CONF-760722-7

SOCIOECONOMIC EFFECTS OF OPERATING REACTORS ON TWO HOST COMMUNITIES: A CASE STUDY OF PILGRIM AND MILLSTONE

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Invited Paper presented at
Conference on LAND USE AND NUCLEAR FACILITY SITING: CURRENT ISSUES
Sponsored by Atomic Industrial Forum
Denver, Colorado
July 18-21, 1976

Work supported by the U.S. Nuclear Regulatory Commission,
Office of Regulatory Research

Oak Ridge National Laboratory
Oak Ridge, Tennessee 37830
Operated by Union Carbide Corporation for the
Energy Research and Development Administration

CONTRACT NO. W-7405-ENG-26

ABSTRACT*

This exploratory case study examines the social, economic, and political/institutional impacts of two operating nuclear power complexes on two New England communities. This work is one of a series planned to broaden knowledge of the effects of large energy generating facilities upon the social structure of local communities. Its primary objectives are to investigate and assess social and economic impacts resulting from construction and operation of nuclear power plants and to generate hypotheses about such impacts for future testing.

The report includes discussions of the study design and objectives, profiles of the towns of Plymouth, Massachusetts, and Waterford, Connecticut, and analysis of the social, economic, and political impacts as observed by members of the ORNL staff. Results are presented from an attitude survey as well as a social impact classification schema devised as a methodological tool.

The study concludes that construction impacts were minor due to a dispersed commuting pattern by construction workers and that the only significant construction impact which can be identified retrospectively is construction worker traffic. The primary impact of the nuclear power plants in both communities was the massive increase in property tax payments paid to the local communities by the utilities and the option chosen by each community to maintain the existing tax rate while using the additional revenue to significantly increase and enhance the public service delivery systems and facilities within the community. Second-order consequences of the direct, first-order economic impact were: (1) changes in community land use policies, (2) increase in salience of growth issues, and (3) alteration of both inter- and intra- community relationships. The majority of residents in both communities express favorable attitudes toward the nuclear plants, primarily because of the substantial increase in the tax base of their communities. Most residents would permit construction of the nuclear facilities again because of real economic benefits and the lack of any perceived disbenefits.

*This abstract describes the original study rather than the present abbreviated paper. Full study is:

Bruce Purdy, Elizabeth Peelle, David Bjornstad, et al., A POST-LICENSING CASE STUDY OF COMMUNITY EFFECTS AT TWO OPERATING NUCLEAR POWER PLANTS, Oak Ridge National Laboratory for the Nuclear Regulatory Commission, in press, 1976.

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I. INTRODUCTION

This paper reports briefly on the background, design, and results of the first post-licensing study of socioeconomic effects of operating reactors at the Pilgrim and Millstone reactor sites. The study was conducted in 1975-76 on site in Plymouth, Massachusetts and Waterford, Connecticut by researchers from Oak Ridge National for the U.S. Nuclear Regulatory Commission.[1] It is the first of a series of such studies aimed at developing data bases, methodologies, hypotheses for test and eventual guidelines for siting through examination of communities which host nuclear reactors. These post-licensing community impact studies are the research followup to the first social impact assessment attempted for the proposed Mendocino nuclear power plant licensing action for the Atomic Energy Commission in 1972.[2] The numerous practical difficulties encountered in that first case study led to other efforts to conceptualize and codify the range of likely social impacts and social costs and benefits,[3] and to the eventual funding of this study.

II. STUDY DESIGN

An exploratory, descriptive case study approach was used to investigate changes in the host communities of Plymouth and Waterford which might be due to the siting of nuclear power reactors within the past decade. While we focused on the current period of operation of the reactors, some retrospective investigation of the construction period was undertaken as data permitted.

