. The fact that a greater percentage of movers tends to locate near plants during the operations period results from work force composition and consumer patterns that are different from those during construction. As permanent in-migrants, there would be a tendency to spend more earned income within the study area. In contrast to the operations period, the construction period was characterized by significant worker commutation, which had the effect of reducing potential income from the project to the study area, thereby producing a lower effective basic income. Further, Malhotra (1979) supports the findings of the Post-Licensing Studies; he found that the proportion of movers with family present is higher for workers in nonconstruction crafts. Thus, the proportionately greater number of movers with dependents during the operation period would have the effect of enlarging the nonbasic-to-basic employment ratio.

Overall, the economic effects associated with nuclear plants were found to be small relative to much of the impact literature, particularly the findings from the

research on energy resources development. The small relative impacts reflect the significant income leakage from direct basic income to effective basic income and is a consequence of both the small size of the rural local economies and the substantial worker commutation.

These findings are supported by a number of studies on the economic impacts of nuclear plants. Johnson, in his 1977 study of the Turkey Point plant in Florida, estimated that up to 50 percent of the earned income generated by the plant left the area because of commuting. He concluded that, although the facility was a positive net benefit, the impacts were not sufficient to make any permanent change on the local economic structure. In reviewing the applicability of the findings of the rural industrialization literature to the kinds and nature of impacts of nuclear power plants (coupled with some preliminary work specifically with nuclear plant effects), he found that the multiplicative employment effects to local areas (of both rural industrialization projects and nuclear facilities) would be small because of income leakages due to commuting. According to Johnson, employment multipliers of 1.2 or 1.3 were noted as common. These findings support the research conclusions of the Post-Licensing Studies.

Further support for the findings of low employment multipliers associated with nuclear plants is provided by a recent study of the socioeconomic impacts of twelve power stations, two of which were nuclear plants. The study argued that, in general, the local nonbasic-to-basic employment ratio at peak construction for rural, sparsely populated regions would range from 0.1 to 0.2, and that the same ratios would apply to more urbanized, moderately populated areas as well. Ratios of 0.2 to 0.3 would be found in fringe areas of metropolitan centers. However, the nonbasic-to-basic ratio for the one nuclear plant to which a multiplier was assigned was estimated at 0.6, substantially larger than the nonnuclear employment multipliers of 0.1 to 0.2 jobs. The summary report unfortunately did not detail the specifics of how the multiplier was determined. The estimated nonbasic-to-basic employment multipliers were larger for the operations period than they were for the peak construction period. (Gilmore et al., 1981

The economic significance of constructing and operating the twelve nuclear stations that were examined in the Post-Licensing Studies appeared to be low to moderate. In terms of the magnitude of the economic effects, the percent of the total labor force from the local area in which the plants were sited was low and purchases for construction from these areas were minimal, thus eliminating any important indirect

income effect that could have occurred in more mature and diversified economies. In addition, in most cases where economic changes were realized, these dissipated with the end of construction activity: no important long-term effects were found. In few of the case studies were economic benefits evaluated as highly significant by local residents.

8.1.6 Demographic Effects

The Post-Licensing Studies found that at peak construction the average of total in-migration and diminished out-migration for the twelve study areas was 1,200 persons. The range in increased population was estimated to be between 146 and 3,308 persons. However, the significance of population change is less likely to be determined by the absolute size of the change than it is by the size of the increase relative to the existing population. Thus, relative to the size of the existing population, the percent increase in population directly attributable to the nuclear plants ranged from 1.3 percent to 19.1 percent. However, for the twelve sites, the average population change as a percent of the study area was only 3.7 percent. The extreme high value (19.1 percent) was anomolous and resulted from a moderately sized in-migration into a small study area. Population change was not assessed to be a major impact agent, either in terms of relative size or in terms of impact on social patterns or demographic profiles. Because the population change was relatively small, the increase was readily absorbed in all cases.

Other studies concerning the population changes brought about by nuclear plants generally support the conclusions found in the Post-Licensing Studies investigation. In the four counties studied for nuclear plant effects in Maryland, population increases ranged from 5 percent to 13 percent of the existing population (Maryland Power Siting Commission, 1978). The FEA study of the impacts of the nuclear facility in Salem County, New Jersey showed that, despite an on-site work force of 3,500 at peak construction, there were few in-migrants due to the significant commutation levels (National Association of Counties Research Foundation, 1976). Further, population impacts measured for the first three years of construction of the nuclear units at WNP 1 and 4 in the State of Washington showed that population growth due to the project was estimated to be 2,400 persons--less than 2 percent of the total county population (Community Development Services, 1979).

In terms of magnitude of change, duration, and evaluation of the effect, demographic impacts due to nuclear stations are of low significancy. The fact that

nuclear plants have not been located in isolated areas has resulted in a general geographical dispersion of movers and their families in the surrounding regions. No one community has served as the "host" community; rather, potential demographic effects were reduced because of residential dispersion. In tourist centers and rapidly growing areas where high levels of transience occur, temporary construction worker in-migration was not conspicuous. The Post-Licensing Studies also found that the construction of nuclear facilities do not have a long-term effect on reversing out-migration from rural areas.

8.1.7 Housing Impacts

Impacts on the housing sector due to the construction and operation of nuclear generating facilities were found to be relatively unimportant. Where effects were realized, they were of a temporary nature. The number of housing units in demand during peak construction among the twelve sites ranged from 58 units to 1,297 units, but as a percent of total housing stock in the study areas the demand ranged from 1.2 percent to over 25 percent. In those areas where the housing market was tight, the demands for accommodation by construction workers exacerbated existing conditions and heightened competition for housing. Nevertheless, in most cases, either the host community or nearby alternative communities were able to accommodate workers and their dependents without undue stress on the market. In only a few cases was the shortage in housing a long-term community problem. This was due, in part, to the decline in worker demand for housing when construction activity terminated. Where pre-project housing markets were especially tight, adjustments were made to the housing stock to accommodate those workers who wanted to rent houses or reside in mobile homes.

Other studies that dealt with housing effects supported the findings of the Post-Licensing Studies—adverse housing impacts were either short-lived or not an important issue (Purdy et al., 1977; Pennsylvania Power and Light Company, 1978; Shields et al., 1979; Johnson, 1977). The Calvert Cliffs plant was pointed out in two studies as an example of a plant that created severe housing shortages, but for a period of only two years. (Maryland Power Siting Commission, 1978; National Association of Counties Research Foundation, 1976.)

Overall changes in the housing stock and housing type attributable to the nuclear stations were minimal. In a few cases, rental costs increased but these were accurately

evaluated as temporary problems and not severe. In other cases, there was evidence that project-related rentals aided the elderly and other homeowners, and that the suburbanization process was accelerated to a limited degree. The significance of changes in the housing sector was rated as low. In general, no major and long-term adverse effects materialized, and positive impacts were not large. Effects on housing were perceived by study area residents as inconsequential.

8.1.8 Public Sector Effects

Tax Revenues

The fact that utility tax and revenue allocations tend to vary substantially among states has been noted in a number of reports that assessed the fiscal effects of nuclear plants (Brownstein, 1978). The Post-Licensing Studies found that a number of revenue arrangements exist. These include:

1. Publically owned utilities that pay no taxes on nuclear plants;
2. Utilities that pay taxes on their nuclear power plants to respective states which in turn reallocate revenues to communities within the state;
3. Utilities which pay taxes directly to the local taxing jurisdictions; and
4. Municipalities that impose a wage tax on workers at a nuclear construction site.

The size of the revenues from the twelve nuclear stations varied substantially. The importance of plant-induced revenues was determined by the proportion of the plant revenues to the total budget of the study area. For revenue paying plants, the proportion of plant revenues to total local revenues in 1976, for example, ranged from 0.3 percent to over 50 percent. The utilities of six of the twelve plants contributed over 20 percent of the total revenues of the study areas in which the nuclear facilities were located.

