Given that many nuclear reactor facilities undergoing decommissioning are old, there is an increased chance that workers will be exposed to molds and other biological organisms that grow in and on the buildings. Molds and fungus, when inhaled, can cause minor to serious pulmonary problems. Dermal contact could cause rash and/or irritation. A thorough inspection of the facility should be conducted and proper cleansing and PPE should be used when biological agents are identified.

In general, human health risks for most decommissioning options are expected to be dominated by occupational injuries to workers engaged in activities such as construction, maintenance, and excavation. Historically, actual injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates. Occupational injury and fatality risks are reduced by strict adherence to NRC and OSHA safety standards, practices, and procedures. Appropriate State and local statutes must also be considered when assessing the occupational hazards and health risks for any decommissioning activity. The staff assumes strict adherence to NRC, OSHA, and State safety standards, practices, and procedures during decommissioning.

Previous or anticipated decommissioning activities at the FBR or HTGR have not and are not expected to result in occupational hazard issues that are different from those found at other nuclear reactor facilities.

4.3.10.4 Conclusions

The staff has considered available information, including comments received on the draft of Supplement 1 of NUREG-0586, on the potential impacts of decommissioning activities on occupational issues. This information indicates that the impacts on occupational issues are not detectable or destabilizing. Therefore, the staff makes a generic conclusion that for all plants, the potential impacts on occupational issues are SMALL. The staff has considered mitigation measures and concludes that no additional mitigation measures are likely to be sufficiently beneficial to be warranted.

4.3.11 Cost

A decommissioning cost assessment is not a NEPA requirement. However, an accurate decommissioning cost estimate is necessary for a safe and timely plant decommissioning. Therefore, this Supplement includes a decommissioning cost evaluation, but the cost is not evaluated using the environmental significance levels nor identified as a generic or site-specific issue.

4.3.11.1 Regulations

The regulatory procedure for decommissioning a nuclear power facility is set out principally in NRC regulations in 10 CFR 50.75, 50.82, 51.53, and 51.95. The regulations to ensure the safe and timely decommissioning of nuclear power facilities and the availability of decommissioning funds were originally established by the NRC in 1988. These regulations, principally 10 CFR 50.75, specify the minimum amount of funds that a LWR licensee must have to demonstrate reasonable assurance of sufficient funds for decommissioning. The minimum decommissioning funds required by the NRC reflect only the efforts necessary to achieve termination of the 10 CFR Part 50 license. Costs associated with other activities related to facility deactivation and site closure, including operation of the spent fuel storage pool, construction, operation, and decommissioning of an ISFSI, demolition of uncontaminated or decontaminated structures that meet release criteria, and site restoration activities after sufficient residual radioactivity has been removed to meet NRC license termination requirements are not included in the minimum decommissioning fund requirement.

The regulations in 10 CFR 50.75 also require that licensees submit, at least once every 2 years, a report on the status of its decommissioning fund, including specifying the amount of funds accumulated, and a schedule for accumulating the remainder to be collected. This report is to be submitted annually for plants that are within 5 years of the end of licensed operations. 10 CFR 50.75 (f)(i) also requires that each power reactor licensee shall report the status of its decommissioning trust fund annually if the facility has already closed (before the end of its licensed life).

In addition to the financial assurance requirements for decommissioning in 10 CFR 50.75, other requirements in 10 CFR 50.75 and 50.82 specify requirements for submitting cost estimates for decommissioning to the NRC:

- 10 CFR 50.75(f)(2) requires that a licensee shall, at or about 5 years prior to the projected end of operations, submit a preliminary decommissioning cost estimate.

- 10 CFR 50.82(a)(4)(i) requires a licensee to provide an estimate of expected costs for the activities being proposed in the PSDAR.

- 10 CFR 50 82(a)(8)(iii) requires a licensee to provide a site-specific decommissioning cost estimate within 2 years following permanent cessation of operations.

- 10 CFR 50.82(a)(9)(ii)(F) requires a licensee to provide an updated site-specific estimate of remaining decommissioning costs as part of its LTP.

The regulations in 10 CFR 50.82 also specify the criteria that a licensee must meet before they can withdraw funds from the decommissioning fund for decommissioning activities.

4.3.11.2 Potential Impacts of Decommissioning Activities on Cost

As indicated in Table E-3 in Appendix E, all aspects of decommissioning will have an impact on decommissioning costs. The potential impacts of decommissioning activities on cost vary due to the cost of waste management and disposal of the LLW generated during decommissioning and to the uncertainty associated with regulatory requirements.

The variability in waste management and disposal arises because the Barnwell Low-Level Radioactive Waste Management Disposal Facility, the last remaining facility that is available to dispose of all classifications of LLW generated by all but two nuclear power facilities located throughout the United States, is scheduled to stop accepting waste from all NRC licensees except those located in the Atlantic Compact by 2009 (see NUREG-1307, Rev. 9, *Report on Waste Burial Charges* [NRC 2000]). However, decommissioning of most of the nuclear power facilities in the United States is not expected to occur until sometime after 2009. This cost uncertainty is generally applicable to most of the nuclear power facilities that are currently being decommissioned and those that will be decommissioned in the future. This cost uncertainty, however, is somewhat mitigated by the availability of the Envirocare disposal facility in Utah. Envirocare can accept most Class A LLW for disposal from any generator in the United States. (More than 95 percent of LLW generated during nuclear power facility decommissioning is Class A.) Other LLW storage and disposal sites are also currently being proposed.

The uncertainty associated with regulatory requirements is a reflection of the different requirements and standards for cleanup applied by different States and localities. While NRC cleanup requirements for terminating a license are well defined, these other external requirements may significantly influence the cost of decommissioning. For example, local jurisdictions might impose additional requirements than those imposed by the NRC. The cost of the extra cleanup is not reflected in the decommissioning fund required by the NRC.

4.3.11.3 Evaluation

The estimated cost of decommissioning all of the nuclear power facilities that have been built and operated in the United States is provided in Table 4-3 (in January 2001 dollars). The costs provided in the table are those estimated by the owners of the individual plants and reported to the NRC.

Shown in the table are the actual costs to complete the decommissioning and terminate the 10 CFR Part 50 licenses for each of those facilities that have reached this milestone of their life-cycle. Facility-specific estimates are also provided for each plant that has been permanently shut down and is either actively undergoing decommissioning or is in safe storage awaiting active decontamination and dismantlement. The costs shown are estimates developed by the licensee and reported in their PSDARs, site-specific cost estimate reports, LTPs, etc. These estimates are adjusted to January 2001 dollars.

Table 4-3 provides the range of costs estimated by utilities to decommission all of the nuclear power facilities that are currently operating or have not indicated an intent to permanently shut down. Cost ranges, rather than facility-specific cost estimates, are provided for these plants, reflecting the fact that these estimates are not as well developed as for those plants that have already permanently shut down. These cost ranges were developed from licensee-provided estimates in the March 1999 biennial decommissioning reports adjusted to January 2001 dollars.

Finally, Table 4-3 provides a range of decommissioning cost estimates for the ENTOMB options. These options have not been used or considered by any U.S. nuclear power facility licensee to date. Cost estimation methods for the ENTOMB options are, thus, not as well developed as for the DECON and SAFSTOR methods. The values quoted in the table were developed from an analysis of the two entombment scenarios described in Chapter 3 for a "reference" (i.e., typical) PWR and BWR. The reference PWR was assumed to be the Trojan Plant in Oregon; the reference BWR was assumed to be the Columbia Generating Station in Washington.

The cost of decommissioning results in impacts on the price of electricity paid by ratepayers. These impacts generally occur over the life of the facility as the decommissioning fund is being collected. However, for those nuclear reactor facilities that shut down prematurely (as is the case for the majority of the facilities identified in Table 4-3), the impact may also occur for a number of years after permanent shutdown while the under-collected portion of the fund continues to be collected.

This analysis assesses the impact of cost by evaluating the total cost to decommission a nuclear power facility and terminate its Part 50 license. This impact is summarized in Table 4-4. As can be seen, the cost to decommission a large (>200 MWe) nuclear power facility is estimated to range from $150 million to $700 million and is highly dependent on the factors discussed previously.

4.3.11.4 Conclusions

The staff has reviewed these data, recognizing that an evaluation of decommissioning cost is not a NEPA requirement. This information is presented here as a summary of actual and predicted decommissioning costs based on recently available data.

4.3.12 Socioeconomics

There are two primary pathways through which nuclear power plant activities create socioeconomic impacts on the area surrounding the plant. The first is through expenditures in the local community by the plant work force, and direct 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. When a nuclear power plant is closed and decommissioned, most of the important socioeconomic impacts will be associated with the plant closure rather than with the decommissioning process.

4.3.12.1 Regulations

There are no Federal or State regulations pertaining to any particular level of socioeconomic impacts, as there are for some environmental effects. Socioeconomic impacts are an element of NEPA documentation that must be addressed and mitigated, if warranted.

4.3.12.2 Potential Impacts of Decommissioning Activities on Socioeconomics

As indicated in Table E-3 in Appendix E, all of the socioeconomic impacts of decommissioning are related to organizational or staffing changes. The impacts of decommissioning were assessed recognizing that the potentially large impacts of plant closure may occur simultaneously with those of the actual decommissioning activities. However, as indicated in Section 1.3, impacts related to the decision to permanently cease operations are outside the scope of this Supplement.

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

Table 4-3. Cost Impacts of Decommissioning (in January 2001 Dollars)

Nuclear Plant	Electric Power Generation Rating	Reactor Type	Decommissioning Option	Estimated Decommissioning Cost, $ million
Decommissioning Completed				
Fort St. Vrain	330 MWe	HTGR	DECON	230 (189 [1996])[a]
Pathfinder	59 MWe	BWR	SAFSTOR	20 (13 [1992])[a]
Shoreham	809 MWe	BWR	DECON	258 (182 [1994])[a]
Currently Being Decommissioned				
Big Rock Point	67 MWe	BWR	DECON	364
Dresden, Unit 1	200 MWe	BWR	SAFSTOR	340
Fermi, Unit 1	61MWe	FBR	SAFSTOR	36
GE-VBWR	13 MWe	BWR	SAFSTOR	10
Haddam Neck	619 MWe	PWR	DECON	404
Humboldt Bay, Unit 3	65 MWe	BWR	SAFSTOR	284
Indian Point, Unit 1	257 MWe	PWR	SAFSTOR	259
La Crosse	50 MWe	BWR	SAFSTOR	111
Maine Yankee	860 MWe	PWR	DECON	400
Millstone, Unit 1	660 MWe	BWR	SAFSTOR	563
Peach Bottom, Unit 1	40 MWe	HTGR	SAFSTOR	65
Rancho Seco	913 MWe	PWR	SAFSTOR	394
San Onofre, Unit 1	410 MWe	PWR	SAFSTOR	427
Saxton	NA	PWR	SAFSTOR	44
Three Mile Island, Unit 2	792 MWe	PWR	SAFSTOR	502
Trojan	1130 MWe	PWR	DECON	250
Yankee Rowe	167 MWe	PWR	DECON	244
Zion, Unit 1	1085 MWe	PWR	SAFSTOR	386
Zion, Unit 2	1085 MWe	PWR	SAFSTOR	495
Currently Operating				
69 PWR Reactors	486 - 1270 MWe	PWR	DECON/SAFSTOR	264 - 695
35 BWR Reactors	514 - 1265 MWe	BWR	DECON/SAFSTOR	152 - 663
"Reference PWR"	1130 MWe	PWR	ENTOMB1/ ENTOMB2	290 - 400
"Reference BWR"	1100 MWe	BWR	ENTOMB1/ ENTOMB2	410 - 750

(a) Actual cost to complete the decommissioning and the year the license was terminated.