Objectives of the study were to:

1. identify significant variables related to social, economic, and political structure;

2. explore the history and character of each community through local informants as a means of further identifying potentially significant factors;

3. collect systematic and comparable data bases for the two communities and assess their validity;

4. develop a classification schema to assist in the identification of possible socioeconomic impacts;

5. assess changes over time in the variables identified and determine, insofar as data permit, relationships between the siting of the nuclear power plant and changes in the social, economic, and political structures of the communities;

6. generate hypotheses for future tests.

III. SITE SELECTION CRITERIA

To permit observation of actual social effects of both operation and construction periods, we decided to select one or more communities which were host to power reactors in operation for at least three years. Of the 53 power reactors licensed for operation in December 1974, 18 had been licensed for three or more years.[4] Eliminating small early reactors, nine reactors of at least 500-MWe capacity and three or more years operating experience remained. These nine reactors and their host communities were examined and reviewed in terms of:

1. technical features of reactors and cooling systems;

2. socioeconomic characteristics of the host communities;

3. availability of local and regional data sources;

4. evidence of cooperation and interest from both the utilities and communities involved;

5. desire to maximize the research output by utilizing sites which were geographically similar and accessible to each other.

On the basis of this review, Plymouth and Waterford were selected for the case study because of similarities in reactor characteristics, socioeconomic variables, regional settings, as well as geographical proximity. Table 1 shows comparisons of host community characteristics. The two sites are similar in preconstruction population, seacoast location, political structure, percentage of the tax base provided by the utility, and certain reactor characteristics. They are dissimilar in subsequent rates of population growth, use of planning and zoning to control growth, and amount of additional nuclear reactor construction presently underway, unemployment rates, and median income.

IV. PROFILES OF PLYMOUTH AND WATERFORD

A. PLYMOUTH, MASSACHUSETTS

The largest town in area in Massachusetts (104 square miles), Plymouth is located on Cape Cod Bay, 35 miles south of Boston 40

Table 1

Comparison of Selected Community Characteristics and Effects

	Plymouth, Mass. (Pilgrim I)	Waterford, Conn. (Millstone I)
Location	Seacoast 40 miles south of Boston New England	Seacoast Southeastern Conn. adjacent to New London, Conn. 40 miles equidistant from Hartford and New Haven, Conn. New England
Type of government	Representative Town Meeting	Representative Town Meeting
Population at onset of construction	15,400 (1965)	16,600 (1965)
Population – 1975 (estimated)	28,000	18,300
Percent increase in population	82%	10%
Effect on land values	Sharp increase	Sharp increase - ($25,000/acre, 1975)
Zoning and planning	No zoning laws until 1974	Tight planning and zoning regulations administered since the 1960s
Approximate percent tax base supplied by reactor -- 1975	~30%	60%
Effect on housing starts	Sharp increase	Gradual increase
Median income - 1970	$7,900	$11,828

Source: Plymouth, Massachusetts, and Waterford, Connecticut, Annual Reports, 1970-1974; U.S. Census of the Population, Massachusetts and Connecticut, 1970.

miles northeast of Providence, Rhode Island, the gateway to the Cape Cod area. It is the county seat for 27 small communities in Plymouth County.

After growing slowly and steadily during the 1950's and 1960's (from 13,600 in 1950 to 15,400 in 1965), Plymouth suddenly underwent explosive growth beginning in 1968 when construction of the Pilgrim I station began. By 1975, Plymouth had a population of 28,000, a growth rate of about 11% per year since 1968. School enrollments increased 108% in the decade to 1975, necessitating double sessions until three new schools were built in 1975. Building permits doubled each year from 1970-72, reaching a peak of 873 in 1972 before declining again. The new residents are primarily employed outside of Plymouth and chose Plymouth as a desirable place to live for many reasons, including the expectation of "low taxes." The oldest town in North America, Plymouth still retains the representative town meeting form of government adopted in 1620. In order to deal with these problems of growth, the town has hired its first full-time planner, executive secretary, and public works director. New problems and issues require attention from local officials and citizens.