In some instances--where there are few in-migrants, where there is a lack of locally purchased construction materials, and when there are large income leakages--the revenues generated by nuclear plants may become the most significant effect of the plants. This was the case in the majority of study areas investigated in the Post-Licensing Studies. In addition, these revenues became particularly important because they were allocated to upgrade, improve, and expand educational facilities and services. In no case was the stress on the provision of public services assessed to be sufficiently large to offset the benefits gained through the allocation of tax revenues or the reduction of property tax rates.

Existing studies on nuclear plant impacts also show significant revenue effects to local areas in which nuclear plants were sited (Bjornstad, 1976; Johnson, 1977; Maryland Power Siting Commission, 1978; National Association of Counties Research Foundation, 1975; Purdy et al., 1977; Shields et al., 1979). In terms of overall importance, relative to other impacts, the revenue effects were evaluated as important at those sites where plant revenues were directly allocated to the local jurisdiction, often a county or school district, in which the plant was sited. In such cases, a high significance was assigned to this impact dimension. High significance occurred in those small rural counties where plant-related revenues were often the largest source of revenues. Equally large absolute plant revenues in large, mature local economies were often not the major source of local revenue and in these cases public evaluation of the importance of this effect was reduced. High significance to revenue impacts was assigned to those areas where the visible manifestation of revenues was highly conspicuous in terms of additional jobs and educational quality and services. This occurred at three of the twelve sites.

While the literature points to beneficial revenue effects, the Post-Licensing Studies provided evidence of wide-ranging effects, from no significance to high significance.

Of the four major public service areas examined—education, transportation, public safety, and social services—the study found that there had been very little demand for project-related expansion in public safety and social services. Traffic congestion, however, was found to be a somewhat serious problem at most sites. Project-related demands on the school system occurred at some of the sites, but in all cases successful adjustments were made to absorb the students without deleterious effects on educational quality. Moreover, the stress placed on the enrollment capacity of the local school systems was generally short lived and resolved through facility expansion programs. The research also found that plant-related stress on enrollment capacity was usually the result of adding to a system already overcrowded due to population growth unrelated to the nuclear facilities. Of total pupil enrollment at the twelve sites, an average of only 2.9 percent was attributable to the nuclear plants. It should be noted, however, that at the tax-paying sites, plant-generated revenues contributed an average of 40 percent of school district revenues.

In a retrospective study of 17 nuclear power plants, Krannich (1979) assessed the perception of impact levels of nuclear stations on a number of dimensions. As Table 8-1 shows, highway and traffic impacts and housing supply problems were perceived as

TABLE 8-1

DISTRIBUTION OF PERCEIVED COMMUNITY SERVICE IMPACTS

	Not Appreciable	Minor	Moderate	Major
School	73.7	21.1	5.3	0.0
Highway	38.9	27.8	22.2	11.1
Sewage Treatment	67.7	27.8	0.0	5.6
Water	77.8	22.2	0.0	0.0
Fire	94.1	5.9	0.0	0.0
Public Safety	70.6	11.8	0.0	0.0
Health Care	88.2	11.8	0.0	0.0
Housing Supply	33.3	33.3	5.6	27.8
Private Services	88.2	11.8	0.0	0.0

Source: Krannich, Socio-Economic Planning Science. vol. 13, pp 41-46, 1979.

serious disamen[illegible] associated with nuclear power plants. Otherwise, the consequences of the plants o[illegible] the provision of public services was minimal. Krannich concluded by noting that the "impact levels perceived were viewed as less problematic than those reported i[illegible]uch of the energy impact literature." The Maryland projective study of nuclear plant impacts reinforced Krannich's findings by concluding that: "as a result of proximity to metropolitan areas, the proportion of workers moving into a project area is also relatively small. Therefore, there is little effect on facilities and services. . . and it becomes unnecessary to greatly expand services and budgets." One of the issues in the area of energy impacts is the timing imbalance between project-induced expenditures and project-induced revenues. While in a few cases, revenues were not received until plant operations commenced, in no case were the plant-related expenditures sufficient to create adverse fiscal conditions.

8.1.9 Social Impacts

The effects of nuclear facilities on social structure and organization had not been systematically investigated prior to the Post-Licensing Studies. This study examined the social structure dimension by looking at changes in the characteristics of major groups constituting the study areas and the pattern of interrelationships among the groups. In no case were major structural changes in community organizations directly or solely attributable to the effects of nuclear facilities. Thus, social effects in terms of organizational change were not significant. In some cases, new in-migrants secured leadership roles in the community and in others the political decision-making process was altered in a limited way. But such changes did not constitute important changes in social fabric or interaction patterns.

The study found that there were few community issues over the economic, demographic, housing, and social changes induced by the plant. While prices for housing may have escalated, the effect was not long term and no controversy over such issues surfaced in the communities studied. Social tensions between newcomers and the indigenous population were not found. There were, however, a few jurisdictional disputes over the distribution of tax revenues. These were isolated disputes that did not result in the emergence of any major community conflict. Overall, few problems were seen in the area of provision of public services.

In a number of cases, the nuclear plant sensitized study area residents and local government officials to growth management issues, even though the nuclear projects

were not necessarily responsible for the growth. In five of the case studies, greater attention was placed on zoning and land use planning subsequent to nuclear plant construction. Examination of this trend found that the public perception of the plants as growth-inducing was not an insignificant factor in a number of cases. Concern over community growth, concomitant with revenues from the plants, resulted in increased professional specialization and expansion of planning functions in local government. This tendency was also observed by the Oak Ridge National Laboratory's post-licensing studies. Political impacts included: (1) issues over growth management; (2) hiring of planners; (3) changes in the style of decision making; and (4) increasing the specialization of administrative functions (Purdy et al., 1977; Shields et al., 1979).

Socioeconomic effects to the study area from the construction and operation of nuclear facilities do not generally result in major community-wide issues. Nonetheless, indirect and subtle political response in the form of administrative changes and concerns resulted. The public response to nuclear facilities is often a manifestation of concern over the safety of nuclear technology and preservation of quality of the environment. In a number of the cases studied, issues over environment and safety did not emerge, and community support for the facilities was strong and long lasting. This was especially true in those places having a long history of economic instability and in those areas where growth was an important and pervasive community value. In other study areas, however, the opposition to nuclear plants paralleled national concerns. The link between level of concern over environmental quality and active opposition to a nuclear plant was found to be related. This is supported by numerous studies (see Kasperson et al., 1980). In fact, the Oak Ridge post-licensing studies concluded that support for nuclear facilities is associated with an "ideology of economic growth." Where local opposition to the plants was active and long lasting, there was a tendency for non-nuclear environmental issues to surface as spin-off effects.

8.2 Summary

The findings of the Post-Licensing Studies suggest that the impacts resulting from building and operating a nuclear generating facility are not generally characteristic of impacts associated with resource-based energy developments and are more akin to impacts of rural industrialization. Economic benefits to local areas were not significant due to large commutation levels, income leakage from rural areas, and relatively few major purchases for construction requirements. This finding is consistent with the available literature. While demographic and housing effects were also found to be of low

to moderate significance in the Post-Licensing Studies, the literature has not systematically and carefully evaluated these dimensions with respect to project attribution, and the findings have, consequently, been inconsistent on the magnitude of these two effects. In addition, the studies on revenue impacts from nuclear plants generally have shown important absolute gains to local jurisdictions. The Post-Licensing Studies found a wide range of revenue impacts to the study area. In some areas, with relatively large absolute revenues from nuclear facilities, the significance of these revenues were of low to moderate significance depending on the relative weight of the revenues compared to other generating sources and the public evaluation of the importance of these revenues. In general, the findings of the Post-Licensing Studies have been consistent with the literature and have offered arguments based on empirical research and a carefully developed methodology.