Table 4-4. Summary of Cost Impacts by Decommissioning Option and Reactor Type and Size (January 2001 Dollars)

	Decommissioning Cost Range, $million					
Decommissioning Option	**PWR < 200 MWe**	**PWR ≥ 200 MWe**	**BWR < 200 MWe**	**BWR ≥ 200 MWe**	**HTGR**	**FBR**
DECON	244	250 - 404	364	>182[a]	189	--
SAFSTOR	44	259 - 597	13 - 284	340 - 563	65	36
DECON/SAFSTOR (currently operating reactors)	--	264 - 695	--	152 - 663	--	--
ENTOMB1/ENTOMB2	--	290 - 400	--	410 - 750	--	--

(a) Cost data from the Shoreham plant, which only generated one effective full power day. There was little or no contamination to many plant systems. Not representative of other large BWRs.

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, where there are considerable increases or decreases in rental rates and housing values, or when substantial conversion or abandonment of housing units occurs.

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 changes in demand related to plant closure and decommissioning 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.

4.3.12.3 Evaluation

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 ranges from 600 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 temporary 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 may be in the local community only a short time, but during these periods of extensive maintenance activities, the additional personnel could have a substantial effect on the locality. If, as expected, the decommissioning process requires a smaller work force than the onsite operating staff (typically 100 to 200 staff) and 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. However, even the small decommissioning work force will tend to mitigate temporarily the full adverse socioeconomic effects of terminating operations.

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.

If the decommissioning work force were substantially larger than the operating work force, the result could be increased demand for housing and public services but also increased tax revenues and higher real estate values. If the economy is characterized by decline, then decommissioning could temporarily reverse the adverse economic effects.

In a stable economy, a net increase in the community work force could lead to some shortages in housing and public services, as well as to the higher tax revenues and real estate values mentioned previously. In a growing economy, decommissioning could act as an exacerbating factor to the ongoing shortages that already might exist.

Changes in work force and population: Changes of over 3 percent to 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 businesses. The size of the work force required during decommissioning, relative to that during operations, is an important determinant of population growth or decline.

The impact from facility closure depends on the rate and amount of population change. If decommissioning 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 active decommissioning begins are more likely 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 less immediate negative impacts; the impacts from the ENTOMB option, assuming those preparations were made immediately after shutdown, would be less significant than those of SAFSTOR.

Data on changes in work force were collected at facilities that are being decommissioned where information on operational and decommissioning work force is available. This information is presented in Appendix J, Table J-1. The table also shows total population in the host county at the time of plant shutdown, to indicate the potential importance of the facility closure.

In order to identify any unusual downward trends in county population around the time of a facility shutdown, data were collected showing the range of percentage changes in population that have occurred at facilities currently being decommissioned. U.S. Census population data for the counties that house the decommissioning facility are used to assess changes in population around the time of shutdown by comparing percentage changes in the county population with State population changes during the same time period. This information is provided in Appendix J, Table J-2.

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 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 destablizing 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 the State of California experienced very high urban population growth. In general, experience of decommissioning facilities to date does not show any impacts from population change, either because the closure-related changes were small relative to the population base or because they were offset by other growth in the area.

Local tax revenues: Changes in tax revenues of less than 10 percent are considered not detectable, i.e., they result 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 or services cut substantially, and the payment of debt for any substantial infrastructure improvements made in the past becomes 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.

More information is available for facilities that have recently closed than for facilities closed more than 10 years ago (see Appendix J, Table J-3). The findings from this body of evidence confirm the findings discussed above. The primary taxing authorities for most of the decommissioning plants are the county and city in which the facility is sited. Tax information is typically provided by local taxing authorities (assessor's office) or from town planners familiar with the tax revenues generated by the facility.

The tax revenue impacts on the local communities of facility closure range from zero impact (tax-exempt plants) to 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. Hence, 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 provided by property-tax revenues. The manner in which a State calculates the value of the plant also affects both the amount and timing of tax losses when a nuclear power facility closes and 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. Several other approaches are discussed in Appendix J.

- 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.

- 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.
- Utility ratepayers in some jurisdictions are entitled to share in funds recovered from 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 (MWt), the larger the tax revenue impact. In addition, aging of the facility depreciates its book value and its 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.

The choice of the decommissioning option appears to have had no bearing on the loss of tax receipts. The impact has to do with the size and suddenness of the loss of tax revenue (size and age of facility) related to plant closure only. The length of delay between shutdown and decommissioning does not appear to affect the size of the impact on tax revenue losses. No commercial nuclear power reactor has used the ENTOMB options, but there is no reason to expect ENTOMB to have any different impact on tax revenue losses than SAFSTOR or DECON.

Public services: The impacts of decommissioning on public services are generally much smaller than the impacts of plant closure. Impacts of closure are closely related to the tax-related impacts on the community and are affected by the same characteristics of the plant (size and age, tax treatment, and 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. Inquiries were made to local governments in the vicinity of closed plants about public service impacts during and after shutdown and decommissioning. Their assessments are discussed in Appendix J and data are shown in 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.

Detectable impacts on housing result when there is a discernable increase or reduction in housing availability, when rental rates and housing values exceed the inflation rate elsewhere in the State, or when 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, where there are considerable increases or decreases in rental rates and housing values, and when there is substantial conversion or abandonment of housing units. 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. However, the decommissioning process itself does not appear to have produced any detectable impacts on housing.

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.

In general, detectable impacts arise when the demand for service or use of the infrastructure is sizeable. Impacts 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. Specific information for each of the areas of public service for closed plants is provided in Appendix J.

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 have to be eliminated because they are not considered 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 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]. However, all of these impacts were related to plant closure; in no case did the decommissioning process itself result in detectable impacts on public services.

(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.

Previous or anticipated decommissioning activities at the FBR or HTGR have not and are not expected to result in impacts on socioeconomics that are different from those found at other nuclear facilities.

Summary: The impacts of plant closure are those that are observed by the community, rather than the impacts from decommissioning activities because they occur at about the same time. The impacts occur either through changing employment levels and local demands for housing and infrastructure, or through decline of the local tax base and the ability of local government entities to provide public services. The effects of employment changes on population growth are expected to be not detectable if population changes (reductions or increases) are less than 3 percent per year, detectable but not destabilizing if the population change is between 3 percent and 5 percent, and destabilizing if the population change is greater than 5 percent per year. Experience so far has shown that in most cases, reductions in employment related to plant closure even at fairly large sites do not generally produce local population changes greater than 3 percent, regardless of the type of plant and decommissioning option selected. The impacts of the decommissioning work force are even smaller.

The effect on the local tax base and public services related to closure depends on the size of the plant-related tax base relative to the overall tax base of local government, as well as on the rate at which the tax base is lost. Changes in annual tax revenues less than about 10 percent are considered nondetectable, i.e., they result 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 but not destabilizing 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. Experience has shown that publicly owned tax-exempt plants will not have an impact through this mechanism. In addition, fully depreciated plants, or a plant that is located in an urban or urbanizing area with a large or rapidly growing tax base will also not be impacted by this mechanism. A large, newer, relatively undepreciated plant, located in a small, isolated community, is much more likely to exceed the 20-percent criterion. If the plant tax base is phased out slowly after closure in these circumstances, the impact is more likely to be mitigated. Neither the type of reactor nor the method chosen for decommissioning matters.

Decommissioning itself has no impact on the tax base and no detectable impact on the demand for public services.

4.3.12.4 Conclusions

The staff has considered available information, including comments received on the draft of Supplement 1 of NUREG-0586, on the potential impacts of decommissioning on socioeconomics. This information indicates that the impacts of decommissioning on socioeconomics are neither detectable nor destabilizing. Therefore, the staff makes the generic conclusion that the impacts on socioeconomics are SMALL. The staff has considered mitigation and concludes

that no additional measures are likely to be sufficiently beneficial to be warranted.

4.3.13 Environmental Justice

An evaluation of environmental justice is performed to determine if minority and/or low-income groups bear a disproportionate share of negative environmental consequences. Executive Order 12898, dated February 16, 1994 (59 FR 7629), directs Federal executive agencies to consider environmental justice under NEPA. The Executive Order does not create whole new categories of impacts that need to be considered; nor does it create any right, benefit, or trust responsibility, substantive or procedural, that can be enforced by law or equity. It is designed to improve internal management of agencies to ensure that low-income and minority populations do not experience disproportionately high and adverse human health or environmental effects because of Federal actions.

Environmental justice has not been evaluated previously for decommissioning activities at reactor facilities.

4.3.13.1 Regulations

The CEQ has provided *Environmental Justice: Guidance Under the National Environmental Policy Act* (CEQ 1997). Although NRC is an independent agency, the Commission has committed to undertake environmental justice reviews, and has provided specific information in Office Instruction LIC-203, Nuclear Reactor Regulation (NRR), *Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues* (NRC 2001a). The CEQ guidance and NRR instructions provide several key definitions and the framework for analysis.

Low-income population: Low-income populations in an environmental impact area should be identified where census block groups within the environmental impact area have (1) more than 50 percent low-income persons or (2) the percentage of persons in households below the poverty level is significantly greater (typically, at least 20 percentage points) than in the geographical area chosen for comparative analysis. In identifying low-income populations, agencies may consider as a community either a group of individuals living in geographic proximity to one another or a set of individuals (e.g., migrant workers or American Indians[a]), where either type of group experiences common conditions of environmental exposure or effect.

