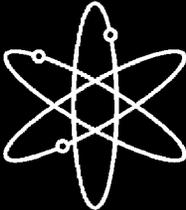


Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities



Supplement 1



Regarding the Decommissioning of Nuclear Power Reactors



Main Report, Appendices A through M

Final Report



**U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, DC 20555-0001**



**Generic Environmental
Impact Statement on
Decommissioning of
Nuclear Facilities**

Supplement 1

**Regarding the Decommissioning of
Nuclear Power Reactors**

Main Report, Appendices A through M

Final Report

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**Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
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Abstract

This document is a supplement to the U.S. Nuclear Regulatory Commission (NRC) document *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities* issued in 1988 (NUREG-0586, referred to here as the 1988 Generic Environmental Impact Statement [GEIS]). This Supplement was prepared because of technological advances in decommissioning operations, experience gained by licensees, and changes made to NRC regulations since the 1988 GEIS.

This Supplement updates the information provided in the 1988 GEIS. It is intended to be used to evaluate environmental impacts during the decommissioning of nuclear power reactors as residual radioactivity at the site is reduced to levels that allow for termination of the NRC license. This Supplement addresses only the decommissioning of nuclear power reactors licensed by the NRC. It updates the sections of the 1988 GEIS relating to pressurized water reactors, boiling water reactors, and multiple reactor stations. It goes beyond the 1988 GEIS to explicitly consider high-temperature gas-cooled reactors and fast breeder reactors. This document can be considered a stand-alone document for power reactor facilities such that readers should not need to refer back to the 1988 GEIS. The environmental impacts described in this Supplement supercede those described for power reactor facilities in the 1988 GEIS.

The scope of this Supplement is based on the decommissioning activities performed to remove radioactive materials from structures, systems, and components from the time that the licensee certifies that it has permanently ceased power operations until the license is terminated. The scope of the document was determined through public scoping meetings and meetings with other Federal agencies and the nuclear industry. An evaluation process was then developed to determine environmental impacts from nuclear power reactor facilities that are being decommissioned. The evaluation process involved determining the specific activities that occur during reactor decommissioning and obtaining data from site visits and from licensees at reactor facilities currently being decommissioned. The data obtained from the sites were analyzed and then evaluated against a list of variables that defined the parameters for facilities that are currently operating but which will one day be decommissioned. This evaluation resulted in a range of impacts for each environmental issue that may be used for comparison by licensees that are or will be decommissioning their facilities.

Appendix J

Socioeconomics and Environmental Justice Impacts Related to the Decision to Permanently Cease Operations

This appendix presents information on the socioeconomic and environmental justice aspects of selected nuclear power facilities currently in the decommissioning process or that have recently completed the process. This Appendix provides a discussion of the impacts related to the decision to permanently cease operations that are outside the scope of this Supplement (See Section 1.3). The NRC staff reviewed this information to provide additional information related to concerns raised during scoping and Supplement development about Socioeconomic Impacts (Section 4.3.12) and Environmental Justice (Section 4.3.13).

Impact significance is assigned to specific issues as described in 10 CFR Part 51 Subpart A, Appendix B, Table B-1. The impacts are based on the definitions of three significance levels. Unless the significance level is identified as beneficial, the impact is adverse, or in the case of "small," may be negligible. The definitions of significance follow:

SMALL -- For the issue, environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. For the purposes of assessing radiological impacts, the Commission has concluded that those impacts that do not exceed permissible levels in the Commission's regulations are considered small.

MODERATE -- For the issue, environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE -- For the issue, environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

J.1 Socioeconomic Impacts

There are two primary pathways through which the decision to permanently cease operations at a nuclear power plant creates socioeconomic impacts on the area surrounding the plant. The first is through direct expenditures in a local community by the plant work force, plus any purchases of goods and services required for plant activities. The second pathway for socioeconomic impact is through the effects on local government tax revenues and services. The impact pathways (direct expenditures and tax revenues) relate specifically to changes in the workforce and population, local tax revenues, housing availability, and public services.

Appendix J

Socioeconomic changes related to direct expenditures in the local community are considered not detectable if there is little or no impact on housing values, education, and other public services, and local government finances are not distinguishable from normal background variation due to other causes. Impacts on housing are considered not detectable when no discernable change in housing availability occurs, changes in rental rates and housing values are similar to those occurring statewide, and little or no housing construction or conversion occurs. Detectable impacts result when there is a discernable increase or reduction in housing availability, rental rates and housing values exceed the inflation rate elsewhere in the State, or more than minor housing conversions and additions or abandonments occur. Destabilizing impacts occur when project-related demand results in a very large excess of housing or very limited housing availability, there are considerable increases or decreases in rental rates and housing values, and there is substantial conversion or abandonment of housing units.