CHAPTER 9: IMPLICATIONS OF THE FINDINGS FOR PROJECTIVE ASSESSMENTS AND PLANNING STUDIES

9.1 Introduction

The emphasis in the preceding chapters has been to document the effects of constructing and operating nuclear generating stations on the residents of the regions in which the facilities have been located. These effects were described in Chapters 4, 5, 6, and 7 and were then compared to the findings of other studies in Chapter 8. Throughout, the focus has been retrospective, and the analytic and methodological questions have centered on problems of attributing the effects to the facilities after the effects have occurred. The purpose of this chapter is to move from the research-oriented, retrospective focus of the previous chapters to the policy-oriented focus of projective planning and assessment studies. The original intent of this research was not only to establish a record of the impacts of twelve existing nuclear stations, but to investigate the extent to which these kinds of impacts could be anticipated.

The implications of the findings for projective assessments are oriented to two sets of considerations: (1) What are the particular kinds of socioeconomic effects likely to be most important; and, (2) How can they best be anticipated? That is, how should a projective study be structured and how can it best be carried out to deal with the types of effects this research has identified as most relevant?

In these discussions, it is important to understand the scope and purpose of the projective assessment being contemplated. This is necessary to keep the methodological considerations in a reasonable relationship to the objectives of the study. It is assumed here that the planning and assessment requirements being discussed are of the type that would currently be undertaken by a utility looking forward to licensing a nuclear station. These studies would be intended to meet federal and state licensing requirements as well as local information requirements in order to anticipate and avoid adverse socioeconomic impacts. The current orientation of such a study is weighted toward planning. In the 1960s and early 1970s, assessments were "compliance-oriented" and focused on trying to accurately describe environmental conditions as they would exist "with" and "without" a certain impacting event. If these project effects were accurately foreseen, it was presumed that responsible decisions could be made with respect to the desirability of the project and that the public interest could be served.

There are elements of this scenario that continue to be relevant, but there has been an important change in emphasis. A key function of assessment is now seen as anticipating undesirable project consequences so that mitigation plans can be undertaken to redefine the project or otherwise minimize adverse effects. Assessment becomes an integral part of the planning process under this interpretation, and the definition of the impacting event is continually modified in response to the kinds of problems anticipated.

Local residents necessarily play an active role in defining appropriate mitigation so there is an important element of public involvement throughout this process. The purpose of this chapter is to examine the implications of the Post-Licensing Studies for the previously described type of integrated planning and assessment study.

This objective is pursued in three steps as follows. First, some general observations are made with respect to the structuring of projective assessments and the definition of the study area. Second, each of the thirteen proximate determinants[1] of socioeconomic impact are examined in terms of their explanatory variables or underlying determinants. The discussion distinguishes project-specific determinants and site-specific underlying factors to explain variability. It also examines what is know about the quantitative relationships that link these variables to impact. Third, summary conclusions are drawn with respect to our ability to foresee and avoid adverse socioeconomic consequences of nuclear power stations.

9.2 Structuring of Projective Assessments and Planning Studies

There is one central implication of the Post-Licensing Studies for the structuring of projective assessments—namely, that there is a logical chain of cause and effect that must link each of the study components if the results of the study are to be correctly interpreted and useful. To be more specific:

(1) Correct anticipation of work force size and distribution is essential to the economic analysis;

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[1]The proximate determinants of socioeconomic impact refer to those dimensions of change that can be measured and are the focus of the socioeconomic investigation. Each of these variables is, in turn, the function of several other underlying variables or of other of the proximate determinants. Proximate determinants include such dimensions as labor force composition and distribution, effective basic income, and social structure.

(2) Correct projection of total employment is the key to anticipating project-induced population change;

(3) Accurate anticipation of population change is critical to the assessment of housing impacts;

(4) The combination of economic, demographic, and housing changes determines increased demands for facilities and services;

(5) Correctly projecting increased demands for facilities and services allows increased operating and capital expenditure demands to be foreseen;

(6) Accurate projections of increased levels of economic and demographic activity also allow increased revenues to be correctly forecast;

(7) Correctly projecting the changes in the variables listed above provides the basis for determining whether the characteristics of area groups will change in a way tending to change the area's social structure;

(8) Accurate projections of these cumulative effects and projection of their distribution among area groups is essential if the evaluation and response of individual groups is to be anticipated; and

(9) The understanding of community values and the nature of community issues will provide a basis for assessing response to the siting and operation of a nuclear power plant.

Thus, each of these study elements must be structured in a synchronized and carefully planned fashion if the assessment as a whole is to meet its objectives. The omission of an element or the incorrect coordination of detail between one step in the process and the next may break the overall causal chain with the possible result of seriously impairing the reliability of the assessment.

A second general implication of the Post-Licensing Studies relates to study area definition. Study area definition is one of the most important decisions that has to be made in any assessment, retrospective or projective. It involves fundamental resource-allocation decisions in which trade-offs have to be made between geographic inclusiveness on the one hand, and depth of analysis on the other. The organizing principal used in this study was the incidence, in a relative sense, of work force, local purchases, and revenue effects. Each of these direct attributes of the nuclear station was distributed, and the study area was then selected based predominantly on the distribution and concentration (absolute size of the effect relative to the size of the area in which it occurred) of the three effects.

The calculation and geographic distribution of these effects can be carried out in the same way for a projective assessment. Based on our findings, however, it is recommended that emphasis be placed primarily on the residential location of the work

force and on the size and jurisdictional distribution of the direct project revenues. Anticipatory data on local purchases are difficult to derive and in no case were they of sufficient magnitude to have any significance in the determination of the study area.[1]

Once the areas with relatively high work force concentrations and direct tax revenues have been identified, the second major consideration in study area selection is jurisdictional boundaries. In particular, a projective assessment will generally be concerned with statutory permitting or licensing processes as well as local planning processes. It is essential, therefore, that the geographic scope of the assessment be consistent with the domain of the regulatory and planning processes which it is designed to support. For example, if a county special-use permit figures prominently in the regulatory process, this will provide a strong impetus to be able to address the effects of the project on the entire county. A secondary reason jurisdictional considerations will figure prominently relates to data availability. The consideration of revenue effects will already have influenced the study area definition in this regard, but there will be strong pragmatic reasons associated with other types of economic and demographic data that influence the study area selection.

The third major influence on study area selection in a projective assessment relates to the perceptions and response of the public with respect to a proposed project. Quite independent of the distribution and concentration of project effects or of the jurisdictional boundaries of entities heavily involved in project-related regulatory or planning activities, there may be levels of public concern or perceived effect that need to be considered in the study area definition process. Early scoping meetings will help identify these concerns, and decisions can then be made on how best to focus the assessment in order to deal with them. In some cases, this may affect the study area definition. In other cases, it may be desirable to direct the public involvement process to a geographic area different from that being formally studied in the assessment process.

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[1]This conclusion will tend to hold because a small area where the effects might be significant will typically be unable to supply the required materials and equipment. A larger area may be able to supply a larger part of a project's requirements, but then the project requirements are likely to be relatively insignificant to the area's economy.

9.3 Proximate Determinants of Socioeconomic Impact

9.3.1 Work Force Composition and Distribution

9.3.1.1 Introduction

It is well recognized that the characteristics of the construction and operation work force are the ultimate determinant of many of the most important social and economic consequences of building and operating a large industrial facility. It is necessary to correctly anticipate: (1) the number of workers over the project's life; (2) their breakdown in terms of nonmovers, movers, and daily commuters; (3) their place of residence; and (4) the extent to which the movers are accompanied by their families. It is important to note that these definitions, as they have been used in this study, depend on the definition of the study area. That is, a nonmover is a previous resident of the study area, a mover is a worker who relocates into the study area, and a commuter is a worker who returns daily to a residence outside the study area. It follows, therefore, that as the size of the study area is diminished, the proportion of movers and nonmovers will diminish relative to commuters, other things remaining the same.

9.3.1.2 Underlying Determinants

	Underlying Determinants		
Proximate Determinant	Other Proximate Determinants	Project-Specific Determinants	Site-Specific Determinants
1. Work Force Composition and Distribution		- craft - duration - union/nonunion job - contractor - site-housing - subsistence policy - transportation policy	- labor supply by distance - competing demand - transportation system - housing availability

Work Force composition and distribution is affected by the interaction of project-specific and site-specific determinants. Craft composition of project labor requirements is important because it interacts with the local availability of craft labor to influence work force composition between movers, nonmovers, and commuters. The duration of particular labor demands importantly affects work force relocation and commutation

decisions. The union/nonunion status of a job influences work force composition because of the tendency of nonunion contractors to do more on-the-job training with resulting greater utilization of local labor. The identity of the contractor will often influence the work force due to policy differences in hiring or in the extent to which labor is retained from one job to the next. The provision of single-status housing at, or near, the site will influence work force composition as will contractor policies with respect to subsistence and worker transportation.