Despite lessening reliance upon tourism for an economic base and the entry of some light industries recently, Plymouth's unemployment rate remains among the highest in the state as it has for many years (14-22% since 1969).

Pilgrim I nuclear station occupies 517 acres within the town on the shores of Cape Cod Bay. One-tenth of the site has been modified by the nuclear complex. The 180 foot high reactor building is clearly visible from the water and from some neighboring areas along the shore, but is concealed from nearby houses and motorists by the 395 foot high forested Pine Hills.

B. WATERFORD, CONNECTICUT

Waterford is located in the prosperous and industrialized southeastern Connecticut area on Long Island Sound, 40 miles from both Hartford and New Haven. Its immediate neighbors are the city of New London and the suburban towns of East Lyme and Montville. Its population of 17,300 (1970) is spread over 40 square miles, while New London's 5.6 square miles contain 31,600 people. Unlike Plymouth, Waterford's growth since the construction of the Millstone I and II complexes has been less than that of its region (11% for the entire period). It is a residential community of single-family homes, whose building permits have remained steady during the past 6-8 years at about 80 per year. School enrollments increased gradually to a peak in 1968 and have declined somewhat since then. Restrictive zoning ordinances implemented by the Representative Town Meeting at the request of an active Planning and Zoning Commission are a primary reason for this controlled growth.

A professional planner was hired in 1974 to administer these ordinances which had been enacted a decade or more ago.

The new tax base provided by the reactor has stimulated new service demands as well as debate over the suitability of the present type of local government. More than half of Waterford residents are professionals, many employed in the heavily industrialized nearby Thames River Industrial Complex consisting of Gen. Dynamics Electric Boat, U.S. Naval Submarine Base in Groton, U.S. Coast Guard Academy, U.S. Naval Underwater Sound Lab, and Phizer Corporation. Two-thirds of the area work force is employed in this complex, and unemployment remains at very low levels (3.3% in Waterford, 6% for the State of Connecticut).

The 500 acre reactor site on Niantic Bay is the largest manmade structure around, visible along the shore for long distances and generally unconcealed by vegetation or hills. The 160 foot high reactor buildings and 375 foot ventilation stack are particularly noticeable.

V. INPUTS

Analysis of the data was conducted using an input-output approach. Inputs to the social system caused by the construction or operation of the nuclear power plant are identified, their interactions with the social system are traced, and the effects outlined. Effects or outputs are defined as impacts which occur from this interaction. More details and discussion can be found in the original report.

Changes introduced into the host communities derive from four distinct categories of inputs which accompany the reactor siting process as shown in Fig. 1: facility characteristics, new human resources, generated revenue, and licensing and regulatory procedures. These characteristics are not unique to nuclear power plants but are common to the siting of all large energy or industrial plants on host communities.

Fig. 1. Inputs to the Social System

Facility Characteristics

- Reactor design
- Cooling system
- Transmission lines/corridors
- Effluents
- Visual characteristics
- Land use characteristics

Human Resources

- Work force
  - New residents
  - Commuters

Fig. 1. Inputs to the Social System (continued)

Revenue

- Employment income
- Taxes/payment in-lieu-of-taxes
- Materials/goods and services purchased

Licensing and Regulatory Procedures

- Information flow/distribution
- Procedural participation
- Perceived/anticipated impacts

Inputs were generally similar in both communities: facility characteristics were almost the same; a large labor force commuted during construction; money inputs came primarily from taxes rather than employment income or purchases of goods and services; and licensing and regulatory procedures were also similar.

The most significant input into the social system in both these cases was money from taxes, or the change in potential tax revenues. Thus our analysis focused on this area and may be followed in the original paper (Chapter 4) and in other papers by David Bjornstad[5] which elaborate upon this input and its effect: the resulting changes in tax structure which occurred in both communities.