Socioeconomic changes related to tax revenues and services (education, transportation, public safety, social services, public utilities, and tourism and recreation) are considered not detectable if the existing infrastructure (facilities, programs, and staff) could accommodate any changes in demand related to plant closure without a noticeable effect on the level of service. Detectable impacts arise when the changes in demand for service or use of the infrastructure is sizeable and would noticeably decrease the level of service or require additional resources to maintain the level of service. Destabilizing impacts would result when new local government programs, upgraded or new facilities, or substantial numbers of additional staff and unsupportable levels of resources are required because of facility-related demand.

The information provided here is based, in part, on data obtained from or about facilities that have completed decommissioning and facilities that are currently being decommissioned. This data was obtained in the areas of workforce and population, local tax revenues, housing availability, and public services. The time period used for was the mid-1960s to 2001.

J.1.1 Changes in Work Force and Population

The size of the work force varies considerably among operating U.S. nuclear power facilities, with the onsite staff generally consisting of 600 to 800 personnel per reactor unit. The average permanent staff size at a nuclear power facility site ranges from 800 to 2400 people, depending on the number of operating reactors at the site. In rural or low-population communities, this number of permanent jobs can provide employment for a substantial portion of the local work force. In addition to the work force needed for normal operations, many nonpermanent personnel are required for various tasks that occur during outages. Between 200 and 900 additional workers may be employed during these outages to perform the normal outage maintenance work. These are work force personnel who will be in the local community only a short time, but during these periods of extensive maintenance activities, the additional

personnel will have a substantial effect on the locality. If the local economy is stable or declining, the result of the reduction in work force related to plant closure could be economic hardships, including declining property values and business activity, and problems for local government as it adjusts to lower levels of tax revenues.

If there is a net reduction in the community work force but the economy is growing, the adverse impacts of this ongoing growth (e.g., housing shortages and school overcrowding) could be reduced. Changes of over 3 percent to a local population in a single year are expected to have detectable effects, while changes of over 5 percent are expected to result in destabilizing impacts. These negative impacts include reduction of school system enrollments, weakened housing markets, and loss of demand for goods and services provided by local business.

The impact from facility closure depends on the rate and amount of population change. If post-closure work begins shortly after shutdown with a large work force, then the impact of facility closure is mitigated. Facilities where layoffs are sudden and there is a long delay before post-closure work begins are likelier to experience negative population-related socioeconomic impacts. Thus, large plants located in rural areas that permanently shut down early and choose the SAFSTOR option are the likeliest to have negative impacts. Considering all variables such as plant size and community size as the same, plants that go into immediate DECON have fewer negative impacts that are less immediate than those of SAFSTOR. The impacts from the ENTOMB option, assuming those preparations were made immediately after shutdown, would also be less significant than those of SAFSTOR.

In only two cases did the corresponding county populations decline around the time of the closure (Indian Point, Unit 1, in Westchester, New York, and Millstone, Unit 1, in New London, Connecticut). However, during the same time period that the host counties experienced population declines, the hosting States also experienced population declines. This suggests that the decline in the county population was most likely part of an overall State population trend. Observing population trends over a decade may not capture small population declines or reductions in the rate of growth from one year to the next; however, longer trends should indicate whether or not the county had any large destabilizing population or housing impacts from the facility closure.

In 18 out of the 20 facility case studies where populations grew, the populations of the counties where the facilities are located increased more rapidly or at the same rate as the State population. The two cases where the populations of the counties grew at a slower rate include relatively rural counties in California (Humboldt and Alameda) during time periods when California as a whole experienced very high urban population growth.

Data was gathered on the changes in workforce at facilities that are currently being decommissioned (i.e., where operations have ceased), where information on operational and

Appendix J

decommissioning workforces was available. This information is shown in Table J-1. The table also shows the total population in the host county at the time of plant shutdown, to indicate the potential importance of the facility closure.

U.S. Census population estimates for the counties that house the closed plants are used to assess population changes around the time of shutdown by comparing percentage changes in county and State populations for the same time periods (Table J-2).

J.1.2 Local Tax Revenues

The tax revenue impacts on the local communities of plant closure vary widely from zero impact (tax-exempt plants) to a loss of 90 percent of the community tax base. The magnitude of tax-related impacts varies primarily by the size of the taxing jurisdiction and the taxing structure of the State in which the plant is sited, as well as certain plant characteristics. All else being equal, the smaller the taxing community (less economically diverse), the greater the tax-revenue impact when the nuclear facility closes down.