While each of the above project-specific determinants of work force composition and distribution is important, they interact with a set of site-specific variables that are equally important in determining the characteristics of the work force. Local supply of labor weighted by distance is obviously very important as is the number, size, and location of projects competing for construction labor. Finally, the availability of housing and the nature of the local transportation system play important roles in the eventual composition and spatial distribution of the work force.

9.3.1.3 Status of Empirical Evidence Linking the Determining Variables to Work Force Composition and Distribution

The starting point in investigating work force characteristics are the surveys that have now been carried out for a variety of types of projects and for all areas of the country. These surveys document the characteristics of the work force, and then investigate the combinations of project characteristics and site characteristics that appear to have been responsible. For nuclear generating stations, the recent work by Malhotra and Manninen (1980) provides a valuable summary and analysis of data from a total of 22 project surveys. Recent work by Dunning (1981) provides a similarly useful summary of surveys on other types of resource development projects, while work by Chalmers (1975) provides the earliest systematic look at these issues for projects in the western United States. Before doing a projective assessment, this literature should be carefully searched for information on projects that are similar in terms of both project-specific and site-specific characteristics.

In general, the survey data demonstrate that systematic relationships exist among the previously mentioned determining variables and work force composition and distribution, but that many of the key relationships are characterized by high variance across sites. This is because there are several additional determinants of work force characteristics that are difficult to generalize about but that play important roles in

determining what happens for a given project. Many of these considerations will be able to be identified and their consequences anticipated through interviews with local officials, union representatives, local contractors, and utility personnel. Thus, the historical survey data provide a starting point, but they should be strongly supplemented with the views of knowledgeable local informants.

Finally, and perhaps most important, there has been an extremely important shift in emphasis during the past few years which lessens the reliance on projective assessment and increases the reliance on monitoring the project and adjusting to conditions as they actually develop. This shift in emphasis is based on the fact that many of the important dimensions of the work force may be difficult to predict accurately, and that substantial costs may be incurred if a strategy is pursued based on incorrect predictions. It makes sense, therefore, to the extent possible, to develop contingency plans that can be implemented as deemed necessary and appropriate. Thus, the emphasis has changed from projecting work force characteristics alone to: (1) projecting likely ranges of characteristics; (2) developing information systems designed to provide rapid feed-back on actual developments; and (3) developing adaptive strategies that can be pursued in light of conditions as they actually develop.

9.3.2 Direct Basic Employment and Income

9.3.2.1 Introduction

There has unquestionably been a chronic tendency in socioeconomic assessments to overestimate the economic effects of constructing and operating large industrial facilities. In order to guard against this, it is suggested by the Post-Licensing Studies research that each of the individual components of economic change be identified, and that the relationships among them be carefully examined to be sure that they are appropriate to the study area being investigated. It is necessary first to identify direct basic employment and income. Direct basic employment and income result from direct employment in the construction or operation of the facility being assessed.

9.3.2.2 Underlying Determinants

Proximate Determinant	Underlying Determinants: Other Proximate Determinants[a]	Underlying Determinants: Project-Specific Determinants	Underlying Determinants: Site-Specific Determinants
2. Direct Basic Employment and Income	1. Work force composition and distribution	- employment - earnings	

[a]This entry means that work force composition and distribution (proximate determinant number 1) is an important determinant of direct basic employment and income (proximate determinant number 2).

Direct basic employment and earnings must be estimated based on the place of residence of the work force. Thus, distribution of the work force, discussed in Subsection 9.3.1 above, together with project-specific information on average earnings per worker, yield the necessary estimate of direct basic employment and income by place of residence.

9.3.2.3 Empirical Evidence Linking the Determining Variables to Direct Basic Employment and Income

The only empirical question here concerns the determination of average annual earnings. Introduction of craft-specificity will help in this process, although this will require that the work force spatial distribution have been carried out on a craft-specific basis. Assumptions with respect to shift structures and overtime also have to be included in the earnings estimate.

While there is nothing conceptually difficult about estimating direct basic employment and income, two considerations must be kept in mind. First, the size and spatial distribution of the work force are the single most important determinants of socioeconomic impact. Second, these estimates are frequently subject to major revision as construction proceeds. Recent work for the Electric Power Research Institute (DRI, 1982) indicates a consistent underestimate of peak work force requirements on the order of 100 to 200 percent. Most manpower estimates are originally developed by architectural and engineering firms in the cost-estimation process. Changes in labor inputs are the most common approach to compensate for other variables affecting construction progress. As a consequence, it is important to emphasize to the project developer and general contractor the significance of the manpower estimates for

socioeconomic assessment and planning purposes. It is also worth emphasizing that the data should reflect most likely labor requirements, not just requirements generated as part of the cost estimating process.

9.3.3 Indirect Basic Employment and Income

9.3.3.1 Introduction

Indirect basic employment and income refer to economic activities that arise from purchases of materials, equipment, or services for either the construction or operation of a project. Estimation of indirect basic in a projective assessment is usually approached in two steps. First, it is necessary to estimate total purchase requirements for a project. Second, the amount of each commodity that might be purchased locally must be estimated. This will depend on the existing capacity of the local economy to supply the required goods and services together with estimates of the extent to which new capacity might develop in response to higher levels of demand. It is also important to ascertain the nature of the goods purchased locally—whether the items are manufactured locally or retailed locally. This will have an effect on the amount of income that is retained.

9.3.3.2 Underlying Determinants

	Underlying Determinants		
Proximate Determinant	Other Proximate Determinants	Project-Specific Determinants	Site-Specific Determinants
3. Indirect Basic Employment and Income		- purchase requirements - purchasing policy	- local availability of materials, equipment, and services

Indirect basic employment and income will depend on the interaction of purchase requirements and company purchasing policies with the availability and cost of the required goods and services in the local economy. There are counterbalancing factors observed in the case studies that tend to make the ultimate impact of indirect basic on the local economy small relative to the size of the economy. In cases where the local economy was small, few of the required goods and services were available with the result that there was little impact. In the case of larger economies where more purchases were possible, the total purchases were small relative to the size of the economy. Even in

cases where local purchases were of reasonable size, the purchases were generally of goods manufactured outside the study area with the result that the amount of indirect basic employment and income generated per dollar of purchases was not large.

9.3.3.3 Empirical Evidence Linking the Determining Variables to Indirect Basic Employment and Income

Information on total purchase requirements for a projective assessment must be developed in conjunction with the project developer, general contractor, and architectural/engineering group responsible for the project. The information must be organized by commodity (or commodity type) and emphasis should be placed only on those commodities that have potential of being locally provided. Once requirements have been defined, local availability can be pursued through secondary data sources and interviews with representatives of key local and regional industries. Once preliminary estimates have been made, useful review can be obtained from purchasing agents familiar with the type of project in question and the local area.

The procedures described above result in estimates that are not easily generalized from one situation to another, but which provide the necessary basis for estimating indirect basic activity in a projective assessment. They rely heavily on primary research into local supply potential given the specific requirements of a given project.

9.3.4 "Other" Basic Employment and Income

9.3.4.1 Introduction

The final category of basic activity was referred to simply as "other" basic. Two kinds of effects were investigated in the case studies—wage-induced effects and revenue effects. Only the revenue-related effects were of significance, and only then in the case of jurisdictions that received very large increases in their tax base as a result of the nuclear station. In cases where very large direct revenue effects are anticipated, the case studies demonstrate that it may be worthwhile to try to anticipate the associated increase in public sector employment beyond that which would be associated with the normal growth for public services and facilities due to the nuclear station.