Minority: Individuals who are members of the following population groups: American Indian and Alaska Native; Asian; Native Hawaiian and other Pacific Islander; Black or African

(a) For consistency, the term "American Indian" is used throughout this document to conform to the definition of "minority population."

American, not of Hispanic or Latino origin; or some other race and Hispanic or Latino (of any race).[a]

Minority population: According to the CEQ, minority populations should be identified where either (a) the minority population of the affected area exceeds 50 percent or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis. In identifying minority communities, agencies may consider as a community either a group of individuals living in geographic proximity to one another or a geographically dispersed/transient set of individuals (e.g., migrant workers or American Indians), where either type of group experiences common conditions of environmental exposure or effect. The selection of the appropriate unit of geographic analysis may be a governing body's jurisdiction, a neighborhood, census tract, or other similar unit that is to be chosen so as not to artificially dilute or inflate the affected minority population. A minority population also exists if there is more than one minority group present and the minority percentage, as calculated by aggregating all minority persons, meets one of the above-stated thresholds. NRR adopted a standard of 20 percentage points as "meaningfully greater."

Disproportionately high and adverse human health effects: When determining whether human health effects are disproportionately high and adverse, agencies are to consider the following three factors to the extent practicable: (a) whether the health effects, which may be measured in risks and rates, are significant (as used by NEPA), or above generally accepted norms (adverse health effects may include bodily impairment, infirmity, illness, or death); (b) whether the risk or rate of hazard exposure by a minority or low-income population, to an environmental hazard is significant (as used by NEPA) and appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group; and (c) whether health effects occur in a minority or low-income population, affected by cumulative or multiple adverse exposures from environmental hazards.

Disproportionately high and adverse environmental effects: When determining whether environmental effects are disproportionately high and adverse, agencies are to consider the following three factors to the extent practicable: (a) whether there is or will be an impact on the natural or physical environment that significantly (as used by NEPA) and adversely affects a minority or low-income population (such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or American Indian tribes when those impacts are interrelated to impacts on the natural or physical environment); (b) whether environmental effects are significant (as used by NEPA) and are or may be having an adverse impact on minority populations, low-income populations, or

(a) "Other" may be considered a separate minority category. In addition, the 2000 Census included multi-racial data. Multi-racial individuals should be considered in a separate minority, in addition to the aggregate minority category.

American Indian tribes that appreciably exceeds or is likely to appreciably exceed those on the general population or other appropriate comparison group; and (c) whether the environmental effects occur or would occur in a minority or low-income population, affected by cumulative or multiple adverse exposures from environmental hazards.

4.3.13.2 Potential Impacts of Decommissioning Activities on Environmental Justice

As indicated in Table E-3 in Appendix E, decommissioning activities that may affect environmental justice are related to organizational or staffing changes and offsite transportation issues. However, the assessment of environmental justice is related to most of the other specific issues discussed throughout this Supplement. Any decommissioning activity that results in a disproportionate share of negative environmental consequences to minority or low-income groups has the potential to be an adverse environmental justice impact.

Detectability and destabilization, as they relate to environmental justice, must be defined in proportion to the minority and low-income populations that reside in the area of the power plant. Proportionment must be determined at each site at the time of decommissioning.

4.3.13.3 Evaluation

Most of the environmental justice impacts relate to land use, environmental and human health, and socioeconomics. Impacts due to onsite land disturbance are likely to be not detectable because the amounts of land disturbance are generally very small and usually occur in areas of the site previously disturbed by construction or operation of the facility. Impacts from disturbances to offsite land will generally not occur because offsite land generally is not disturbed as a result of decommissioning. If offsite land disturbance is required (e.g., if a new offsite road or rail spur is needed to transport large components or waste from decommissioning), the impact on environmental justice is site-specific because it will depend on the location of the new route relative to low-income populations or other affected resources on which they may depend. Some minority and low-income populations normally live along rail lines and truck routes. Previous transportation analyses have found that the impacts would be small from normal operations or from accidents. Thus, no disproportionately high and adverse effects are expected for any particular segment of the population, including minority and low-income populations, that may live along proposed rail and truck routes. Siting and construction of these offsite transportation upgrades would include an evaluation of cultural and other resources in the disturbed areas. Usually, offsite physical environmental impacts of decommissioning will be not be detectable because offsite environmental impacts from decommissioning are generally not detectable.

Socioeconomic impacts on minority and low-income populations due to plant closure could range from nondetectable to destabilizing, depending on the distribution of job impacts within the community and the effects of plant closure on local tax revenues and public services; however, the impact of decommissioning would generally not be detectable. More generic

information on overall socioeconomic impacts can be obtained by observing demographic statistics. In the 21 decommissioning case studies observed, it was concluded that facility closure would not have a detectable socioeconomic impact on low-income and minority populations. In other words, there appears to be no indication that minority or low-income populations would suffer disproportionately high and adverse impacts from the closure of the facilities. Because decommissioning has even smaller effects, its impact also would have been not detectable. The environmental justice conclusions are based on demographic information, i.e., the overall impact of the facility on the community. Discussions were also held with community members at some sites.

In addition, information provided by local government and social service providers helps determine the socioeconomic impacts on low-income and minority populations. In many of these case studies, the nuclear facilities are located in primarily white communities and tend to be located near bodies of water where upper-income real estate is built. Those that are employed by the facility tend to fall into the upper-income bracket within the communities where the facilities are located. Selected socioeconomic indicators are found in Appendix J, Table J-5, for the closed nuclear power plants studied.

The determination of whether the minority or low-income populations are disproportionately highly and adversely impacted by facility decommissioning activities needs to be made on a site-by-site basis because their presence and their socioeconomic circumstances will be site-specific. Data indicate there is no reason to expect adverse socioeconomic impacts to be correlated with type of plant (see Table J-5). However, adverse socioeconomic impacts are correlated with large facility size, early shutdown, and small, isolated host communities. If minority and low-income populations are present, adverse impacts from facility closure would be somewhat more likely in small, isolated communities than in larger urban areas. It is not clear whether these effects would be disproportionately high and adverse.

Previous or anticipated decommissioning activities at the FBR or HTGR have not and are not expected to result in environmental justice considerations that are different from those found at other nuclear facilities.

4.3.13.4 Conclusions

The staff has considered available information on the potential impacts of decommissioning on environmental justice, including comments received on the draft of Supplement 1 of NUREG-0586. Based on this information, the staff has concluded that the adverse impacts and associated significance of the impacts must be determined on a site-specific basis. Executive Order 12898 (59 FR 7629), dated February 16, 1994, directs Federal executive agencies to consider environmental justice under the National Environmental Policy Act 1969 (NEPA). Although the NRC is an independent agency, the Commission has committed to undertake environmental justice reviews. Subsequent to the submittal of the PSDAR, the NRC staff will consider the impacts related to environmental justice from decommissioning activities.

4.3.14 Cultural, Historic, and Archeological Resources

Cultural resources include any prehistoric or historic archeological site or historic property, site, or district listed in or eligible for inclusion in the National Register of Historic Places or otherwise having significant local importance. The Federal agency (in this case the NRC) is responsible for the evaluations through consultations with the State Historic Preservation Officer (SHPO), or if appropriate, the Tribal Historic Preservation Officer (THPO), that is responsible for determining which sites or properties are of significant historic or archeological importance. The NRC is also responsible for including other interested parties and affected American Indian tribes. Disagreements between the parties are resolved by the Advisory Council on Historic Preservation.

Evaluation of the potential presence of cultural resources should not rely solely on a query of the SHPO database, but should be based on field surveys and evaluations of the site. Although these evaluations may have been performed as part of the initial environmental evaluation for the sites or as part of another licensing action (e.g., license renewal), the coverage and adequacy of earlier survey efforts needs to be re-evaluated in cases where an impact may occur. Earlier field surveys and methods may not conform to current standards.

4.3.14.1 Regulations

The Federal statute that is most directly applicable to cultural resource issues during the decommissioning process is the National Historic Preservation Act (NHPA) of 1966 as amended (16 USC 470 et seq.). This Act created the National Register of Historic Places (National Register) and requires the heads of all Federal agencies to consider the impacts of the undertakings on any cultural properties that are listed on the National Register or that are eligible for listing. Section 106 of the NHPA requires each Federal agency to identify, evaluate, and determine the effects of an undertaking on any cultural resource site that may be within the area impacted by that undertaking. This section also requires consultation to resolve adverse effects of an undertaking and establishes mechanisms to obtain and incorporate comments from consulting parties. Federal agencies are directed by 36 CFR Part 800 to comply with the stipulations of NHPA as well as pertinent cultural, historical, and archeological protection provisions of NEPA, the Historic Sites Act of 1935, and the Antiquities Act of 1906 and their implementing regulations. The Historic Sites Act of 1935 (16 USC 461-467) declared a national policy of preserving for the public historic sites, buildings, and objects of national significance. It also led to the establishment of the Historic Sites Survey, the Historic American Buildings Survey, and the Historic American Engineering Record within the National Park Service.

Most other cultural, historical, and archeological protection regulations are primarily directed at resource protection on Federal lands, but in some cases these statutes may be applicable to the decommissioning of commercial power reactors. Several commercial nuclear power reactors are located on Federal lands. The Antiquities Act of 1906 (16 USC 431-433) prohibits destruction of vertebrate fossils and archeological sites on Federal lands and regulates their

removal under a permitting procedure. These regulations were further strengthened by the Archeological Resources Protection Act of 1979 (16 USC 470aa-47011), which prohibits the willful or knowing destruction and unauthorized collection of archeological sites and objects located on Federal lands. It also establishes a permitting system for archeological investigations and requires consultation with concerned tribes prior to permit issue. The Native American Graves Protection and Repatriation Act of 1990 (25 USC 3001 et seq.) protects graves on Federal lands and establishes tribal ownership of human remains and/or associated funerary objects taken from Federal lands and requires the inventory and repatriation to the tribes of any remains or funerary objects held by Federal agencies. Certain more recent Executive Orders regarding consultation with American Indian tribes and protection of religious sites and values could also be relevant.

Many of the States also have statutes that protect cultural, historical, and archeological resources on State lands. Some States also have burial and cemetery statutes that apply to private land as well. These State-level statutes are usually administered through the appropriate SHPO.

4.3.14.2 Potential Impacts of Decommissioning Activities on Cultural, Historic, and Archeological Resources

As indicated in Table E-3 in Appendix E, decommissioning activities that have a potential to adversely impact cultural resources include stabilization, decontamination and dismantlement, and large component removal. These activities adversely impact cultural resources primarily via land disturbance, which could damage or destroy the resource, or alter the contextual setting of the resource. In addition to the direct effects of land clearing, indirect effects such as erosion and siltation may adversely affect some cultural resources. Decommissioning activities also may alter the site access and administrative protection of the resources.