In communities where the revenues from the facility made up over 50 percent of the tax revenue base (with the remaining tax revenues made up primarily of private residential real estate), there were significant increases in the tax rates on the remaining real estate as well as cut-backs in services supported by property-tax revenues. The manner in which a State calculates the value of the plant also affects (a) both the amount and timing of tax losses when a nuclear power facility closes and (b) how much such a closure disrupts the tax revenue stream in a given community:

- At one plant, the assessed value of the plant was calculated as a proportional share of the value of the parent corporation, where the percentage is based on the book value of assets in the State (or sub-State taxing jurisdiction) compared with the book value of the assets of the entire corporation. This approach kept the plant at full assessed value for 7 years after its permanent closure until it was dropped from the books of the parent corporation as an asset.
- Tax rules may or may not permit gradual phase-out. In some cases, the taxable asset value of the plants was allowed to phase out over a period of time (3 to 5 years). In other cases, the plants were simply taken off the tax roles in 1 year.

Table J-1. Impact of Plant Closure on Workforce at Nuclear Power Plants Currently Being Decommissioned

| Nuclear Plant | Thermal Power | Decommissioning Option^(a) | Shutdown Date^(b) | Maximum Workforce | Post-termination Workforce | Maximum Workforce Change | County Population |
|---------------------------|----------------------|---|------------------------------------|--------------------------|-----------------------------------|---------------------------------|--------------------------|
| Big Rock Point | 240 MW | DECON | 08/30/97 | -- | 232 | -- | 24,496 (1997) |
| Dresden, Unit 1 | 700 MW | SAFSTOR | 10/31/78 | -- | -- | -- | -- |
| Fermi, Unit 1 | 200 MW | SAFSTOR ^(c) | 09/22/72 | -- | -- | -- | -- |
| Fort St. Vrain | 842 MW | DECON ^(d) | 08/18/89 | -- | -- | -- | -- |
| GE-VBWR | 50 MW | SAFSTOR | 12/09/63 | -- | -- | -- | -- |
| Haddam Neck | 1825MW | DECON | 07/22/96 | -- | -- | -- | -- |
| Humboldt Bay, Unit 3 | 200 MW | SAFSTOR ^(c) | 07/02/76 | 150 | 60 | 90 | 99,692 (1975) |
| Indian Point, Unit 1 | 615 MW | SAFSTOR | 10/31/74 | -- | -- | -- | -- |
| La Crosse | 165 MW | SAFSTOR | 04/30/87 | 82 | 23 | 59 | 25,965 (1987) |
| Maine Yankee | 2700 MW | DECON | 12/06/96 | 481 | 360 | 121 | 31,760 (1997) |
| Millstone, Unit 1 | 2011 MW | SAFSTOR | 11/04/95 | -- | -- | -- | -- |
| Pathfinder | 190 MW | SAFSTOR ^(d) | 09/16/67 | -- | -- | -- | -- |
| Peach Bottom, Unit 1 | 115 MW | SAFSTOR | 10/31/74 | -- | -- | -- | -- |
| Rancho Seco | 2772 MW | SAFSTOR ^(c) | 06/07/89 | -- | 200-250 | -- | -- |
| San Onofre, Unit 1 | 1347 MW | SAFSTOR ^(c) | 11/30/92 | 424 | 295 | 129 | 2,723,782 (1997) |
| Saxton | 23 MW | SAFSTOR ^(c) | 05/01/72 | -- | -- | -- | -- |
| Shoreham | 2436 MW | DECON ^(d) | 06/28/89 | -- | -- | -- | 1,303,501 (1989) |
| Three Mile Island, Unit 2 | 2772 MW | Accident cleanup, followed by storage | 03/28/79 | 1150 | 125 | 1125 | 222,100 (1979) |
| Trojan | 3411 MW | DECON | 11/09/92 | 1319 | 177-432 | 887-1142 | 44,513 (1997) |
| Yankee Rowe | 600 MW | DECON | 10/01/91 | -- | -- | -- | -- |
| Zion, Unit 1 | 3250 MW | SAFSTOR | 02/21/97 | -- | -- | -- | -- |
| Zion, Unit 2 | 3250 MW | SAFSTOR | 09/19/96 | -- | -- | -- | -- |

(a) The option shown in the table for each plant is the option that has been officially provided to NRC. Plants in DECON may have had a short (1 to 4 yr) SAFSTOR period. Likewise, plants in SAFSTOR may have performed some DECON activities or may have transitioned from the storage phase into the decontamination and dismantlement phase of SAFSTOR.

(b) The shutdown date corresponds to the date of the last criticality.

(c) Plant has recently performed or is currently performing the decontamination and dismantlement phase of SAFSTOR.