9.3.4.2 Underlying Determinants

Proximate Determinant	Underlying Determinants: Other Proximate Determinants	Underlying Determinants: Project-Specific Determinants	Underlying Determinants: Site-Specific Determinants
4. "Other" Basic Employment and Income			- property tax statutes - local labor market conditions - local industrial structure

"Other" basic activity is used to denote changes in economic activity due to a project beyond indirect basic or nonbasic changes. The most commonly suggested effects are reductions in activity due to the impact of increased wages on local producers and increases in public sector activity due to the large increase in revenues associated with some nuclear stations. The size of the revenue effects will depend on statutory provisions for property tax equalization and the location of the facility relative to taxing jurisdictions in the local area. In situations where substantial assessed valuation is generated for local jurisdictions, part of the local response may be in the form of reduced mill-levies and part may be in the form of increased expenditures (and employment). In cases where there are public sector employment increases beyond normal levels expected to accompany general growth in the area, this must be treated as another kind of increase in basic activity.

Labor market effects are also frequently cited consequences of nuclear station construction. The hypothesis is that sharp increases in the demands for particular labor skills so diminish local labor availability and increase local wages that production and employment have to be curtailed in other sectors of the local economy. The extent to which this occurs will depend on the supply/demand characteristics of local labor markets and the structure of local industry. In general, if local industry is dependent on low-wage labor, and if the supply of labor is relatively inelastic, there could be significant effects of this type.

9.3.4.3 Empirical Evidence Linking the Determining Variables to "Other" Basic Employment and Income

The case studies showed that in the face of massive increases in revenues, local jurisdictions tended to increase employment considerably faster than would have been expected purely on the basis of area growth. The larger the revenue increase, the larger the expected increase in public sector employment. Anticipating the political decisions that will be made in the face of assessed valuation increases is necessarily difficult, but it is safe to assume that some of the increased valuation will find its way into increased government employment.

Labor market effects are equally difficult to anticipate. In general, the case studies indicate that they have been of little quantitative significance. Local respondents frequently mentioned labor market tightness and wage escalation associated with plant construction, but in no instance did this appear to have resulted in significant reductions in local employment or income. Some care should be taken in a projective assessment if there is a large local industry particularly vulnerable to increased competition for labor. It will more usually be the case, however, that no attempt need be made to quantify changes in "other" basic employment and income due to labor market effects.

9.3.5 Effective Basic Employment and Income

9.3.5.1 Introduction

Direct, indirect, and "other" basic or exogenous income and employment are the driving forces behind the nonbasic or induced response to an industrial facility. An extremely important implication of the case studies, however, is that these components of basic income do not necessarily have equal impacts on local economic activity. It is necessary, therefore, to adjust total basic to "effective" basic income. This puts all of the income on an equivalent basis to income received by local residents. The major adjustment is to decrease income received by movers with their families absent (and singles) since their local spending is significantly lower per dollar of income than that of nonmovers. Some minor adjustment must also be made to include the effect on income spent in the local area by workers commuting daily from residences outside the study area.

9.3.5.2 Underlying Determinants

Proximate Determinant	Underlying Determinants: Other Proximate Determinants	Underlying Determinants: Project-Specific Determinants	Underlying Determinants: Site-Specific Determinants
5. Effective Basic Employment and Income	1. Work Force Composition and Distribution		- local availability of goods and services
	2. Direct Basic Employment and Income		
	3. Indirect Basic Employment and Income		
	4. "Other" Basic Employment and Income		

The underlying determinants of "effective" basic income are the size of basic income and its distribution among the work force according to the status and location of the workers. This will be influenced further by the local availability of goods and services. The fewer the goods available locally, the more similar will be the purchase patterns of all workers--namely, none of them will purchase much locally and "effective" basic will be similar to total basic. As more goods are available locally, the disparity between the purchase patterns of local and nonlocal workers will increase and the discrepancy between "effective" basic and total basic will rise.

An extreme case sometimes arises if there is a remote, single-status facility housing a substantial proportion of the construction force. This will generate large amounts of basic income, but the "effective" basic income associated with the work force may be very low.

9.3.5.3 Empirical Evidence Linking the Determining Variables to "Effective" Basic Employment and Income

Determining the appropriate weights to convert basic employment and income to "effective" basic is straightforward for a project that is underway. Workers in both the nonmovers and movers categories need to be interviewed with respect to the amounts of their income that is spent locally. The data for the movers should then be disaggregated

according to the family status of the worker--i.e., married, family present; married, family absent; or single. In general, the purchase patterns of movers who are married with their families present are similar to those of nonmovers. The large differences occur with the married, family absent, and single workers.

Because the concept of "effective" basic income is recent, there is little published survey research on the topic. The limited research available is summarized in the recently completed technical documentation for the Colorado Cumulative Impact Task Force (Mountain West Research, Inc., 1982). In the absence of existing evidence, methodology similar to that employed in the Post-Licensing Case Studies can be used. The essence of that approach was to use secondary data on the availability of goods and services together with key informant interviews to make estimates of the proportion of various consumption categories that would be purchased locally by each class of worker.

9.3.6 Nonbasic Employment and Income

9.3.6.1 Introduction

Once an estimate has been derived of effective basic income, the next step is to estimate the size of the nonbasic or induced employment response expected per dollar of effective basic income. Typically, this would be determined by using county-level multiplier estimates. Care must then be exercised, however, to reduce the size of the county multiplier if the study area is only a subarea of the county. The case studies make it clear that the combination of a small multiplier with a low ratio of effective basic to total basic income results in a surprisingly small nonbasic employment response given the magnitude of the basic stimulus.

A final consideration in estimating the size of the multiplier effects is common to all multiplier analysis. Basically, if demand increases when local production is at full capacity, and if the increase in demand is viewed as sufficiently permanent to warrant an increase in employment, then it is reasonable to expect the full multiplier effect to operate as nonbasic activity responds to the increase in basic activity. On the other hand, if there is excess capacity in the production system, or if the increase in demand is viewed as only temporary, local business may find it unnecessary, or perhaps be unwilling, to expand employment in the face of the increase in exogenous demand.

9.3.6.2 Underlying Determinants

Proximate Determinant	Underlying Determinants		
	Other Proximate Determinants	Project-Specific Determinants	Site-Specific Determinants
6. Nonbasic Employment and Income	5. Effective Basic Income		- size of the local economy - level of local resource utilization - expectations

In looking at the underlying determinants concerning nonbasic employment and income, it is important to recognize that effective basic income stands for all the project-specific and site-specific variables that influence it. It would be incorrect to conclude from the table that there are no project-specific determinants of nonbasic activity; on the contrary, many of the determinants of effective basic income are project-specific; they are simply acting through the previously discussed proximate determinants.

As shown, nonbasic activity is determined by the interaction of effective basic income with site-specific characteristics of the local economy. Effective basic income is the exogenous stimulus to the local economy produced by a project. It is income due to the project that has been adjusted for the effect of transient workers so that the income is commensurate to income received by local residents.

The effect of this stimulus on the local economy depends principally on three characteristics of the economy. First, the size of the economy in terms of availability of goods and services will have much to do with the magnitude of the nonbasic response that occurs. If needed goods and services are not available in the local economy, then the nonbasic response will necessarily be smaller. The larger and more isolated the local economy, the larger will be the nonbasic response.

The second determinant of nonbasic response is the extent of local resource utilization. If resources in an area are underutilized, increased activity may be able to be accommodated with no increase in capital investment or employment. In this case,

nonbasic income would respond to the increased activity, but there might be little or no increase in employment.

Finally, significant increases in employment and capital investment will only occur if businessmen feel that the expected returns justify such actions. Their expectations play a critical role, therefore, in determining the extent of the expansion that will actually occur. The most important question is the extent to which businessmen see long-term expansion in an area. If so, the stimulus due to construction and operation of a nuclear station provides an opportunity to expand in the anticipation of future growth. If, however, long-term prospects for an area are not encouraging, the stimulus due to a nuclear station may be viewed as only temporary and not sufficient to justify expansion of capacity.