In a few situations, the nuclear facility itself could be potentially eligible for inclusion in the National Register of Historic Places, especially if it is older than 50 years and represents a significant historic or engineering achievement. In this case, appropriate mitigation would be developed in consultation with the SHPO. Even for buildings that are less than 50 years old, the processes and engineering that were employed may be of interest and may be eligible for the Historic American Engineering Record.

Impacts to cultural, historical, or archeological resources are considered detectable if the activity has a potential to have a discernable adverse affect on the resources. The impacts are destabilizing if the activity would degrade the resource to the point that it would be of significantly reduced value to the future generations, such as physically damaging structures or artifacts or destroying the physical context of the resource in its environment.

4.3.14.3 Evaluation

In most cases, the amount of land required to support the decommissioning process is relatively small and is a small portion of the overall plant site. Usually, the areas disturbed or utilized to support decommissioning are within the operational areas of the site and typically are within the protected area. Usually, there is sufficient room within the operational areas to function as temporary storage, laydown, and staging sites. In most cases, management, engineering, and administrative staff would be assigned space in existing support or administration buildings. In some cases, the licensees have installed trailers or temporary buildings to house engineering and administrative staff or to otherwise support decommissioning. In most cases examined, the licensees expect to restrict decommissioning activities to highly disturbed operational areas but a few do expect to use lands beyond the operational areas. The licensees typically anticipate utilizing an area of between 0.4 ha (1 ac) to approximately 10.5 ha (26 ac) to support the decommissioning process. One facility (Big Rock Point) required a new transmission line right of way (ROW) to provide electrical power to the plant site during decommissioning (this line will also provide power to the onsite independent spent fuel storage installation [ISFSI] after decommissioning is completed). However, construction of a new transmission line ROW is considered an unusual situation. It is expected that some sites will require the reconstruction or installation of new transportation links, such as railroad spurs, road upgrades, or barge slips. Activities conducted within the operational areas are not expected to have a detectable effect on important cultural resources because these areas have normally been highly degraded during facility construction and operation. Activities conducted outside of the operational areas may have detectable impacts, depending on the size and type of impact, and the cultural resources potentially affected.

The potential for adverse impacts is probably not affected by the type of facility (BWR, PWR, HGTR, or FBR) or the decommissioning option selected. However, the different decommissioning options are likely to alter the timing of the impact to cultural resources more than the magnitude of the impacts. DECON may require slightly more land area to support a larger number of activities occurring at the same time. ENTOMB2 would probably have the least likelihood of adverse impacts because some large components may be left in place, reducing the land requirements needed for large construction equipment, as well as waste storage and barge or rail loading areas. The potential impacts of SAFSTOR may be smaller than DECON or ENTOMB1, depending on the time period over which activities are performed. If dismantling and decontamination occur slowly over many years (incremental decontamination and dismantlement), the same storage and staging areas can be reused for sequential activities; however, if many activities are performed over a short time period at the end of the SAFSTOR period, the impacts may be as large as DECON.

4.3.14.4 Conclusions

The staff has considered available information on the potential impacts of decommissioning on cultural, historic, and archeological resources, including comments received on the draft of

Supplement 1 of NUREG-0586. For plants where the disturbance of lands beyond the operational areas is not anticipated, the impacts on cultural, historic, and archeological resources are not considered to be detectable or destabilizing. Therefore, the staff makes a generic conclusion that for such plants, the potential impacts to cultural, historic, and archeological resources are SMALL. The staff has considered mitigation measures and concludes that no additional mitigation measures are likely to be sufficiently beneficial to be warranted.

If disturbance beyond the operational areas is anticipated, the impacts may or may not be detectable or destabilizing, depending on site-specific conditions, and cannot be predicted generically. Therefore, the staff concludes that if disturbance beyond the operation areas is anticipated, the potential impacts may be SMALL, MODERATE, or LARGE and must be determined through site-specific analysis. Before the licensee conducts any decommissioning activity that might result in the disturbance of historic properties or archeological resources outside the site operational area, the NRC will, in accordance with the National Historic Preservation Act of 1966 as amended (16 USC 470 et seq.), consult with the appropriate SHPO or THPO to evaluate potential impacts.

4.3.15 Aesthetic Issues

Aesthetics is the study or theory of beauty and the psychological responses to it. Aesthetic resources include natural and man-made landscapes and the way the two are integrated. In this evaluation, aesthetic resources are considered to be primarily visual and relate the structures and the visual attributes of the decommissioning site.

4.3.15.1 Regulations

There are no regulations that relate specifically to the degree to which aesthetics may be impacted by a Federal project. The Bureau of Land Management (BLM), however, has developed a Visual Resource Management (VRM) system,[a] which involves cataloging scenic values, establishing management objectives for those values through the resource-management planning process, and evaluating proposed activities to determine whether they conform with the management objectives. This system provides tools for identifying the visual resources of an area and assigning them to inventory classes. It also provides tools for determining whether the potential visual impacts from proposed activities or developments meet the management objectives established for an area or whether design adjustments will be required. This tool was designed to meet the BLM's responsibilities for maintaining scenic values of public lands. However, it does not directly apply to a decommissioning facility, where the landscape has already been altered by the facility's structure.

(a) VRM System (http://www.blm.gov/nstc/VRM/vrmsys.html), accessed July 7, 2001.

4.3.15.2 Potential Impacts of Decommissioning Activities on Aesthetics

Table E-3 in Appendix E indicates that structure dismantlement and entombment are activities that may have aesthetic impacts. Nuclear power facilities generally contain four main buildings or structures, as described in Chapter 3: the containment or reactor building, the turbine building, auxiliary building, and cooling towers (if any). Cooling towers and stacks may be clearly visible from a distance. Sites also contain a number of storage tanks, a large switchyard, and various administrative and security buildings. Decommissioning may include demolition or dismantlement of any of these structures. The switchyard may be left in place after the termination of the license because it is an integral part of the power distribution grid.

Levels of impacts for aesthetic resources are defined largely by the impact of the proposed changes as perceived by the public, not merely the magnitude of the changes themselves. The potential for significance arises with the introduction (or continued presence) of an intrusion into an environmental context, resulting in measurable changes to the community (e.g., population declines, property value losses, increased political activism, tourism losses).

Decommissioning activities and the changes that they bring are considered to have a nondetectable impact on the host communities' aesthetic resources if there are (1) no complaints from the affected public about a changed sense of place or a diminution in the enjoyment of the physical environment and (2) no measurable impact on socioeconomic institutions and processes. They are considered to have detectable but not destablizing impacts on the host communities' aesthetic resources if there are (1) some complaints from the affected public about a changed sense of place or a diminution in the enjoyment of the physical environment and (2) measurable impacts that do not alter the continued functioning of socioeconomic institutions and processes. The activities are considered to have detectable and destabilizing impacts on the host community's aesthetic resources if there are (1) continuing and widely shared opposition to the activities or the changes the activities bring based solely on a perceived degradation of the area's sense of place or a diminution in the enjoyment of the physical environment and (2) measurable social impacts that perturb the continued functioning of community institutions and processes.

4.3.15.3 Evaluation

The aesthetic impacts of decommissioning fall into two sets: (a) impacts, such as noise, associated with decommissioning activities that are temporary and cease when decommissioning is complete and (b) the changed appearance of the site when decommissioning is complete.

Typically, nuclear power facilities are located in flat-to-rolling countryside in wooded or agricultural areas. In some cases, the facility structures are visible for many miles. In other cases, there are only a few views of the facility from the land, although it is more obvious from the water (lake, ocean, or bay).

Aesthetic issues related to construction and operation of facility structures were addressed in many (but not all) of the Final EISs prepared in response to applications for construction permits and operating licenses. In most cases, the visual impacts of the plant were said to have been mitigated to some extent by the surrounding topography or vegetation. In other cases, visible structures (such as cooling towers) were said to be "highly visible" but "the staff does not consider such an impact to be unacceptable." For decommissioning, the issue related to aesthetics is not one of placing another facility or building on a site, but one of removing buildings or structures.

The issues evaluated in this section concern the impacts of decommissioning activities on aesthetic resources at and around all types of nuclear power facilities (PWRs, BWRs, HTGR, or FBR). During the decommissioning period, the appearance of the facility will be slowly altered if the buildings are dismantled.

During decommissioning, the impact of activities on aesthetic resources would be temporary. The impacts would be limited both in terms of land disturbance and the duration of activity and would have characteristics similar to those encountered during industrial construction: dust and mud around the construction site, traffic and noise of trucks, and construction disarray on the site itself. In most cases, these impacts would not easily be visible offsite. Aesthetic impacts could improve fairly rapidly in the case of an immediate DECON if the licensee chooses to dismantle the facility, remove the structures, and regrade and revegetate the site before license termination. Impacts could also remain the same or similar in the case where the licensee maintains the structures throughout the decommissioning period and leaves them standing even after license termination (either after decontamination of the structures or possibly along with entombment of the reactor building) or throughout a long SAFSTOR period or ENTOMB. In these latter cases, the aesthetic impacts of the plant would be similar to those that occurred during the operational period.

The removal of structures is generally considered beneficial to the aesthetic impacts of the site. In a few cases, where facilities have been located on the Great Lakes or ocean coast, the facility may have been used by boaters as a landmark. However, it is highly unlikely that this would become an issue that would preclude dismantlement of the facility structures.

The retention of the structures during a SAFSTOR period or the retention of structures onsite at the time the license is terminated is likewise not an increased visual impact, but instead a continuation of the visual impact analyzed in the facility construction or operations FES. The staff has not identified any mechanism that would result in a greater negative aesthetic impact than had previously been considered during the development of the construction FES.

Decommissioning activities will be conducted onsite, both inside and outside existing buildings (in the case of dismantlement or shipping activities). Any visual intrusion (such as the

dismantlement of buildings or structures) would be temporary and would serve to reduce the aesthetic impact of the site. At a minimum, the aesthetic impact of the site would not be improved but would remain that of an industrial site as evaluated in the facility's original FES.

Licensees are expected to use best-management practices (BMPs) to control many of the potentially adverse impacts of decommissioning activities on aesthetics (e.g., dust and noise), as discussed in other sections.

4.3.15.4 Conclusions

The staff has considered available information, including comments received on the draft of Supplement 1 of NUREG-0586, on the potential impacts of decommissioning activities and the changes in plant appearance on aesthetics. This information indicates that the impacts on aesthetics are not detectable or destabilizing. Therefore, the staff makes a generic conclusion that for all plants, the potential impacts on aesthetics are SMALL. The staff has considered mitigation measures and concludes that no additional mitigation measures are likely to be sufficiently beneficial to be warranted.