(d) Plants has completed decommissioning.

Appendix J

Table J-2. County and State Population Changes During Plant Closure and Decommissioning

| Nuclear Plant | Reactor Type | Thermal Power | Decommissioning Option | Location | County | County Population | County Population Change, % | State Pop. Change, % |
|---------------------------|--------------|---------------|---------------------------------------|--------------------|-------------|-------------------|-----------------------------|----------------------|
| Big Rock Point | BWR | 240 MW | DECON | Charlevoix, MI | Charlevoix | 24,496 (1997) | 6.5 | 1.7 |
| Dresden, Unit 1 | BWR | 700 MW | SAFSTOR | Morris, IL | Grundy | 28,400 (1975) | 14.9 | 2.8 |
| Fermi, Unit 1 | FBR | 200 MW | SAFSTOR | Monroe Co., MI | Monroe | 126,300 (1975) | 12.7 | 4.1 |
| Fort St. Vrain | HTGR | 842 MW | DECON | Platteville, CO | Weld | 130,764 (1979) | 18 | 18 |
| GE-VBWR | BWR | 50 MW | SAFSTOR | Alameda Co., CA | Alameda | 1,071,446 (1975) | 2.6 | 16.4 |
| Haddam Neck | PWR | 1825 MW | DECON | Haddam, CT | Middlesex | 149,010 (1997) | 4.1 | 4.2 |
| Humboldt Bay, Unit 3 | BWR | 200 MW | SAFSTOR | Eureka, CA | Humboldt | 99,692 (1975) | 9.8 | 25.8 |
| Indian Point, Unit 1 | PWR | 615 MW | SAFSTOR | Buchanan, NY | Westchester | 874,300 (1975) | -2.7 | -3.3 |
| La Crosse | BWR | 165 MW | SAFSTOR | Genoa, WI | Vernon | 25,965 (1987) | 6.1 | 5.7 |
| Maine Yankee | PWR | 2700 MW | DECON | Wiscasset, ME | Lincoln | 31,760 (1997) | 5.8 | 2.6 |
| Millstone, Unit 1 | BWR | 2011 MW | SAFSTOR | Waterford, CT | New London | 246,959 (1997) | -0.8 | -0.5 |
| Pathfinder | BWR | 190 MW | SAFSTOR | Sioux Falls, SD | Minnehaha | 95,209 (1975) | 12.2 | 3.4 |
| Peach Bottom, Unit 1 | HTGR | 115 MW | SAFSTOR | Delta, PA | York | 272,603 (1975) | 13.8 | 1 |
| Rancho Seco | PWR | 2772 MW | SAFSTOR | Sacramento, CA | Sacramento | 869,581 (1989) | 8.1 | 8.3 |
| San Onofre, Unit 1 | PWR | 1347 MW | SAFSTOR | San Clemente, CA | San Diego | 2,723,782 (1997) | 9 | 8.3 |
| Saxton | PWR | 23 MW | SAFSTOR | Saxton, PA | Bedford | 42,353 (1975) | 10.7 | 1 |
| Shoreham | BWR | 2436 MW | DECON | Suffolk County, NY | Suffolk | 1,303,501 (1989) | 3.1 | 0.5 |
| Three Mile Island, Unit 2 | PWR | 2772 MW | Accident cleanup, followed by storage | Middletown, PA | Dauphin | 232,317 (1979) | 2.4 | 0.2 |
| Trojan | PWR | 3411 MW | DECON | Rainier, OR | Columbia | 44,513 (1997) | 16.5 | 14.1 |
| Yankee Rowe | PWR | 600 MW | DECON | Rowe, MA | Franklin | 70,626 (1997) | 1.8 | 1.7 |
| Zion, Unit 1 | PWR | 3250 MW | SAFSTOR | Zion, IL | Lake | 594,799 (1997) | 8.3 | 4.4 |
| Zion, Unit 2 | PWR | 3250 MW | SAFSTOR | Zion, IL | Lake | 594,799 (1997) | 8.3 | 4.4 |

- The State may or may not share the burden with local government. In one State, school districts' lost property-tax collections were offset by equalization methods at the State level, which reduced the impact due to plant closures. In another State, the small neighboring township was the sole recipient of all property-tax revenues generated by the plant. Thus, the community's tax revenues were significantly reduced when the revenue source shut down.
- In addition, ratepayers in some jurisdictions are entitled to share in funds recovered from the sale of plant components and commodities and unspent decommissioning funds. These are not taxes but are available to general fund revenues.