9.3.6.3 Empirical Evidence Linking the Determining Variables to Nonbasic Employment and Income

Multipliers for small areas can be derived in a number of different ways. All of the approaches are very similar in their objective in that they are trying to estimate the relationships of induced activity in an economy to the level of exogenous or autonomous activity. Economists have traditionally pursued this question using one of three approaches—input/output, economic base, or econometric modeling. If models of this type have been constructed for an area in which a projective assessment is to be made, existing estimates of the economic multipliers may be able to be used. If no estimates exist, there are several alternatives. A primary data input/output model could be constructed. This is quite expensive, however, for a large industrial economy where input/output is most relevant. For a small rural economy, input/output is less relevant because of the limited amount of interindustry transactions in the economy and because of the high probability of structural change if there is any significant growth. Secondary data input/output is frequently used, as in the Post-Licensing Case Studies, and is an attractive option for large, complex economies where input/output is appropriate, but where primary data research is expensive.

Economic base studies are frequently used for small, rural economies where it is easy to apply and is as reliable as any other modeling technique. Finally, annual or quarterly econometric models are sometimes used for large economies. These have some strong advantages for forecasting, but are generally less desirable for impact analysis.

In general, therefore, the first step is to see what kind of modeling has already been done for the study area. If no usable work exists, close consideration should be given to secondary data input/output for larger economies (counties of 50,000 to 75,000 or more) and to economic base analysis for smaller economies (counties of 50,000 to 75,000 or less).[1]

Whatever modeling approach is employed, some considerable judgment has to be used in order to avoid overestimating the total employment and income response due to the construction and operation of a nuclear generating station. The evidence of the case studies suggests that three important factors need to be recognized to avoid overstatement of employment effects: (1) effective basic income will often be substantially less than basic income; (2) a study area multiplier for a subcounty area will be smaller than the county multiplier; and (3) the full multiplier effect will only be realized under conditions of full utilization of capacity and expectations that the increased demand will persist over time. To the extent that these conditions do not hold, the actual response in nonbasic employment may be substantially smaller than that predicted by the multiplier.

9.3.7 Demographic

9.3.7.1 Introduction

Demographic effects due to construction and operation of a nuclear station are often a major concern to local residents because of potential housing, fiscal, or social effects. Population change is directly related to employment change. Large changes in employment (on a place-of-residence basis) necessarily imply adjustments in the labor force and population. In an expanding area, this implies in-migration. In a declining area, it may only imply diminished out-migration.

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[1]These modeling approaches are discussed in more detail, and the relevant literature referenced, in the Economic Demographic Assessment Manual (Chalmers and Anderson, 1978).

9.3.5.2 Underlying Determinants

Proximate Determinant	Other Proximate Determinants	Underlying Determinants: Project-Specific Determinants	Underlying Determinants: Site-Specific Determinants
7. Demographic Change	1. Work Force Composition and Distribution 2 - 6. Total Employment		- local labor market conditions - expectations of growth or decline in local demand for labor

Projection of the demographic effects of constructing and operating a nuclear generating station flows directly from the analysis of employment change. The case study analysis showed that population change could be associated with each of the four major components of employment change—direct basic, indirect basic, "other" basic, and nonbasic. In a projective assessment, the analysis of population change due to the direct basic work force will be part of the process of determining work force characteristics—that is, what part of the work force will be movers and to what extent will they be accompanied by dependents? This part of the demographic analysis will often be the subject of considerable analysis and planning because of the importance of work force availability to the builder. It will also usually be the case that this source of population change is carefully monitored as a project is underway so that earlier projections and associated plans can be adapted as necessary.

The population change associated with the other components of employment change due to a nuclear station is more difficult because it generally will not be able to be distinguished from changes occurring in response to other forces acting on the local area. The case studies showed that population effects could occur in one of two ways depending on local economic conditions. In general, if an economy has a high utilization of labor (i.e., high participation rates and low unemployment rates), the increased demand for labor in indirect basic, "other" basic, or nonbasic jobs will have to be met through labor force in-migration to the area. At the other extreme, an area with low labor utilization (i.e., with low participation rates and high unemployment) may be able to accommodate a substantial increase in the demand for labor out of the pool of currently unutilized workers.

In fact, in an area with a declining economic base and substantial out-migration, the case studies showed that a significant consequence of the construction and operation of the nuclear station may be to diminish out-migration. Thus, the analyst in a projective assessment must give careful thought to the possibility of population change from either in-migration or diminished out-migration. Labor market conditions at the time of employment change due to the nuclear station will play a major role as will expectations with respect to future growth or decline in the local demand for labor.

9.3.7.3 Empirical Evidence Linking the Determining Variables to Demographic Change

Population change associated with direct basic employment must already have been determined as a precondition to the economic analysis. Projections will be available from the project developer, but care must be taken to monitor them closely since work force adjustments are the most commonly pursued means of reacting to scheduling problems that occur in the course of construction.

Population change due to indirect basic, "other" basic, or nonbasic employment is very difficult to project without a cohort-survival population projection model and some sort of labor market adjustment model. With such models, population can be survived forward and age/sex-specific labor force participation rates can be applied to the resulting population cohorts to determine the labor force.

The labor force can then be contrasted to total employment and assumptions made about reasonable bounds within which the unemployment rate can move. If the implied unemployment rate is above that range, out-migration is assumed to occur; if the implied rate is below the range, in-migration is assumed. The impact of the nuclear facility is then derived by comparing simulations with and without the facility.[1] Ad hoc approaches are very difficult to apply because of the significance of other factors affecting the labor market at the time the nuclear station is built and because of the complications involved in tracking the age and sex of the labor force over time.

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[1]An example of models constructed for this purpose is explained in CITF Technical Documentation and Summary (Mountain West Research, Inc., 1982).

9.3.8 Housing

9.3.8.1 Introduction

In any assessment, retrospective or projective, economic and demographic analyses provide the foundation for determining housing needs. The housing analysis needs to be tied directly to the population changes associated with the different categories of changed employment. In a projective assessment, these are the areas where coordinated planning between the developer and local governments is essential. Increasingly, therefore, these areas are more concerned with adaptive planning and adjustment than they are with projection per se. At the same time, however, projection and monitoring are essential parts of the planning process so there is still a well recognized need to analyze and predict infrastructure requirements.

9.3.8.2 Underlying Determinants

	Underlying Determinants		
Proximate Determinant	Other Proximate Determinants	Project-Specific Determinants	Site-Specific Determinants
8. Housing	2 - 6. Total Employment and Income 7. Demographic Change	- work force housing strategy	- housing availability and price

Project impacts on local housing depend on a complex set of supply and demand relationships. The principal demand determining factor is the number of new households moving into the region as a result of the project. This is then conditioned by the income of the new households, by any housing directly provided by the project developer (or contractor), and by the general price and availability of housing in the area.

Since income and family characteristics are known by type of employee (direct basic, indirect basic, "other" basic, and nonbasic), housing demands can first be estimated based on new households associated with each category of employment. Supply response can then be analyzed in terms of the existing stock, permitted construction, or housing assistance planned by the project developer. It must be kept in mind that the work force, economic, and demographic analyses all presumed housing availability for the population ultimately allocated to the study area. If for some reason the housing does not materialize from the supply side, or if it turns out to be unaffordable, or in some other

way undesirable, the new population may end up not residing in the study area and the economic and demographic analyses will have to be revised accordingly.

9.3.8.3 Empirical Evidence Linking the Determining Variables to Housing Impact

Projecting the demand for housing in terms of number and type of units given assumptions about housing prices and employee income is not difficult. There is likely to be locally available data on trends in the mix of unit types and Current Population Survey data can be used to examine type of household residence by age, sex, and income of the household head.

Interaction of these demands with local supply involves both the private and the public sector and is better thought of as a planning problem than a problem of prediction. Emphasis in the assessment process should, therefore, be placed on correctly anticipating housing demand. This, then, is the starting point for addressing the different policy issues that will arise in the course of considering alternative housing supply strategies.