4.3.16 Noise

Noise is a "direct effect," as defined by Section 1508 of the CEQ Regulations for Implementing NEPA, i.e., effects caused by an action that occur at the same time and place as that action. For NRC licensees, the implementing regulations for NEPA are given in 10 CFR Part 51.

Noise is usually defined as sound that is undesirable because it interferes with speech, communication, or hearing; is intense enough to damage hearing, or is otherwise annoying. Noise levels often change with time. To compare levels over different time periods, several descriptors were developed that take into account this time-varying nature. These descriptors are used to assess and correlate the various effects of noise, including land-use compatibility, sleep and speech interference, annoyance, hearing loss, and startle effects:

- A-weighted sound levels (dBA) - typically used to account for the response of the human ear
- C-weighted scale (dBC) - generally used to measure impulsive noise such as air blasts from explosions, sonic booms, and gunfire
- day-night average sound level (DNL) - used to evaluate the total community noise environment. The DNL is the average A-weighted sound level during a 24-hour period with 10 dB added to nighttime levels (between 10 p.m. and 7 a.m) to account for the increased human sensitivity to night-time noise events.

The discussions in this section relate to noise and related impacts that may be heard offsite. The impacts from noise to workers is addressed in Section 4.3.10.

4.3.16.1 Regulations

The EPA was given the jurisdiction in the Noise Control Act of 1972 (42 USC 4901 et seq.) to promulgate and enforce the regulations that were issued under the Act. Funding for EPA to perform this function was eliminated in early 1981. However, Congress did not repeal the Noise Control Act. The DNL was endorsed by the EPA and is mandated by the U.S. Department of Housing and Urban Development (HUD), the Federal Aviation Administration (FAA), and the Department of Defense (DoD) for land-use assessments. The EPA has determined that no significant effects on public health and welfare occur for the most sensitive portion of the population (within an adequate margin of safety) if the prevailing DNL is less than 55 dB (NAS 1977). The FAA bases its noise guidelines on land use. For residential uses, sound levels up to 65 dB are acceptable. Certain residential areas with sound-blocking features can handle up to 75 dB. For livestock farming and breeding, compatibility is considered to exist up to 75 dBA. These guidelines are advisory in nature and are not mandatory (14 CFR Part 150).

The Federal Housing Administration (FHA), under HUD, established noise assessment guidelines under 24 CFR 51B (1979; amended April 25, 1996). The FHA/HUD site acceptability levels are summarized as follows:

- Acceptable (DNL is 65 dBA or less) - Typical building materials and construction will make any impacts to indoor noise minimal. Outdoor recreation and activities would not be impacted. No approval requirements or abatement measures are needed under this condition.

- Normally unacceptable (DNL is 65 to 75 dBA) - Noise exposure will impact outdoor use of the area and indoor use may be affected. Walls or other barriers may be needed to reduce outdoor noise levels. Indoor noise levels may need to be reduced using special construction methods.

- Unacceptable (DNL above 75 dBA) - The noise conditions in this situation are unacceptable and activities need to be approved on a case-by-case basis.

Local and State regulations may also exist regarding noise restrictions and abatement decisions. Many States prohibit only nuisance noise and have not established specific numerical environmental noise standards, while others have very specific requirements. For example, the State of Maine has sound-level limitations for construction that are a function of time of day, area characteristics, and duration of the noise.

4.3.16.2 Potential Impacts from Noise of Decommissioning Activities

Table E-3 in Appendix E indicates that structure dismantlement is an activity that may have noise impacts. During the decommissioning process, the sounds that might be heard at offsite locations include noise from construction, vehicles, grinders, saws, pneumatic drills, compressors, and loudspeakers. Noise levels from these sources have to be compared to current noise levels of the operating facility and background noise present at the site to determine potential impacts. Table 4-5 lists predicted noise ranges for significant sources of noise during decommissioning.

Noise level increases larger than 10 dBA to the DNL at the site boundary during the day might be expected to lead to interference with outdoor speech communication, particularly in rural areas or low-population areas where the day-night background noise level is in the range of 45 to 55 dBA.

The noise impacts of decommissioning activities are considered detectable if sound levels are sufficiently high to disrupt normal human activities on a regular basis. The noise impacts of decommissioning activities are considered destabilizing if sound levels are sufficiently high that the affected area is essentially unsuitable for normal human activities, or if the behavior or breeding of a threatened or endangered species is affected.

Table 4-5. Predicted Noise Ranges from Significant Decontamination and Dismantlement Sources (INEEL 1999)

Source	Source Strength dBA	Reference Distance, m	Predicted Noise Level Ranges (dBA) at Various Distances from the Reference Distance			
			150 m (500 ft)	300 m (1000 ft)	0.8 km (0.5 mi)	1.6 km (1 mi)
Construction Equipment	85-90	15[a]	65-75	59-69	51-61	45-55
Truck	85-90	15	65-75	59-69	51-61	45-55
Rail Engine	86-96	30[b]	76-86	71-81	64-74	58-68
Rail Car, 64 km/h (40 mph)	80-86	30	68-74	62-68	53-59	48-54

(a) 15 m ≈ 50 ft.
(b) 30 m ≈ 100 ft.

4.3.16.3 Evaluation

When noise levels are below those that result in hearing loss, impacts are judged primarily in terms of adverse public reactions to the noise. Generally, surveys around major sources of noise such as large highways and airports find that, when the DNL increases above 60 to 65 dBA, noise complaints increase significantly (FICN 1992). FHA/HUD uses a DNL of 65 dBA as the primary criterion for impact on residential properties and nearby populations. The staff believes that noise levels below 60 to 65 dBA are considered to be insignificant. Business and institutional properties may be less sensitive to changes in noise levels, but all populations of concern should be considered when estimating the noise impact of decommissioning activities.

Typically, operating reactor facilities do not result in offsite sound levels greater than 10 dBA above background. However, at some sites, sound levels at and above this level have been calculated at critical receptor locations. The principal sources of noise from facility operations are natural-draft and mechanical-draft cooling towers, transformers, and loudspeakers. Other occasional noise sources may include auxiliary equipment, such as pumps to supply cooling water from a remote reservoir. Generally, noise from these sources is not heard by a large number of people offsite. Of these sources, only loudspeakers would be anticipated to continue during the decommissioning period. The staff assumes that decommissioning activities will be scheduled to minimize high noise levels during the night and during critical periods for important animal species.

In most cases, during decommissioning the sources of noise would be sufficiently distant from critical receptors outside the plant boundaries that the noise would be attenuated to nearly ambient levels and would be scarcely noticeable, as in the case for operating plants. However, in some cases, such as the use of equipment to demolish concrete, the noise levels offsite could be sufficiently loud (60 to 65 dBA at the nearest receptor site) that activities may need to be curtailed during early morning and evening hours. It is highly unlikely, based on past decommissioning experience, that the offsite noise level from a plant during decommissioning would be sufficient to cause hearing loss. However, in one case, noises at a facility being decommissioned have been reported at levels of up to 107 dB (dropping to 50 dB less than 1.6 km [1 mi] away) as a result of the spent fuel pool cooling system. Nearby residents complained to the plant staff about these noise levels; engineering changes were made in the fans that were causing the noise and the issue was resolved.

The timing of the noise impacts and the duration or intensity will vary depending on the decommissioning option and the procedures that are used. More noise will occur during active dismantlement than during the storage period of SAFSTOR. Some demolition activities could increase noise levels temporarily. In addition to mitigation of noise levels based on engineering design, noise abatement procedures can be considered in decommissioning plans to reduce noise, particularly at night.

No differences are expected between the noise levels of future decommissioning activities at operating plants and the noise levels observed at facilities undergoing decommissioning. It is anticipated that most decommissioning activities will not represent an audible intrusion on the community for any type of nuclear power facility (BWR, PWR, HGTR, or FBR).

4.3.16.4 Conclusions

The staff has considered available information, including comments received on the draft of Supplement 1 of NUREG-0586, on the potential noise impacts of decommissioning activities. This information indicates that the noise impacts are not detectable or destabilizing. Therefore, the staff makes a generic conclusion that for all facilities, the potential noise impacts are SMALL. The staff has considered mitigation measures and concludes that no additional mitigation measures are likely to be sufficiently beneficial to be warranted.

4.3.17 Transportation

In considering activities for decommissioning, transportation can be considered both an activity and an issue. Transportation of equipment, material, and waste is an activity that is performed throughout the entire decommissioning process. However, it is treated as an issue in this Supplement and is given its own section.

This section addresses impacts related to transporting equipment and materials (radiological and nonradiological) offsite. Materials transported to offsite disposal facilities include nonhazardous waste, LLW, hazardous waste, and mixed waste. As discussed in Chapter 1, the shipment of spent nuclear fuel is not within the scope of this Supplement. Radiological impacts include exposure of transport workers and the general public along transportation routes. Nonradiological impacts include additional traffic volume, additional wear and tear on roadways, and potential traffic accidents.

4.3.17.1 Regulations

Regulations that apply to the transportation of hazardous, mixed waste, and radioactive material promulgated by the U.S. Department of Transportation (DOT) are contained in 49 CFR Parts 171-177. NRC regulations related to transportation of LLW are contained in 10 CFR Part 71, "Packaging and transportation of radioactive material." These regulations contain requirements for transport vehicles, maximum radiation levels for packages and vehicles, special packaging requirements, driver training, vehicle and packaging inspections, marking and labeling of packages, placarding of vehicles, and training of emergency personnel to respond to mishaps. Highway routing restrictions for certain shipments of LLW are also included in DOT regulations. NRC regulations contain performance requirements for certain

types of transportation packages of radioactive material. In addition, Federal and State regulations govern the size and weights of trucks. The staff assumes that equipment, materials, and waste transportation are conducted within applicable regulations.

4.3.17.2 Potential Decommissioning Impacts from Transportation

Table E-3 in Appendix E indicates that transportation-related activities may impact the transportation infrastructure and public health and safety. The types of transportation impacts for decommissioning nuclear power facilities and operating plants are similar. The factors that determine the magnitude of transportation impacts of decommissioning include:

- changes in waste production due to decontamination and dismantlement activities that increase the amount of waste shipped offsite
- changes in the transportation methods (rail, truck, or barge) related either to the increased amount to be shipped offsite or to the type of material to be shipped.
- changes in the mix of types of waste categories shipped offsite.