In addition to characteristics specific to the taxing jurisdiction, the size, age, and ownership of the facilities play a role in how much the facilities affect tax revenues. Generally, the larger the facility (in the MWt), the larger the tax revenue impact. In addition, aging of the facilities depreciates its book value and assessed value over time. Usually, the falling assessed value of an aging facility will have reduced the tax revenue of the facility before closure, thus lessening the change in tax revenues generated by the facility after closure. A facility that closes suddenly, well before the end of its license expiration, will have a greater impact on the community tax base. Finally, if a facility is owned by a public entity, there is no effect on the tax base from closure because the facility was never taxable.

Changes in tax revenues of less than 10 percent are considered not detectable, i.e., they resulted in little or no change in local property tax rates and the provision of public services. Losses between 10 percent and 20 percent result in detectable impacts, with increased property tax levies (where State statutes permit) and decreased services by local municipalities. Changes over 20 percent have destabilizing impacts on the governments involved. Tax levies must usually be increased substantially or services cut substantially, and the payment of debt for any substantial infrastructure improvements made in the past becomes extremely problematic. Borrowing costs for local jurisdictions may also increase because bond rate agencies downgrade their credit rating. However, it is important to remember that these rules of thumb are based on uncompensated changes. For example, if a local taxing jurisdiction lost a nuclear facility that amounted to 35 percent of its tax base, but 30 percentage points of this loss were made up by the opening of a new manufacturing facility, the net impact would be 5 percent or not detectable. Small, rural areas are more likely to be affected than more urban areas having a wider variety of economic opportunities and more sources of tax revenue. Impacts depend on the type of plant, size of plant, and whether or not there are multiple units at a site, all of which help determine the net loss in employment at plant closure as well as the loss of tax base.

Table J-3 shows the impact of closure on local tax revenues for selected plants currently in decommissioning (or that have completed decommissioning), for which data are available. The primary taxing authorities for most of the closed plants are the county and city in which the plant is sited. Tax information is typically provided by local taxing authorities (an assessor's office) or from town planners familiar with the tax revenues generated by the plants. Only in the case of Humboldt Bay was tax-impact information available on a smaller, older plant (-\$377,000 in 1983-84). The plants where information is not available are very small plants that most likely had very little impact on the tax base of the community. Many of these plants were shut down in the 1960s and 1970s.

Appendix J

Table J-3. Impact of Plant Closure on Local Tax Revenues

| Nuclear Plant | Location | Shutdown Date | Thermal Power | Decom-missioning Option | Tax Revenues Change, millions (M) | Tax Change, % | Notes |
|---------------------------|------------------|-----------------------|----------------|--------------------------------------|--|---|--|
| Big Rock Point | Charlevoix, MI | 08/30/97 | 240 MW | DECON | -- | -- | -- |
| Haddam Neck | Middlesex, CT | 07/22/96 | 1825 MW | DECON | yr 1 -\$0.7M yr 2 -\$0.7M yr 3 -\$1.3M yr 4 -\$1.2M yr 5 -\$0.5M | -30% (phased out over 5 yr) | |
| Maine Yankee | Wiscasset, ME | 12/06/96 | 2700 MW | DECON | yr 1 -\$6.3M yr 2 -\$2.5M yr 3 -\$1.1M yr 4 -\$0.6M | -70% (phased out in 4 yr) | Taxes paid to town. Plant made up about 90% of tax revenue. They have phased out tax expenditure payments over 6-yr period. |
| Millstone, Unit 1 | Waterford, CT | 11/04/95 | 2011 MW | SAFSTOR | -\$0.8M | -2% due to plant closure | Impacts to tax revenues in this area during this time include 1) the natural depreciation rate of Unit 1. Assessment had become less than 5% of market value of plant by time of closure. (2) Deregulation environment brings assessed value of plants down 50%. |
| Rancho Seco | Sacramento, CA | 6/7/89 | 2772 MW | SAFSTOR | no change | 0 | Rancho Seco was tax-exempt because it is considered to be owned by the government. Besides sales tax, etc., no impact. |
| San Onofre, Unit 1 | San Clemente, CA | 11/30/92 | 1347 MW | SAFSTOR | yr 1 -\$1.2M yr 2 -\$1.1M yr 3 -\$1.2M | | |
| Shoreham | Suffolk Co., NY | 06/28/89 | 2436 MW | DECON | -\$10M/yr up to -\$115M total change after phase-out | 10% decrease in yr 1, to 60% decrease by 2003 | This county was hit hard by the abrupt manner in which this plant ceased operation and the lawsuits over tax assessment that proceeded (in which a judge determines assessed value close to 0 based on projected income stream from plant). |
| Three Mile Island, Unit 2 | Middletown, PA | 03/28/79 | 2772 MW | Accident cleanup followed by storage | no change | 0 | Utilities were tax exempt in 1979. |
| Trojan | Rainier, OR | 11/09/92 | 3411 MW | DECON | yr 1-7 no change yr 8 -\$2.3M | 7.3% reduction for the county as a whole. Loss of 52.6% for one rural fire protection district. | Oregon taxes on the basis of the percentage of capital value of the parent company (ENRON) in county, based on 87% of book value of the parent in state. The Trojan "asset" stayed on ENRON's books until the year 2000. |
| Yankee Rowe | Rowe, MA | 10/01/91 | 600 MW | DECON | -\$0.4M | 12% reduction | Rowe has a hydro-electric plant that generates most of the tax revenue (over 75%). This alleviated some of the tax impacts. |
| Zion, Units 1 and 2 | Zion, IL | 02/21/97 and 09/19/96 | 3250 MW (each) | SAFSTOR | yr 1 -\$0.4M yr 2 -\$3M yr 3 -\$7M | 12% in yr 1, rising to 50% by yr 5 (2002) | This is an assessment of both units together. There is a phase-out approach, where assessed value is reduced from \$210 M to \$10 M over 8 yr. |