The impact of the Millstone and Pilgrim Stations on assessed values and upon property tax rates is shown in Tables 2 and 3. The great increase in assessed values as the value of the nuclear station is added to the tax rolls is shown in Table 2. Tax rates remain stable or decline in both communities after these new revenues are received (Table 3), with the exception of 1972 when Plymouth chose to make a large capital expenditure out of current income.

VI. ATTITUDE SURVEY RESULTS

A brief survey of residents' views on selected aspects of their community and the nuclear plant was conducted as part of the research in summer 1975. One hundred and twenty-six persons in Plymouth and 182 persons in Waterford were interviewed by local interviewers after random selection by means of modified area sampling (Plymouth) and use of a random-number table and voting lists (Waterford).

Table 2

Impact of Millstone and Pilgrim Stations on Assessed Values

	Waterford, Connecticut				Plymouth, Massachusetts			
	Total value	Plant value	Plant proportion of total value	Non-Plant value	Total value	Plant value	Plant proportion of total value	Non-Plant value
1966*	$ 66,053			$66,053	$ 45,451			$45,451
1967	66,462			66,462	45,827			45,827
1968	72,744	$ 5,643	0.08	67,101	47,629	$ 132		47,497
1969	90,334	20,867	0.21	69,467	51,515	1,456	0.03	50,059
1970	97,983	25,846	0.26	72,137	65,751	11,510	0.21	54,241
1971	112,585	39,369	0.33	75,216	93,726	29,808	0.32	63,200
1972	130,564	51,351	0.39	79,213	114,553	41,808	0.39	69,731
1973	168,456	81,728	0.49	86,728	154,429	76,442	0.49	77,987
1974	221,189	129,756	0.59	91,433	165,212	76,442	0.46	88,770

*Due to differing fiscal years, this column indicates similar but not identical timeframes for each town.

Source: *Annual Report*: Town of Waterford (various years).
Annual Report: Town of Plymouth (various years).
Additional unpublished data was provided by each town's assessor's office.

Table 3

Property Tax Rates in Plymouth, Massachusetts and Waterford, Connecticut

	Published Tax Rate	
	Waterford	Plymouth
1966	42.0	74.4
1967	42.0	78.8
1968	42.0	92.8
1969	42.0	97.2
1970	43.0	88.4
1971	43.0	79.6
1972	38.0	96.0
1973	31.0	76.4
1974-75	31.0	76.0

Source: *Annual Report*: Town of Waterford (various years).

Annual Report: Town of Plymouth (various years).

Those sampled expressed satisfaction with their community in general and were concerned about growth issues. Plymouth residents were equally divided on whether Plymouth should encourage more growth, whereas 70% of Waterford residents favored more growth. Sixty percent of residents in both communities felt that the nuclear plant had had "no effect" upon their lives. When asked "Would you permit construction of the nuclear plant again?" of the residents who answered, 72% in Plymouth and 94% in Waterford said yes. Plymouth and Waterford residents approve of their nuclear plant neighbor because of its obvious tax benefits and because they perceive few disbenefits resulting from its presence.

These responses may be compared with those of three "nuclear communities" surveyed by the Harris-Ebasco poll of 1975[6] where those favoring "more nuclear power plants" range from 56-75%, and the national sample favored nuclear power by 63%.

VII. CONCLUSIONS AND HYPOTHESES

A. CONCLUSIONS

1. Construction Period

It is the nearly unanimous opinion of both the analysts and community leaders interviewed that construction impacts at both sites have been minor. Unlike most large construction projects where socioeconomic impacts are quite evident, there appeared to be little impact at either Waterford or Plymouth. Hence, the following conclusions:

- Social, political, and economic impacts upon the towns of Waterford and Plymouth during construction of their respective nuclear plants have been minimal. The only impact of any magnitude identified retrospectively is construction worker traffic.

- Most construction workers in the case of Pilgrim I and Millstone I and II commuted to the site from their existing place of residence within the metropolitan areas rather than relocate closer to the site or within the host community. As a result, little impact on commercial activity was noted in either community during construction.