9.3.9 Public Facilities and Services

9.3.9.1 Introduction

Assessing impacts on public facilities and services is similar in many ways to assessing housing impacts. Projection of facilities and services demands is relatively straightforward. Once demands are defined relative to existing capacities, however, development of the mitigation strategies felt appropriate to deal with shortfalls is necessarily an involved planning problem that requires local political involvement and public participation.

9.3.9.2 Underlying Determinants

	Underlying Determinants		
Proximate Determinant	Other Proximate Determinants	Project-Specific Determinants	Site-Specific Determinants
9. Public Facilities and Services Impacts	7. Demographic Change 8. Housing		- physical standards - cost standards - facility capacities

Most public facilities and services demands can be gauged in terms of population change or change in the number of dwelling units. Physical standards specific to a study area can be used to convert changes in these variables into demands for space, water treatment capacity, classrooms, or whatever. Once demands are determined, they must be compared to existing facility capacities to see whether facility expansion is required. If so, cost standards need to be applied to estimate the magnitude of the required capital outlays.

The operating and maintenance expenditures of local jurisdictions may also be affected by construction and operation of a nuclear station. Per capita operating and maintenance costs need to be derived for each of the functional budget categories served by the jurisdictions in the study area. Changes in per capita costs can be related both to the size of the jurisdictional unit and to its growth experience.

9.3.9.3 Empirical Evidence Linking the Determining Variables to Impacts on Public Facilities and Services

As indicated, the methodology associated with facilities/services impact analysis is straightforward. Once existing capacities have been inventoried, it remains only to determine locally relevant physical standards and cost standards. Since it is essential that this analysis have credibility with local elected officials and planners, the analysis of infrastructure requirements must reflect locally defined expectations based on historical patterns of service delivery in an area. This comes back to the same point, therefore, that the principal job of the analyst is to make clear the underlying economic/demographic conditions that will result from construction and operation of a facility. Local input is then required to plan appropriate responses in terms of master planning, zoning, housing, new facility construction, and service provision. The case studies serve as a reminder, however, that in many cases the demands on local infrastructure are very modest. When this is combined with the fact that excess capacity in community facilities can have cost implications that are as serious as problems associated with excess demands, it is important to avoid overstating the demands likely to be associated with a facility.

9.3.10 Revenues

9.3.10.1 Introduction

Revenue effects depend both on characteristics of the project itself and on the extent to which the project stimulates other tax bases through indirect or induced increases in economic or demographic activity.

Problems arise in the case of nuclear generating stations in that the direct revenue effects may be so large that important changes occur in public sector behavior. In general, if revenue flows exceed project-induced public expenditure requirements, then the opportunity exists to increase service levels or decrease tax rates. Predicting political response to these kinds of alternatives is neither easy nor particularly useful in a projective assessment. Rather, the assessment must recognize that the tax base will increase and that options exist for local decision makers in terms of how to respond.

9.3.10.2 Underlying Determinants

	Underlying Determinants		
Proximate Determinant	Other Proximate Determinants	Project-Specific Determinants	Site-Specific Determinants
10. Public Revenue Impacts	2 - 6. Employment and Income Effects 7. Demographic Change 8. Housing Effects	- value of plant and equipment facilities - local purchases subject to sales or use tax	- revenue statutes - local political response

Project direct revenues depend on applicable revenue codes. Unless owned by a government entity, the facility will be subject to property taxation based on the value of the station. The extent to which this revenue will return to local jurisdictions depends on state statutes dealing with equalization of valuation throughout the state. In addition to property taxes, a facility may generate direct sales or use tax receipts through local purchases or use of materials and equipment. Finally, there may be some form of income taxation that will generate local revenues.

Beyond these direct revenues, construction and operation of a nuclear station will have indirect and induced effects that will increase assessed valuation bases, sales or use tax bases, and other sources of local revenues. These will typically depend directly on the total stimulation of economic/demographic activity by the project and the provisions of local revenue codes.

9.3.10.3 Empirical Evidence Linking the Determining Variables to Impacts on Public Revenues

Because of the site-specific provisions of revenue codes, revenue projections have to be carefully grounded in an understanding of the relevant statutes. In general, once the codes are understood, it is not difficult to develop projection methodology that will approximate revenue flows provided that the underlying driving variables are accurately foreseen. A further issue pertains to areas where local political discretion plays a key role in determining future revenue flows. In these cases, it is recommended that working assumptions be developed as a substitute for trying to anticipate the workings of the political process.

9.3.11 Social Structure

9.3.11.1 Introduction

An important contribution of the retrospective case studies was to demonstrate operational procedures by which social structure could be defined and studied. The study area population was broken into a set of functional groups for this purpose and social structure was defined in terms of the groups, their characteristics, and the ways in which they interacted. It turned out that two principal criteria motivate the group identification process. First, there is reason to differentiate between groups that will be unequally affected by the construction and operation of a nuclear generating station. Second, there is reason to differentiate between groups that would differently evaluate given consequences of a station. That is, groups with important value differences with respect to the kinds of effects that might result from the nuclear station ought to be individually identified and studied.

The case studies demonstrated that it was relatively easy to distribute the socioeconomic consequences of a station among the groups in a study area and to examine whether group characteristics or group interaction patterns were in any way importantly affected. This same process could be followed in a projective assessment. It would not usually be difficult to anticipate the way in which group characteristics would be changed. Further, given the case studies' conclusion that interaction patterns were well established and were generally unaffected by the nuclear stations, it will probably be safe to assume that interaction patterns will be unaffected except under unusual and obvious circumstances.

9.3.11.2 Underlying Determinants

Proximate Determinant	Underlying Determinants		
	Other Proximate Determinants	Project-Specific Determinants	Site-Specific Determinants
10. Social Structure Effects	1. Work Force Composition and Distribution 2 - 6. Economic 7. Demographic 8. Housing 9 - 10. Expenditure-Revenue		- group characteristics - intragroup interaction patterns - intergroup interaction patterns

Construction and operation of a nuclear power station can affect the social structure of an area in several different ways. It can add new groups to an area, change the size or composition of existing groups, or change interaction patterns within or between groups. Each of the previously discussed proximate determinants of socioeconomic impact are potentially relevant to these three kinds of social change. The composition of the work force, the size of the employment and income effects, and demographic or housing effects are all capable of resulting in significant changes in group size or group characteristics.

9.3.11.3 Empirical Evidence Linking the Determining Variables to Impacts on Social Structure

The body of empirically based knowledge relating economic, demographic, and infrastructure changes to changes in social structure is limited and does not lend itself to mechanical application from one local area to another. Much of the relevant literature is reviewed by Mountain West Research, Inc. in the "Social Effects Project" carried out for the BLM (Mountain West Research, Inc., 1981). In general, social structure is extremely resilient and will not experience structural alternations unless the dislocations to the local area are extreme. In the Post-Licensing Case Studies, there were only infrequent cases of social structure change and, in these cases, the effects were small.

9.3.12 Evaluation

9.3.12.1 Introduction

The identification of groups and the distribution of project effects to groups is important for two reasons. First, it is the basis for analyzing project effects on social structure. Second, it provides the basis for understanding how the project is evaluated by affected groups. Historically, these two issues have been confused in the literature. The first, social structure change, is a type of objective change that may accompany a nuclear station—as would increase in employment or revenues. The second, however, refers to the subjective evaluation of all of the project effects which may influence a group. The case studies show that the resiliency of social structure in the face of relatively small socioeconomic changes makes the first issue less important than the second.

An understanding of the evaluation of a station requires knowledge of both the distribution of effects among groups and of the groups' evaluations of the consequences of the plant. The responsibility of the analyst in a projective assessment is, therefore, to present clear and carefully explained information to affected groups on the kinds of objective change they can expect to experience. It is then necessary to get representative information from each group regarding their reaction to individual effects and to summarize their overall evaluation of the nuclear station. It may be possible to infer their evaluation from an understanding of their basic values and the nature of the effects they are expected to experience, but it will usually be preferable to get the evaluations directly from the persons potentially affected.