J.1.3 Housing Availability

The prevailing belief of realtors and planners in communities surrounding the case study facilities is that closing the facilities has had a range of effects on the marketability or value of homes in the vicinity. Housing choices of local residents are rarely affected by the presence of the facility, but people may move into the area in response to (temporarily) softer housing prices and commute to a nearby urban area.

J.1.4 Public Services

The impacts of closure on public services are closely related to the tax-related impacts on the community and are affected by the same characteristics of the plant: its size and age, its tax treatment, and the dependence of the local community on plant-related revenues, but not on the choice of decommissioning option or the amount of time between shutdown and active decommissioning. The impacts to the following public services may occur as a result of plant closure: education, transportation, public safety, social services, public utilities, and tourism and recreation.

Inquiries were made to local governments in the vicinity of closed plants about public service impacts during and after shutdown and decommissioning (Table J-4). Analysis was also conducted in the course of preparing NUREG-1437 (NRC 1996). Based on that experience, the following generalizations can be made.

In general, detectable impacts arise when the demand for service or use of the infrastructure is sizeable and would noticeably decrease the level of service or require additional resources to maintain the level of service. Destabilizing impacts would result when new programs, upgraded or new facilities, or substantial additional resources and staff are required because of facility-related demand.

In general, the communities that suffered the most from the tax-related impacts of plant closure also experienced the greatest impacts on public services. To some extent, the communities themselves control the amount of impact by how they allocate property taxes to local budgets before shutdown and how they prioritize these services post-shutdown. For example, one community channeled a great deal of the surplus revenues into building extensive social services for the elderly and for local youth in its community. After the plant ceased operations, the tax revenues decreased, all of the social services were downsized, and many will be eliminated because these are not considered to be priority programs (relative to public safety and education). In a second case, the county provided relatively few social services. Thus, the impact on social services after the shutdown was minor, although several other categories of

Appendix J

Table J-4. Impact of Plant Closure on Local Public Services

| Nuclear Plant | Housing | Education | Transportation | Public Safety | Social Services | Public Utilities | Tourism and Recreation |
|---------------------------|-------------------|-------------------|-----------------------|----------------------|------------------------|-------------------------|-------------------------------|
| Big Rock Point | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL |
| Dresden, Unit 1 | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL |
| Fermi, Unit 1 | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL |
| Fort St. Vrain | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL |
| GE-VBWR | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL |
| Haddam Neck | SMALL to MODERATE | MODERATE | SMALL to MODERATE | MODERATE | SMALL to MODERATE | SMALL | SMALL |
| Humboldt Bay, Unit 3 | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL |
| Indian Point, Unit 1 | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL |
| La Crosse | SMALL | SMALL to MODERATE | SMALL | SMALL to MODERATE | SMALL | SMALL | SMALL |
| Maine Yankee | MODERATE | MODERATE | SMALL | MODERATE | SMALL | SMALL | SMALL |
| Millstone, Unit 1 | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL |
| Pathfinder | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL |
| Peach Bottom, Unit 1 | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL |
| Rancho Seco | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL |
| San Onofre, Unit 1 | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL |
| Saxton | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL |
| Shoreham | MODERATE | MODERATE to LARGE | MODERATE | MODERATE | SMALL to MODERATE | MODERATE | SMALL |
| Three Mile Island, Unit 2 | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL |
| Trojan | SMALL to MODERATE | MODERATE | SMALL | SMALL to MODERATE | SMALL | SMALL | SMALL |
| Yankee Rowe | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL |
| Zion, Unit 1 | SMALL | MODERATE | MODERATE | MODERATE | MODERATE to LARGE | SMALL | SMALL |
| Zion, Unit 2 | SMALL | MODERATE | MODERATE | MODERATE | MODERATE to LARGE | SMALL | SMALL |

public service experienced larger impacts. For example, education was largely funded by plant tax revenues and the responsible school district has recently indicated that it may have to file for bankruptcy, so the impact there was substantial.^(a)