The public health impacts result from exposures of transport workers and the general public along transportation routes during normal shipments and from material released as a result of transportation accidents, as well as from transportation accidents that do not involve the release of radioactive material. The radiological impacts to public health and safety are considered detectable if the dose rates from shipping containers exceed regulatory limits. They are considered destabilizing if material is shipped in unapproved containers. The nonradiological impacts of transportation of radioactive waste are considered detectable or destabilizing if the vehicles are maintained or driven in a manner that would result in a significantly greater accident rate than experienced by the trucking industry.

The nonradiological, infrastructure impacts are increases in traffic density, wear and tear on roadways and railways, and transportation accidents. The impacts of decommissioning activities on the transportation infrastructure are considered detectable if the increased traffic causes a decrease in level of service or measurable deterioration of affected roads that can be directly tied to activities at the plant. The impacts of decommissioning activities are considered destabilizing if the level of service becomes unacceptable or roads become unusable because of activities at the plant.

4.3.17.3 Evaluation

The transportation impacts are dependent on the number of shipments to and from the facility, the type of shipments, the distance that material is shipped, and the nonradiological waste/fixed waste quantities and disposal plans. The distance that the waste travels depends on the plant's proximity to a disposal site. One decommissioning facility, located in Oregon, ships LLW 480

km (300 mi) to the U.S. Ecology burial site on the Hanford Reservation in Richland, Washington. Another decommissioning facility located in California ships LLW 4300 km (2700 mi) to the Barnwell facility in South Carolina.

The number of shipments and volume of waste shipped during the decontamination and dismantlement phases of decommissioning are greater than during operations. Information on shipments, which was received from nine plants, is shown in Appendix K. Because data on the waste volume of shipments were received from only seven plants, estimates of waste volume and shipment numbers in several cases (as footnoted in the table) reflect only a single facility and may be significantly higher or lower than for the average facility in that grouping. The impacts from FBRs and HTGRs would be encompassed by those for the PWRs and BWRs since the distance shipped is less and the plant sizes are generally smaller.

Nonradioactive material from the site for general disposal will likely be shipped to landfills. However, because licensees cannot release material with detectable amounts of radioactive material, a number of sites may ship much of their solid waste to vendors specializing in the management of LLW or to LLW sites such as that at Clive, Utah.

A generic analysis was conducted to estimate human health impacts associated with transporting decontamination and dismantlement wastes from reactor sites to LLW burial grounds. The RADTRAN 4 computer code (Neushauser and Kanipe 1992), which is commonly used for transportation impact calculations in support of environmental documentation, was used for the analysis. RADTRAN 5 (Neushauser and Kanipe 1996) is the latest version of the code, originally developed by Sandia National Laboratories to support the NUREG-0170 environmental impact analysis (NRC 1977). It uses the same basic methods for calculating impacts but does the calculations in a probabilistic framework.

Based on information from Trojan and Maine Yankee, LLW was categorized as one of three types--high activity, low activity, and very low activity--and a typical volume and activity were estimated for each type of LLW. The impacts of transporting each type of LLW were estimated. There are likely to be additional nonradiological impacts on public health and safety from transportation accidents associated with transportation of uncontaminated material.

Radiological impacts: For this Supplement, the public health and safety impacts of transportation of radioactive waste are evaluated on the basis of compliance with applicable regulations. The Commission has taken the position (46 FR 21619) that its "...regulations are adequate to protect the public against unreasonable risk from the transportation of radioactive materials." This evaluation was based, in part, on the findings of NUREG-0170 (NRC 1977). A recent re-evaluation of transportation risks, using updated information and assessment tools (Sprung et al. 2000), found that risks are lower than estimated in NUREG-0170. Licensees are expected to comply with all applicable regulations when shipping radioactive waste from decommissioning. Therefore, the effects of transportation of radioactive waste on public health and safety are considered to be neither detectable nor destabilizing.

Nevertheless, the staff performed an evaluation of the likely magnitude of these impacts using available data. Radiological impacts are divided into those for "routine" or incident-free shipments (i.e., the shipment reaches its destination without incident) and those for shipments that involve an accident with a subsequent radiological release. In each case, the impact is expressed in cumulative dose for the transport workers and public. The results of the calculations are shown in Table 4-6. The details of the assumptions made in the analysis are discussed in Appendix K. In order to bound the impacts, a distance of 4800 km (3000 mi) was selected. Dose rates for incident-free shipment of high-activity LLW were assumed to be at the regulatory limits, and dose rates for incident-free shipment of low-activity LLW were assumed to be at one-tenth of regulatory limits. Radiological impacts of shipment of very low-level activity LLW were assumed to be negligible compared to shipments of high-level and low-level activity LLW. However, shipment of very low-level activity waste was considered in evaluating nonradiological transportation of LLW. With these assumptions and the additional assumptions listed in Appendix K, the results of the analysis should bound the transportation impacts for all decommissioning options for PWRs and BWRs.

Ramsdell et al. (2001) indicate that shipment of spent fuel by rail reduces the radiological impacts significantly (more than a factor of 10 for shipments from the northeast to Nevada). Similar reductions would be expected in the radiological impacts of the shipment of LLW from decommissioning if shipments were made by rail rather than by truck. Barge shipments of the high-activity waste could reduce the radiological impacts even further.

Nonradiological impacts: Nonradiological impacts of transportation of LLW include increased traffic and wear and tear on roadways. Decommissioning experience has been that the number of LLW shipments from a site averages much less than 1 per day. This number of shipments per day is not nearly large enough to have a detectable or destabilizing effect on traffic flow or road wear.

Nonradiological impacts of transportation accidents are typically expressed in terms of fatalities. RADTRAN estimates fatalities caused by traffic accidents using the distance traveled and average fatality rates per unit distance. Traffic accidents are not related to radioactivity; therefore, the impacts of transportation accidents should be based on the round-trip distance between the decommissioning site and the waste facility. For consistency, a 9600-km (6000-mi) round-trip distance is assumed for the fatality estimates shown in Table 4-6. Again, these numbers reflect the entire decommissioning period. The fatality estimates would be the same for shipments of any other commodity.

The following values may provide some perspective for evaluating the values in Table 4-6. A recent publication (Saricks and Tompkins 1999) gives average accident rates on interstate highways. The average accident rates for trucks are 3.15×10^{-7}, 3.66×10^{-7} and 6.54×10^{-7} per kilometer (5.07×10^{-7}, 5.89×10^{-7}, and 1.05×10^{-6} per mile) for highways in rural, suburban, and urban areas, respectively. The national average fatality rate for trucks is 5.5×10^{-9} fatalities per

Table 4-6. Impacts of Transportation of LLW from Decommissioning

	High-Activity Waste	Low-Activity Waste	Very Low-Activity Waste	Total
Number of Shipments during Decommissioning	227	84	360	671[a]
Incident-Free Transportation Impacts -- Cumulative Dose, person-Sv (person-rem)				
Crew	0.496 (49 6)	0.184 (18.4)	--	0.680 (68 0)
Public along route	0.129 (12 9)	0 020 (2 00)	--	0.149 (14 9)
Onlookers	0.123 (12 3)	0 019 (1.90)	--	0.142 (14.2)
Total	0.748 (74.8)	0 223 (22.3)	--	0 971 (97.1)
Incident-Free Transportation Impacts -- Latent Cancer Fatalities (LCF)				
Crew[b]	0 0198	0.00736	--	0.0272
Public along route[c]	0 0065	0 00100	--	0 00744
Onlookers[c]	0 0062	0 00096	--	0.00711
Total	0.0324	0 00931	--	0.0417
Accident Impacts				
Cumulative Dose, person-Sv (person-rem)	5.39×10^{-5} (5.39×10^{-3})	1.28×10^{-4} (1.28×10^{-2})	--	1.82×10^{-4} (1.82×10^{-2})
Nonradiological Fatalities	0 0120[d]	0 00465[d]	0.019[d]	0.0356[d,e]
Total				
Cumulative Dose, person-Sv (person-rem)	0.748 (74.8)	0 223 (22.3)	--	0 971 (97.1)
Fatalities	0 0419	0.0136	0 0190	0 0745[e]

(a) The total number of shipments during decommissioning may be significantly increased if State or local government agencies require removal of all structures and concrete from the site. However, the additional shipments would be uncontaminated material.
(b) Assuming 4.0×10^{-2} LCF/person-Sv (4.0×10^{-4} LCF/person-rem) for crew.
(c) Assuming 5.0×10^{-2} LCF/person-Sv (5.0×10^{-4} LCF/person-rem) for general public.
(d) Based on fatal accident rate of 5.5×10^{-9} per km (8.8×10^{-9} per mi).
(e) The number of fatalities will increase if there are additional shipments of uncontaminated material in proportion to the number of miles driven.

kilometer (8.8×10^{-9} fatalities per mile). Historically, the accident rate for activities at nuclear facilities has been lower than the national average for similar activities because of the industry emphasis on training and adherence to established procedures.

It is not likely that the actual nonradiological impacts of transportation accidents would be as high as indicated or that they would be either detectable or destabilizing.

The number of shipments into the decommissioning facility would be much smaller than the number of shipments from the facility. The concrete used to entomb a plant would be manufactured at a batch plant onsite, or the licensee would use local sources for the materials needed for entombing a facility. Shipments of materials into the facility during decommissioning or following the preparation for entombment of the facility would be minimal. It is anticipated that many of the shipments to the facility undergoing decommissioning, including shipments of equipment and heavy machinery, would come from local sources and, thus, the distance traveled would be minimal. Therefore, the staff concludes that transporting the materials to the site would not significantly impact the overall traffic volume or compromise the safety of the public.

Previous or anticipated decommissioning activities at the FBR or HTGR have not and are not expected to result in impacts on transportation that are different from those found at other nuclear facilities.

4.3.17.4 Conclusions

The staff has considered available information, including comments received on the draft of Supplement 1 of NUREG-0586, on the potential transportation impacts of decommissioning activities. This information indicates that the transportation impacts are not detectable or destabilizing. Therefore, the staff makes a generic conclusion that for all plants, the potential transportation impacts are SMALL. The staff has considered mitigation measures and concludes that no additional mitigation measures are likely to be sufficiently beneficial to be warranted.

4.3.18 Irreversible and Irretrievable Commitment of Resources

Irreversible commitments are commitments of resources that cannot be recovered, and irretrievable commitments of resources are those that are lost only for a period of time. The irreversible and irretrievable commitments of resources that are anticipated during the decommissioning process are similar to those that were considered in the FESs for facility construction permits and operating licenses. The FESs for plant operation cite uranium as the principal natural resource irretrievably consumed in facility operation. However, following permanent cessation of operations, uranium is no longer consumed. As discussed in Chapter 1, disposal of uranium as part of spent nuclear fuel is not within the scope of this Supplement. Other resources considered in some FESs include land, water, human resources, cultural, and threatened and endangered species.