- In both Plymouth and Waterford little interaction took place between construction worker crews and local townspeople. What interaction did take place was primarily in local grocery stores and taverns.

- Speeding by construction workers appeared to be a problem in Waterford and Plymouth. In Waterford, a police officer had to be stationed at the entrance to the construction site each night in order to control speeding onto secondary town roads.

2. Operation Period

Since the economic impacts during operation were large in magnitude as well as the source of many of the secondary impacts in both the social and political areas, economic impacts will be considered first. Impacts upon the social and political structure appear to be more diverse and are second order consequences of the primary economic impacts which occur.

(a) Economic impacts

- The major impact of the nuclear plant in both Plymouth and Waterford is the large increase in tax base provided by the operating reactor.

- Other economic impacts are minimal since there are few permanent jobs created, minor quantities of local goods or services purchased, and few public services demanded as a direct result of the siting of the power plant Both utilities provide their own security guards and elaborate fire protection in case of emergency. Both utilities have provided their own water and sewer hookups and have provided their own roadways linking the plant site with existing town roadways.

(b) Political-institutional impacts

- One option chosen by both communities has been to lower (or stabilize) the existing tax rates while currently using the additional revenues to significantly increase public services and facilities.

- Both communities have taken some steps to professionalize administration of services through hiring new staff and creating some new positions in local government. In both communities new departments of public works have been established and town planners have been hired to control future land use development. In Plymouth, a town manager has been hired to oversee local affairs.

- External relationships of the two communities have been altered by the presence of the nuclear power plant, principally because of the augmented tax base. The presence of the nuclear power plant may create new tensions or exacerbate existing tensions.
    - Neighboring towns have, in varying degrees, become resentful or antagonistic over the favored status and resources of the host community. The transportation of nuclear waste through neighboring towns in both Plymouth and Waterford has caused some concern and has resulted in challenge of the legality of the transfer of that waste.
    - Efforts have been initiated in both states to redistribute the utility tax payments so that a larger proportion will go to other jurisdictions and/or the state.
- Existing relationships between the utility and community decision makers are constructive and stable in both communities.
    - Both communities maintain both formal and informal links of communication with the utility. Relations in both communities are based on equilateral trade-offs. The communities attempt to stabilize relations so as not to disturb their favorable financial position; the utilities in turn attempt to maintain cooperation, lest agitation reaches a level wherein communities (or states) no longer permit siting of power plants within their boundaries.
    - The majority of citizens in each community have favorable attitudes toward the utility in their communities.
- Residents, in general, are unconcerned about the nuclear plant in their community unless it has an accident or radioactive spill.
    - Intervenors in both communities are few; those who do intervene or are vocal about nuclear power face opposition from the majority of local residents.
    - Intervention in both Waterford and Plymouth focuses primarily on health/safety and environmental issues rather than socioeconomic or political concerns.

- Communities appear to adopt an "out of sight, out of mind" attitude toward the facility. The relative isolation of the physical plant appears to be a factor in the perceptions of residents. Transmission lines and corridors which are more highly visible may have more of a visual and, hence, psychological impact upon local residents than the actual physical plant structure.

(c) Social impacts

- The sudden population growth occurring in Plymouth since 1968 (the beginning of the nuclear plant construction) was intensified by construction and operation of Pilgrim I, but growth would have occurred soon because of regional growth patterns and proximity to Boston. Growth was one consequence of the lowered tax rate in Plymouth.

- Strict zoning ordinances and definitive planning regulations adopted by the town of Waterford prior to the siting of the nuclear plant have prevented rapid population growth such as that which occurred in Plymouth.

    - Waterford officials, while desiring controlled growth for the community, feel pressured by neighboring communities (and some local residents) to grow at a more rapid rate and provide additional housing and services with their new monies to all groups in society.