(a) The size of impact can be significantly influenced by the mechanism that the State uses for funding, e.g., if the State makes up the difference between what the local school districts can fund from the local property tax and what the State has decided is the appropriate level of per-student expenditures.

In general, impacts are nondetectable and nondestabilizing if the existing infrastructure (facilities, programs, and staff) could accommodate any plant-related demand without a noticeable effect on the level of service. Detectable and nondestabilizing impacts arise when the demand for service or use of the infrastructure is sizeable and would noticeably decrease the level of service or require additional resources to maintain the level of service. Detectable and destabilizing impacts would result when new programs, upgraded or new facilities, or substantial additional staff are required because of plant-related demand. The impacts of plant closure were determined for education, transportation, public safety, social services, public utilities, and tourism and recreation.

Education: The NRC considered changes in enrollment in another licensing framework (see *The Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, NUREG-1437 [NRC 1996]) that is useful in the context of plant closure. In general, nondetectable and nondestabilizing impacts are associated with project-related enrollment increases of 3 percent or less. Impacts are considered nondetectable and nondestabilizing if there is no change in the school systems' abilities to provide educational services and if no changes in the number of teaching staff or classroom space are needed. Detectable but destabilizing impacts generally are associated with 4 to 8 percent decreases in enrollment. Impacts are considered moderate if a school system must decrease its teaching staff or classroom space even slightly to preserve its pre-project level of service. Any decrease in teaching staff, however small (e.g., 0.5 full-time equivalent), that occurs from retiring or laying off personnel or changing the duties of existing personnel (e.g., a guidance counselor assuming classroom duties) may result in moderate impacts, particularly in small school systems. Detectable and destabilizing impacts are associated with project-related enrollment decreases of more than 8 percent. Some of the case-study communities had challenges adjusting to the loss of children of the plant staff from the local school systems. For example, some of the local schools had to go on a 4-day week in the Rainier, Oregon, area because loss of enrollment made the schools much more expensive to run per student served.

Transportation: The U.S. Nuclear Regulatory Commission (NRC) considered transportation issues in another licensing framework (see NUREG-1437 [NRC 1996]) that is useful in the context of plant closure. That framework considered impacts on the Transportation Research Board's level of service (LOS) definitions (Transportation Research Board 1985). LOS is a qualitative measure describing operational conditions within a traffic stream and their perception by motorists.

LOS A and B are associated with nondetectable and nondestabilizing impacts because the operation of individual users is not substantially affected by the presence of other users. At this level, no delays occur and no improvements are needed. LOS C and D are associated with detectable and nondestabilizing impacts because the operation of individual users begins to be severely restricted by other users, and at level D small increases in traffic cause operational

Appendix J

problems. Consequently, upgrading of roads or additional control systems may be required. LOS E and F are associated with detectable and destabilizing impacts because the use of the roadway is at or above capacity level, causing breakdowns in flow that result in long traffic delays and a potential increase in accident rates. Major renovations of existing roads or additional roads may be needed to accommodate the traffic flow.

Impacts to transportation during the license renewal term would be similar to or less than those experienced during current operations, driven mainly by the workers involved in plant closure, who are generally fewer in number than the operating staff. Consequently, LOS conditions are likely to move in the direction of A and B at all plants. Based on past and projected impacts at the case study sites, transportation impacts would continue to be nondetectable and nondestabilizing at all sites.

Public safety: Impacts on public safety are considered nondetectable and nondestabilizing if there is little or no need for additional police or fire personnel. No disruptions of police and fire-protection services occurred at the case-study sites after plant closure. Existing services were adequate to handle the influx of decommissioning staff, who are less numerous than the operations staff.

Social services: The impacts on social services are considered nondetectable and nondestabilizing if no change in the current level of service occurs, detectable and nondestabilizing if service declines noticeably, and detectable and destabilizing if services are seriously disrupted. Impacts on social services following closure largely depend on the ability of the community to replace the jobs lost at the end of operations or to successfully assist the laid-off workers and other affected workers in the community to transition out of the community. Most of the case-study sites have been able to do this, so closure impacts have been nondetectable and nondestabilizing to detectable but nondestabilizing.