4.3.18.1 Regulations

CEQ regulations at 40 CFR 1502.13 and NRC regulations at 10 CFR 51, Appendix A to Subpart A, state that an environmental impact statement include a discussion of any irreversible or irretrievable commitments of resources. In addition, there are regulations that deal with the use of land (addressed in Section 4.3.1, "Onsite/Offsite Land Use"), water use and quality (Sections 4.3.2 and 4.3.3), and air quality (Section 4.3.4). Disposal of uranium is not within the

scope of this document. Land devoted to LLW disposal sites or in industrial landfills is also not within the scope of this document and is addressed in the licensing documents for the disposal site.

4.3.18.2 Potential Impacts of Decommissioning Activities on Irretrievable Resources

Table E-3 in Appendix E indicates that decommissioning activities with the potential to impact irreversible and irretrievable commitment of resources include structural dismantlement; LLW packaging, storage, and disposal; and transportation.

An irreversible commitment of resources is defined as a loss that is detectable and destabilizing, such as when a species becomes extinct, or, in the case of mining, when ore is removed. Irretrievable commitments can be considered as a tradeoff. If a transportation corridor is constructed, the land uses are not available for as long as the corridor remains. The destabilizing impacts are those that adversely impact the resources discussed in this Supplement (Sections 4.3.1 through 4.3.17).

4.3.18.3 Evaluation

Although most FESs addressed primarily uranium fuel, other resources were discussed in some of the FESs. This included land used for plant buildings, components such as large underground concrete foundations, and certain other equipment considered irretrievable due to practical aspects of reclamation and/or radioactive decontamination. The use of the environment (air, water, and land) by the facilities was not deemed to represent significant irreversible or irretrievable resource commitments but rather a relatively short-term investment.

Whether land is considered to be an irretrievable resource depends largely on the decisions at the time of license termination. If the license is terminated for unrestricted use, then the land will be available for other uses, whether or not the decommissioning process returned the land to a "Greenfield" site or to an industrial complex. If ENTOMB1 is selected, license termination could still allow unrestricted access after 30 to 60 years. However, if the ENTOMB2 option is selected, the land under the facility will not be available for alternative uses and would be considered irretrievable.

The only other irretrievable resources that would occur during the decommissioning process would be materials used to decontaminate the facility (e.g., rags, solvents, gases, and tools), and fuel used for construction machinery and for transportation of materials to and from the site. However, these resources are minor.

Although the use of land, water, air, and fuel oil during decommissioning is minimal or nonexistent, the disposal of radioactive waste and nonradioactive waste would be considerable for some options, such as DECON to a "Greenfield" (nonindustrial) site. Even though the disposal of radioactive waste is outside the scope of this document, the volume of land required for radioactive waste disposal is estimated in Table 4-7 for the SAFSTOR and DECON options, based on data obtained from six plants. The quantities of waste shown in Table 4-7 for the two

ENTOMB options were estimated based on the scenarios described in Chapter 3. The greatest estimated volume of radwaste is from a facility that is being decommissioned to "Greenfield" (no structures remaining onsite). It is located in a State that does not allow disposal of the industrial waste within an in-state industrial waste site.

Table 4-7. Volumes of Land Required for LLW Disposal[a]

Decommissioning Option	Reactor Type	Volume of Land Required for LLW Disposal, m^3 (ft^3)	Plant Size (Electrical Capacity, MWe)
DECON	PWR	8000 - 10,000 (282,500 - 353,000)	1130 to 1825
	BWR	2000 (71,000)	240
SAFSTOR	PWR	600 - 45,000 (21,000 -1.5 million)	23 to 1437
	BWR	18,000 (636,000)	660
ENTOMB1	Either	<5000 (<177,000)	Variable
ENTOMB2	Either	<500 (<17,700)	Variable

(a) Data were available from a limited number of facilities and based on actual estimates provided by the licensees.

4.3.18.4 Conclusions

The staff has considered available information on the potential impacts of decommissioning on irreversible and irretrievable commitments of resources, including comments received on the draft of Supplement 1 of NUREG-0586. This information indicates that the impacts of decommissioning on irreversible and irretrievable commitments are neither detectable nor destabilizing. Therefore, the staff makes the generic conclusion that the impacts on irreversible and irretrievable commitments are SMALL. The staff has considered mitigation and concludes that no additional measures are likely to be sufficiently beneficial to be warranted.

4.4 References

10 CFR 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, "Standards for protection against radiation."

10 CFR 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic licensing of production and utilization facilities."

10 CFR 51. Code of Federal Regulations. Title 10, Energy, Part 51, "Environmental protection regulations for domestic licensing and related regulatory functions."

10 CFR 71. Code of Federal Regulations, Title 10, *Energy*, Part 71, "Packaging and

transportation of radioactive material."

10 CFR 100. Code of Federal Regulations, Title 10, *Energy*, Part 100, "Reactor site criteria."

14 CFR 150. Code of Federal Regulations, Title 14, *Aeronautic and Space*, Part 150, "Airport noise compatibility planning."

24 CFR 51B. Code of Federal Regulations, Title 24, *Housing and Urban Development*, Part 51B, "Environmental criteria and standards."

29 CFR 1902. Code of Federal Regulations, Title 29, *Labor*, Part 1902, "State plans for the development and enforcement of State standards."

29 CFR 1910. Code of Federal Regulations, Title 29, *Labor*, Part 1910, "Occupational safety and health standards."

29 CFR 1926. Code of Federal Regulations, Title 29, *Labor*, Part 1926, "Safety and health regulations for construction."

29 CFR 1952. Code of Federal Regulations, Title 29, *Labor*, Part 1952, "Approved State plans for enforcement of State standards."

36 CFR 800. Code of Federal Regulations, Title 36, *Parks, Forests, and Public Property*, Part 800, "Protection of historic properties."

40 CFR 50. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 50, "National primary and secondary ambient air quality standards."

40 CFR 51. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 51, "Requirements for preparation, adoption, and submittal of implementation plans."

40 CFR 61. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 61, "National emission standards for hazardous air pollutants; regulation of radionuclides."

40 CFR 81. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 81, "Designation of areas for air quality planning purposes."

40 CFR 82. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 82, "Protection of stratospheric ozone."

40 CFR 190. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 190, "Environmental radiation protection standards for nuclear power operations."

40 CFR 1502. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 1502, "Environmental Impact Statement."

40 CFR 1508. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 1508, "Terminology and index."

49 CFR 171 - 177. Code of Federal Regulations, Title 49, *Transportation*, Parts 171-177, "General information, regulations, and definitions"; "Hazardous materials table, special provisions, hazardous materials, communications, emergency response information, and training requirements"; "Shippers--general requirements for shipments and packagings"; "Carriage by rail"; "Carriage by aircraft"; "Carriage by vessel"; "Carriage by public highway."

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5.0 No-Action Decommissioning Alternative

The action discussed in this Supplement and in the *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities* (1988 GEIS; NRC 1988) is decommissioning. The only alternative to the action of decommissioning is not to decommission the facility. The option to restart the reactor is not considered to be an alternative to decommissioning because the regulations do not allow the licensee to reload fuel and restart the facility after submitting a certification that the fuel has been removed from the reactor vessel.

The alternative to decommissioning at the end of the licensing period is a "no action" alternative, implying that a licensee would simply abandon or leave a facility after ceasing operations. Once the facility permanently ceases operation, if the licensee does not conduct decommissioning activities to an extent that meets the license termination criteria in 10 CFR 20 Subpart E, then the license will not be terminated (although the licensee will not be authorized to operate the reactor). The licensee will be required to comply with the necessary requirements for the operating license. As a result, the environmental impacts for maintaining the nuclear reactor facility will be considered to be in the bounds of the appropriate, previously issued Environmental Impact Statements.

The objective of decommissioning is to restore a radiologically contaminated facility to a condition such that there is no unreasonable risk from the decommissioned facility to the public health and safety. The U.S. Nuclear Regulatory Commission (NRC) regulations do not allow the option of not decommissioning. Under NRC regulations, the original operating license for a nuclear power plant is issued for up to 40 years. The license may be renewed for additional 20-year periods if NRC requirements are met. However, at the end of the term of the license (whether it has been extended or not), the regulations require that the facility be decommissioned.

5.1 Reference

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6.0 Summary of Findings and Conclusions

6.1 Summary of Findings

This chapter summarizes the findings and conclusions from the evaluation of environmental impacts related to decommissioning of permanently shutdown commercial nuclear power reactors. Table 6-1 presents each environmental issue that was evaluated and identifies whether the issue is considered generic or site-specific. Of the environmental issues assessed (see Table 6-1), most of the impacts are generic and SMALL for all plants regardless of the decommissioning activity and identified variables (see Appendix E for a list of the variables).

Two issues were identified that require a site-specific analysis: threatened and endangered species and environmental justice.

In accordance with the Endangered Species Act of 1973 (16 USC 1531 et seq.), the appropriate Federal agency (either the U.S. Fish and Wildlife Service or the National Marine Fisheries Service) must be consulted about the presence of threatened or endangered species. Informal consultation will be initiated by the U.S. Nuclear Regulatory Commission (NRC) staff with the appropriate service after the licensee announces permanent cessation of operations. It is expected that any formal or informal consultation will be completed prior to the licensee beginning major decommissioning activities, which can occur 90 days after the submission of the post-shutdown decommissioning activities report (PSDAR). At that time, it will be determined whether such species could be affected by decommissioning activities and whether formal consultation will be required to address the impacts. Each State should also be consulted about its own procedure for considering impacts to State-listed species.

Executive Order 12898 (59 FR 7629), dated February 16, 1994, directs Federal executive agencies to consider environmental justice under the National Environmental Policy Act of 1969 (NEPA). Although the NRC is an independent agency, the Commission has committed to undertake environmental justice reviews. Subsequent to the submittal of the PSDAR, the NRC staff will consider the impacts related to environmental justice from decommissioning activities.

Four issues were determined to be, depending on the circumstances, either generic or site-specific: land use, aquatic ecology, terrestrial ecology, and cultural and historic resources. Impacts resulting from onsite land use, impacts to aquatic and terrestrial resources resulting from activities occurring within the facility's operational areas, and impacts to cultural or historic resources resulting from activities within the facility operational area were determined to be generic and SMALL.