- Community cohesion has been disrupted in Plymouth due to the influx of newcomers interacting with long-time Plymouth residents. Newcomers demand more public services and facilities while at the same time they want to control growth and maintain the "rural," low-density character of their community.

- Tourism is little affected by the presence of the nuclear power plant in either community. In Plymouth, tourists now visit the plant along with their visits to historical sites in the community.

- Few, if any, groups within the community remain totally unaffected by the presence of the nuclear plant. Those most directly affected are those who interact either directly with the physical plant (i.e., residents who live near the plant) or the local utility officials (i.e., local public officials). Those indirectly impacted are taxpayers, who in both Plymouth and

Waterford, have an increased disposable income as a result of the stabilized or lowered tax rates relative to residents of other communities in the surrounding region.

B. GENERAL HYPOTHESES FOR FUTURE TEST

Combining general knowledge with the specific circumstances of impacts at Plymouth and Waterford, the following attempt is made to draw broad, general hypotheses for testing in future research.

1. Construction Period

(a) Economic impacts

- A commuting labor force generates minimal fiscal, social, or political impacts on a host community.
- If a nuclear plant is sited in or near a metropolitan area, the likelihood of access to an adequate labor force increases.
- If substantial numbers of construction workers relocate to the site, substantial economic effects through payroll infusions to local economies are created.

(b) Social impacts

- If a large, temporary population increase occurs during construction, then major changes in social composition and organization of a host community will occur.
- A community can accommodate some influx of new population without "significant" disruption given a certain level of social, political, and economic development as indicated by size, level of services, location, etc.

(c) Political-institutional impacts

- If an increasing construction population demands major increased public services, then major political impacts upon local governments will occur.
- If a community lacks revenue, staff, planning capability, experience, or the administrative infrastructure needed for dealing with sudden growth, then these inadequacies will exacerbate the need to deal with immediate problems and intensify social and political impacts.

2. Operating Period

(a) Economic impacts

- If utility property tax payments from the nuclear plant siting go directly to the local municipality, then the major impact of the operating power plant is the augmented tax base.

- When utility property tax payments go directly to the local municipality, then new economic-fiscal options include the choice between recovering money benefits in the private sector through lowered tax rates, recovering money benefits through the public sector with increased services, or some combination of these two.

(b) Political-institutional impacts

- When an operating nuclear reactor is sited within a community, it makes few public service or social service demands upon that community.

- If an operating nuclear reactor pays property taxes directly to the local municipality, then new options offered by the augmented tax base include needs and opportunities to (1) professionalize and develop administrative infrastructures, and (2) develop and/or alter political and decision-making structures.

- If an operating nuclear reactor pays property taxes directly to the local municipality, then the available economic and fiscal options present public officials with a variety of growth-no-growth options. If augmentation of the local tax base occurs, then siting of a nuclear generating station alters the relationships of the host community with neighboring towns, the region, and the state.

  - Neighboring towns may become resentful or antagonistic over the favored status and resources of the host community.

  - Efforts will be initiated or intensified on the state level to redistribute the utility tax payments so that more revenues go to the state or region involved.

(c) Social impacts

- Community growth is a function of many interrelated variables of which a nuclear plant is only one. If certain planning and zoning conditions exist, then a nuclear power generating station can act as a powerful catalyst to community growth and development.

(d) Public acceptance and perceptions of nuclear generating stations

- Unless a nearby operating nuclear plant has an accident, spill, or release, or a concerned citizens group brings attention to possible hazards, residents are generally unaware or unconcerned about the power plant.

- Local acceptance varies directly with actual or anticipated economic benefits. Lack of actual or perceived economic benefits means lowered acceptance or increased opposition.

- If a host community develops and enforces strict zoning and land use regulations prior to the siting of a nuclear reactor from which it will derive massive economic benefits, (1) the chances for major changes in the social and political composition of that community will decrease, and (2) the community will have a mechanism for controlling the rate and direction of population increase.

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