9.3.12.2 Underlying Determinants

	Underlying Determinants		
Proximate Determinant	Other Proximate Determinants	Project-Specific Determinants	Site-Specific Determinants
12. Evaluation	1 - 11. All proximate determinants including their distribution across groups		- group attitudes and values

Evaluation is a function of the distribution of objective socioeconomic change associated with a nuclear station together with the attitudes and values of the groups affected by it.

9.3.12.3 Empirical Evidence Linking the Determining Variables to Evaluation

Evaluation is an explicitly subjective process which requires that locally affected groups be given an opportunity to react to the various changes associated with construction and operation of a nuclear station that may affect them. The responsibility of the researcher is to be sure that likely objective changes are clearly defined so that evaluation can take place based on an understanding of what the plant would mean to different individuals. Evaluation ought to be pursued with respect to individual effects likely to influence the individual or group.

There is little that can be generalized from one project site to another with respect to evaluation. This is a step in the assessment process that requires site specific research whether in a retrospective or projective assessment.

9.3.13 Public Response

9.3.13.1 Introduction

In the Post-Licensing Studies, public response was examined in each case in an attempt to understand whether public response either influenced, or was influenced by, local socioeconomic impacts. In general, the case studies showed that local socioeconomic impact had very little to do with the nature or extent of public response. In particular, response was often dominated by regional issues associated with nuclear power, transmission line location, thermal pollution, and so forth, that had no relationship to the kinds of impacts discussed in the preceding sections.

Public response that occurred in the study areas, in terms of opposing the plant at the permit hearings and expressions of concerns outside the hearings process, were related to project-specific events such as accidental discharge of radioactive material and to site-specific factors including such things as the level of environmental activism in the study areas prior to the construction of the plants.

9.3.13.2 Underlying Determinants

Proximate Determinant	Underlying Determinants		
	Other Proximate Determinants	Project-Specific Determinants	Site-Specific Determinants
13. Public Response	Evaluation	- project-specific events	- local values - political activism and public participation patterns

The evidence from the twelve case studies shows that the intensity and extent of the public response was strongly related to prevailing values held by residents and groups in the study areas. In areas where progrowth sentiments prevailed, especially in areas with little experience in interest group political behavior, there was a high likelihood of strong support for the nuclear stations.

Although the projection of anticipated public response to a project is fraught with difficulties, assessments can be undertaken to provide indicators of potential response. Information on how communities have historically responded to stress and crises, and actions or inactions toward environmental quality or growth issues, will provide clues as to possible response to the location of nuclear plants in host areas. Public participation styles, the role of leadership in the community, and the number of public interest groups and organizations in the area and their concerns, are important data elements for projective assessments of the nature of the public response. Attitude and opinion surveys are sometimes used by utilities to gauge concern over siting of nuclear facilities. Questions with respect to saliency of concern and possible political action can be included, but these may not be highly reliable indicators of actual behavior.

9.4 Summary

The preceding discussion has identified the thirteen measurable dimensions of socioeconomic change that were the focus of the Post-Licensing Studies and examined what has been learned about these dimensions as it may be relevant to projective assessments. An inescapable conclusion of the examination is that tight, logical interrelationships exist among these variables. The analysis of one is often the requisite for analysis of the next and so on throughout the planning and assessment process.

Recognition of this fact is essential to proper organization and implementation of a projective assessment.

In general, the results of the case study research have been encouraging for those with responsibilities for projective assessments. The effects of the stations were modest, those significant effects that did occur could have been foreseen, and what few adverse effects occurred could have been avoided. Public sector effects were judged to be either moderately or highly significant in eight of the twelve case studies. This was due uniformly, however, to the effect of the station on revenues, not expenditures, and these can be projected with little difficulty. The other categories of effect—economic, demographic, housing, and social—were significant in only two to four of the case studies and most of these were rated as moderate.[1] The greatest danger here is that effects may be overestimated rather than underestimated. Care has to be taken to insure that work force projections are carefully monitored and that nonbasic economic response has been realistically assessed in light of the size of the local economy, local levels of resource utilization, and future expectations.

Finally, there was a conspicuous absence of significant adverse effects due to the construction and operation of the nuclear stations. Without exception, each of the effects rated of moderate or high significancy were beneficial in their effects on the local area, not adverse. The adverse effects tended to be relatively minimal and clearly transitory in impact on the area. As such, they were often endured or could have been mitigated had there been a commitment to do so.

Despite the apparent absence of adverse socioeconomic impact stemming from the nuclear stations, public response at many of the sites indicated concern with the risks associated with nuclear power. Even though it was difficult to gauge the depth of these concerns in the case study research, they should not be underestimated as a potential source of adverse effect.

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[1]There was one site, Arkansas, where the significancy of the economic effects was rated high.

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*U.S. GOVERNMENT PRINTING OFFICE : 1982 0-361-297/2310

NRC FORM 335 (11 81)

U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

1. REPORT NUMBER *(Assigned by DDC)*: NUREG/CR-2750

4. TITLE AND SUBTITLE *(Add Volume No., if appropriate)*
Socioeconomic Impacts of Nuclear Generating Stations
Summary Report on the NRC Post-Licensing Studies

2. *(Leave blank)*

3. RECIPIENT'S ACCESSION NO.

7. AUTHOR(S)
J. Chalmers, D. Pijawka, K. Branch, P. Bergmann/MWRI
J. Flynn, C. Flynn/SIRI

5. DATE REPORT COMPLETED
MONTH: May YEAR: 1982

DATE REPORT ISSUED
MONTH: July YEAR: 1982

9. PERFORMING ORGANIZATION NAME AND MAILING ADDRESS *(Include Zip Code)*
Mountain West Research, Inc. w/ Social Impact Research, Inc.
1414 W. Broadway, Suite 228 Areis Building, Suite 427
Tempe, AZ 85282 2366 Eastlake Avenue East
Seattle, WA 98101

6. *(Leave blank)*

8. *(Leave blank)*

12. SPONSORING ORGANIZATION NAME AND MAILING ADDRESS *(Include Zip Code)*
Division of Health, Siting and Waste Management
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

10. PROJECT/TASK/WORK UNIT NO.

11. FIN NO.
B6268

13. TYPE OF REPORT
Final Report

PERIOD COVERED *(Inclusive dates)*
Oct. 1, 1978 to Jan. 4, 1982

15. SUPPLEMENTARY NOTES

14. *(Leave blank)*

16. ABSTRACT *(200 words or less)*

The Post-Licensing Studies had four objectives. The first was to identify the socioeconomic effects resulting from the construction and operation of each of twelve nuclear power stations. The socioeconomic variables examined included: economic, demographic, housing, government, public response, and social organization characteristics. The second objective was to determine the way in which the identified effects were evaluated by study area groups. The third objective was to identify the determinants of the project-related effects. This task required knowledge of what combination of site, project, or other determinants was responsible for the project-related effects and for the evaluation of the effects. The fourth objective was to make recommendations with respect to assessment methodologies that could best be used to project the socioeconomic effects of the construction and operation of proposed nuclear generating stations. The objectives of the Post-Licensing Studies are met by the twelve individual case studies and by the Summary Report. The case studies identified the nuclear power stations and describe the evaluation of the effects by area residents. The Summary Report describes the collective findings of the individual case studies, compares the findings across sites to identify possible determinants of the effects, and examines the implication of the findings for future siting decisions and for the methodology most appropriate for projective assessments.

17. KEY WORDS AND DOCUMENT ANALYSIS

17a. DESCRIPTORS

17b. IDENTIFIERS/OPEN-ENDED TERMS

18. AVAILABILITY STATEMENT
Unlimited

19. SECURITY CLASS *(This report)*: Unclassified

21. NO. OF PAGES

20. SECURITY CLASS *(This page)*: Unclassified

22. PRICE
$

NRC FORM 335 (11 81)

120555078877 1 ANRE
US NRC
ADM DIV OF TIDC
POLICY & PUBLICATIONS MGT BR
PDR NUREG COPY
LA 212
WASHINGTON DC 20555