Public utilities: The NRC considered public utility issues in another licensing framework (see NUREG-1437 [NRC 1996]) that is useful in the context of plant closure. As in that framework, impacts on public-utility services are considered nondetectable and nondestabilizing if little or no change occurs in the ability to respond to the level of demand, and, thus, there is no need to add to capital facilities. Impacts are considered detectable and nondestabilizing if overtaxing of facilities during peak demand periods occurs. Impacts are considered detectable and destabilizing if existing service levels (such as the quality of water and sewage treatment) are substantially degraded and additional capacity is needed to meet ongoing demands for services. Overall, there have been nondetectable and nondestabilizing impacts on public utilities as a result of plant closure. The existing capacity of public utilities was sufficient to accommodate the small influx of decommissioning staff, and some locales experienced a noticeable decrease in the level of demand for services with the completion of plant operations.

Tourism and recreation: Few adverse effects have occurred during current operations at the case-study sites, and some positive effects have resulted because taxes paid by the plants and tours of the plants have also increased local tourism. Based on the case-study analysis, it is projected that because decommissioning essentially turns the operating facility back into a construction site while removing tax payments, the impacts of plant closure should be temporary, nondetectable and nondestabilizing at all plants. Some positive impact to tourism and recreation also may continue if the plant site is then converted for tourism activities, as planned for Trojan.

J.2 Environmental Justice

An evaluation of environmental justice is performed to determine if minority and low-income groups bear a disproportionate share of negative environmental consequences. Selected socioeconomic indicators are found in Table J-5 for closed nuclear power plants for which data were available. These include the median county family income as a percentage of State median family income in the year 1989, and the percentage of minority (non-white plus white Hispanic) persons in the county in the year 2000.

J.3 Reference

U. S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, NRC, Washington, D.C.

Appendix J

Table J-5. Socioeconomic Indicators Relevant to Environmental Justice at Closed Nuclear Power Plants

| Nuclear Plant | Reactor Type | Decommissioning Option | Public Services Impacts | County Median Family Income (MFI), as % of State MFI^(a) | Minority (Non-White and White Hispanic) in County, %^(b) |
|---------------------------|---------------------|---------------------------------------|--------------------------------|---|---|
| Big Rock Point | BWR | DECON | SMALL | 79.5 | < 5 |
| Dresden, Unit 1 | BWR | SAFSTOR | SMALL | 107.4 | < 6 |
| Fermi, Unit 1 | FBR | SAFSTOR | SMALL | 110.4 | < 6 |
| Fort St. Vrain | HTGR | DECON | SMALL | 85.8 | 30 |
| GE-VBWR | BWR | SAFSTOR | SMALL | 110.9 | 59 |
| Haddam Neck | PWR | DECON | SMALL to MODERATE | 103.4 | 10 |
| Humboldt Bay, Unit 3 | BWR | SAFSTOR | SMALL | 74.8 | 18 |
| Indian Point, Unit 1 | PWR | SAFSTOR | SMALL | 148.3 | 35 |
| La Crosse | BWR | SAFSTOR | SMALL | 75.4 | < 2 |
| Maine Yankee | PWR | DECON | SMALL to MODERATE | 103.1 | < 2 |
| Millstone, Unit 1 | BWR | SAFSTOR | SMALL | 87.9 | 15 |
| Pathfinder | BWR | SAFSTOR | SMALL | 124.2 | < 8 |
| Peach Bottom, Unit 1 | HTGR | SAFSTOR | SMALL | 107.7 | < 9 |
| Rancho Seco | PWR | SAFSTOR | SMALL | 93.2 | 42 |
| San Onofre, Unit 1 | PWR | SAFSTOR | SMALL | 128.3 | 45 |
| Saxton | PWR | SAFTSOR | SMALL | 72.7 | < 2 |
| Shoreham | BWR | DECON | SMALL to MODERATE | 134.0 | 21 |
| Three Mile Island, Unit 2 | PWR | Accident cleanup, followed by storage | SMALL | 106.9 | 24 |
| Trojan | PWR | DECON | SMALL to MODERATE | 106.5 | < 7 |
| Yankee Rowe | PWR | DECON | SMALL | 82.4 | < 6 |
| Zion, Unit 1 | PWR | SAFSTOR | MODERATE | 135.2 | 26 |
| Zion, Unit 2 | PWR | SAFSTOR | MODERATE | 135.2 | 26 |

(a) Source: 1990 Census of Population. *American Factfinder* Table 1990 QT. <http://factfinder.census.gov>

(b) Source: 2000 Census of Population. *American Factfinder* Table QT. <http://factfinder.census.gov>