Table 6-1. Summary of the Environmental Impacts from Decommissioning Nuclear Power Facilities

Issue	Generic	Impact
Onsite/Offsite Land Use		
- Onsite land use activities	Yes	SMALL
- Offsite land use activities	No	Site-specific
Water Use	Yes	SMALL
Water Quality		
- Surface water	Yes	SMALL
- Groundwater	Yes	SMALL
Air Quality	Yes	SMALL
Aquatic Ecology		
- Activities within the operational area	Yes	SMALL
- Activities beyond the operational area	No	Site-specific
Terrestrial Ecology		
- Activities within the operational area	Yes	SMALL
- Activities beyond the operational area	No	Site-specific
Threatened and Endangered Species	No	Site-specific
Radiological		
- Activities resulting in occupational dose to workers	Yes	SMALL
- Activities resulting in dose to the public	Yes	SMALL
Radiological Accidents	Yes	SMALL
Occupational Issues	Yes	SMALL
Cost	NA[a]	NA
Socioeconomic	Yes	SMALL
Environmental Justice	No	Site-specific
Cultural and Historic Resource Impacts		
- Activities within the operational areas	Yes	SMALL
- Activities beyond the operational areas	No	Site-specific
Aesthetics	Yes	SMALL
Noise	Yes	SMALL
Transportation	Yes	SMALL
Irretrievable Resources	Yes	SMALL

(a) A decommissioning cost assessment is not a specific National Environmental Policy Act (NEPA) requirement. However, an accurate decommissioning cost estimate is necessary for a safe and timely plant decommissioning. Therefore, this Supplement includes a decommissioning cost evaluation, but the cost is not evaluated using the environmental significance levels nor identified as a generic or site-specific issue.

Impacts resulting from offsite land use to support decommissioning activities, impacts to aquatic and terrestrial resources resulting from activities occurring outside the facility's operational areas, and impacts to cultural, historic or archeological resources resulting from activities beyond the operational areas cannot be evaluated generically and would require a site-specific analysis before undertaking the activity. These are termed conditionally site-specific.

Before a licensee conducts any decommissioning activity that might result in the disturbance of historic properties or archeological resources outside the site operational area, the NRC will, in accordance with the National Historic Preservation Act of 1966, as amended (16 USC 470 et seq.), consult with the appropriate State (or Tribal) Historic Preservation Officer to evaluate potential impacts.

The issue of cost was addressed in this Supplement but was not evaluated.

The staff also determined that the issue of long-term radiological aspects of Rubblization or onsite disposal of slightly contaminated material could not be evaluated generically and would require a site-specific analysis. The site-specific analysis would be conducted at the time the license termination plan (LTP) for the site is submitted.

For the 19 reactors listed in Table F-1 that have permanently ceased operation during the period 1963 through 1997, the staff has determined that no issue or activity must be re-evaluated immediately, provided that the licensee does not change the decommissioning option previously chosen. The NRC staff conducted a detailed environmental review on a number of these facilities prior to 1996 as part of the decommissioning plan review. Licensees for several of these reactors have submitted LTPs for NRC review and approval, and the staff has evaluated or is evaluating site-specific environmental impacts as part of that review. Therefore, for many of the 19 facilities, a site-specific assessment has been performed. Because decommissioning is substantially underway at all 19 reactors, the impacts for the issue of environmental justice have already occurred and an evaluation at the present time would provide little value and opportunity for mitigation. Impacts on threatened and endangered species are considered on an ongoing basis and the issuance of this Supplement would not accelerate a review of the issue solely because the issue is one that cannot be evaluated generically. The staff will continue to conduct site-specific consultations with the appropriate resource agency, as the need arises.

Therefore, the NRC has determined that it is not necessary at this time to conduct an evaluation of the environmental justice or impacts on threatened and endangered species at the 19 permanently shutdown reactors listed in Table F-1. However, should a licensee choose a different decommissioning option from its current choice (e.g., SAFSTOR rather than DECON),

then the site-specific issues would need to be considered prior to undertaking a decommissioning activity not previously evaluated.

For the 19 facilities listed in Table F-1 that have initiated decommissioning, as well as for any facilities that permanently cease operation in the future, any planned decommissioning activity would require a site-specific analysis prior to undertaking the proposed activity (see Section 1.5) if the activity:

- results in an impact outside the range of impacts postulated by this Supplement or
- raises environmental issues that were not considered in this Supplement or
- involves an issue determined to be site specific or conditionally site-specific as described above in this Supplement or
- involves a combination of the above.

6.2 Conclusions

A licensee undergoing or planning decommissioning of a nuclear reactor facility may use this Supplement in its evaluation of the environmental consequences from decommissioning activities. The impacts identified in this Supplement are designed to span the range of impacts for all commercial power reactor facilities that have permanently shut down as well as for the reactor facilities that are currently operating, including the facilities that have, or may, renew their operating license beyond the original 40-year license.

For those issues that have been determined to be generic, licensees may proceed with the decommissioning activity without further analysis provided that the impacts resulting from those activities fall within the range of impacts as described in Chapter 4. However, if the impacts of an activity fall outside the range predicted in Chapter 4, or if the activity results in impacts to environmental issues not considered in this Supplement, or if the impact involves an environmental issue determined to be conditionally site-specific as defined above, then the activity cannot be performed until a further site-specific analysis is completed along with a license-amendment request and NRC has approved the license amendment (the license-amendment request will provide an opportunity for a public hearing).

6.3 References

Endangered Species Act of 1973, as amended, 16 USC 1531 et seq.

Executive Order 12898. 1994. "Environmental Effects of Federal Programs on Minority and Low-Income Populations." 59 FR 7629, February 16, 1994.

National Environmental Policy Act (NEPA) of 1969, as amended, 42 USC 4321 et seq.

National Historic Preservation of 1966, as amended, 16 USC 470 et seq.

Appendix A

Appendixes A and B have been moved and redesignated as Appendixes N and O. All comments and responses, whether written or oral, are now contained in Appendixes N, O, and P, which comprise Volume 2 of this Supplement.

Appendix B

Appendixes A and B have been moved and redesignated as Appendixes N and O. All comments and responses, whether written or oral, are now contained in Appendixes N, O, and P, which comprise Volume 2 of this Supplement.

Appendix C

Contributors

Appendix C

Contributors

The overall responsibility for the preparation of this Supplement to the Generic Environmental Impact Statement (GEIS) on Decommissioning was assigned to the Office of Nuclear Reactor Regulation (NRR), U.S. Nuclear Regulatory Commission (NRC). This Supplement was prepared by members of the NRR with assistance from other NRC organizations and the Pacific Northwest National Laboratory.

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Appendix D

Further Discussion of Out-of-Scope Activities

Appendix D

Further Discussion of Out-of-Scope Activities

Various activities that are performed during decommissioning may seem intuitively to be part of the decommissioning process. However, they are not considered within the scope of this Supplement because these activities have already received an environmental review during the promulgation of the U.S. Nuclear Regulatory Commission (NRC) regulations governing such activities. They are reviewed and regulated by the NRC under other regulations. These activities include the following:

- Independent Spent Fuel Storage Installation (ISFSI): construction/maintenance/decommissioning: An ISFSI is a facility designed and constructed for the interim storage of spent nuclear fuel and other radioactive materials associated with spent fuel storage. The ISFSI may be located at the same site as the nuclear power facility or at another location. ISFSIs are used by operating plants that require increased spent fuel storage capacity because their spent fuel pools have reached their capacity and the U.S. Department of Energy (DOE) facility for disposing of spent fuel and high-level nuclear waste is not yet available. Decommissioning facilities may use ISFSIs as an alternative to leaving the fuel in the spent fuel pool while waiting for DOE to take ownership of the spent fuel. Licensees that remove the spent fuel from their pools and place it in an ISFSI can then complete the decommissioning process on the power-generation facilities and subsequently terminate the facility license. In some instances, the license for the nuclear power reactor can be terminated while the ISFSI, which has a separate license and is located on the facility site, would continue to be regulated by the NRC.

  An ISFSI can be operated either under the same license that is used for the operating or decommissioning facility (called a "Part 50 license," referring to 10 CFR Part 50), or under a site-specific license (called a "Part 72 license," referring to 10 CFR Part 72). Regulations for the licensing and operation of an ISFSI, including quality assurance and quality control requirements, are found in 10 CFR Part 72. If a licensee chose to operate the ISFSI under a Part 50 license, they could, by way of a license-amendment request, change the ISFSI to a Part 72 license, thus allowing termination of the Part 50 license at the end of the reactor facility decommissioning process.

The decommissioning of the ISFSI is also handled separately from the decommissioning of the nuclear power facility. The 1988 Generic Environmental Impact Statement (GEIS) (NRC 1988) contained a section on decommissioning of ISFSIs, which is not updated in this Supplement.

- Spent fuel storage and maintenance: The Commission has independently, in a separate proceeding, the "Waste Confidence Proceeding," made a finding that there is:

  > reasonable assurance that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation (which may include the term of a revised license) of that reactor at its spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations. (54 FR 39767)

  The Commission has committed to review this finding at least every 10 years. In its most recent review, the Commission concluded that experience and developments since 1990 were not such that a comprehensive review of the Waste Confidence Decision was necessary at that time (64 FR 68005). Accordingly, the Commission reaffirmed its finding of insignificant environmental impacts cited above. This finding is codified in the Commission's regulations at 10 CFR 51.23(a). The operation of a spent fuel pool or an ISFSI is not uniquely linked to decommissioning. All operating nuclear power facilities have spent fuel pools and some (with the number anticipated to increase) have ISFSIs generally located adjacent or near to the power reactor facility.

- Spent fuel transport and disposal away from the reactor location: The temporary storage or future permanent disposal of spent fuel at a site other than the reactor site is not within the scope of this Supplement. Licensees are prohibited from shipping spent fuel from one reactor's spent fuel pool to another's without NRC approval. Amendment of one or both of the facilities' licenses would be required before fuel transfer.

  Transportation of spent fuel and other high-level nuclear wastes is governed by regulations in 10 CFR Part 71, "Packaging and Transportation of Radioactive Material." Disposal of spent fuel and high-level wastes (HLW) are governed by the Nuclear Waste Policy Act (NWPA) of 1982, as amended, which defined the goals and structure of a program for permanent, deep geologic repositories for the disposal of high-level radioactive waste and non-reprocessed spent fuel. Under this Act, the DOE is responsible for developing permanent disposal capacity for spent fuel and other high-level nuclear wastes. On July 9, 2002, the U.S. Congress approved Yucca Mountain as the first long-term geologic repository for spent nuclear fuel and high-level radioactive waste. A HLW repository will be built and operated by DOE and licensed by the NRC. Title 10 CFR Part 61 contains rules