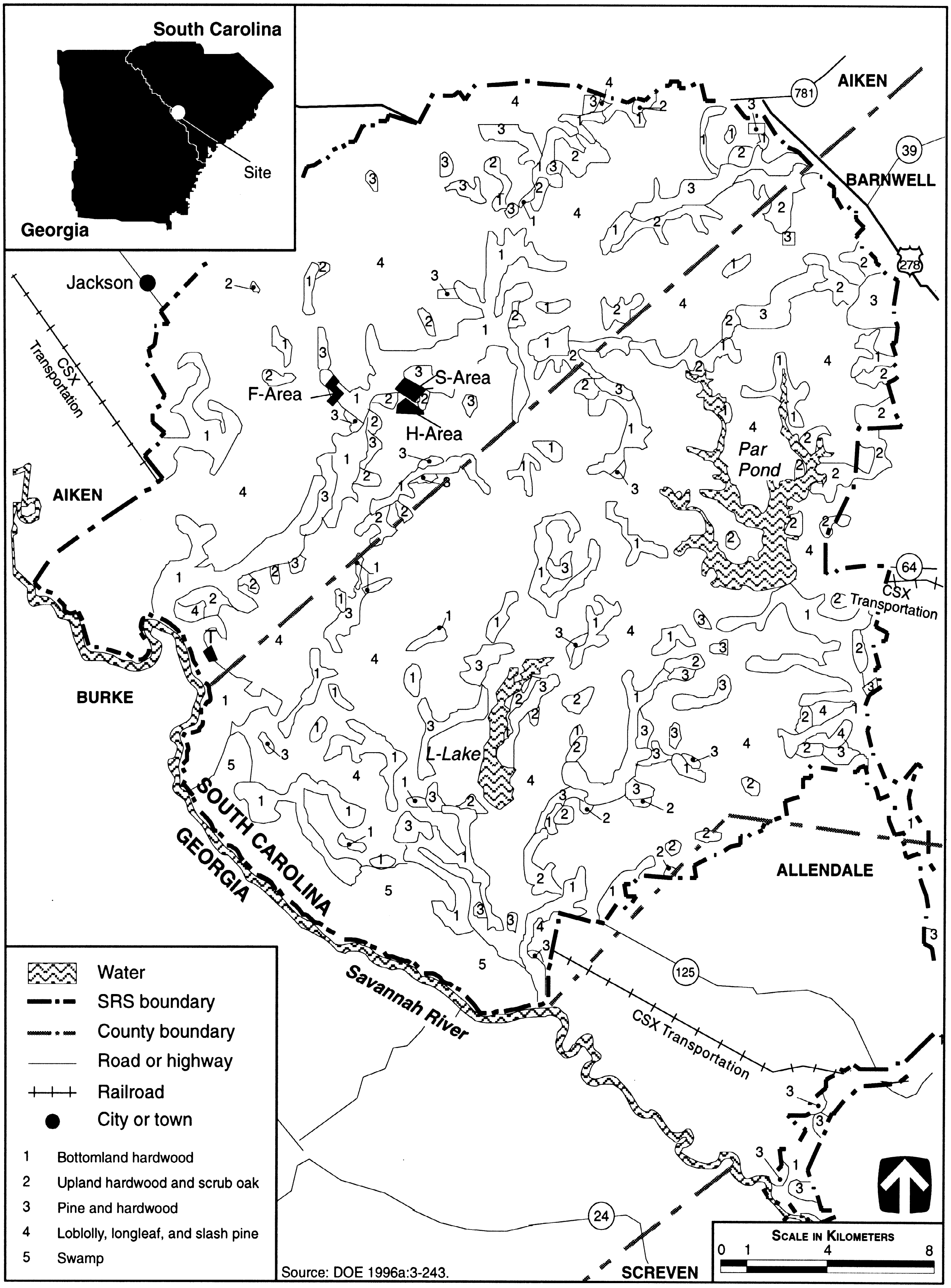

Figure 3–32. Major Plant Communities at SRS

Upper Three Runs Creek and its tributaries and three Carolina bays constitute the aquatic habitat in the vicinity of F-Area and S-Area. Streams support largemouth bass, black crappie, and various species of pan fish. Upper Three Runs Creek has a rich fauna; more than 551 species of aquatic insects have been collected (DOE 1996a:3-244; WSRC 1997b:5-32). It is important as a spawning area for blueback herring, and as a seasonal nursery habitat for American shad, striped bass, and other Savannah River species. Aquatic resources information on the three Carolina bays is unavailable (DOE 1996a:3-244).

3.5.8.2 Sensitive Habitat

Sensitive habitat comprises those terrestrial and aquatic (including wetlands) areas of the site that support threatened and endangered, State-protected, and other special-status plant and animal species.[9]

3.5.8.2.1 General Site Description

SRS wetlands, most of which are associated with floodplains, streams, and impoundments, include bottomland hardwood, cypress-tupelo, scrub-shrub, and emergent vegetation, as well as open water. Swamp forest along the Savannah River is the most extensive wetlands vegetation type (DOE 1996a:3-242).

Sixty-one threatened, endangered, and other special-status species listed by the Federal Government or the State of South Carolina may be found in the vicinity of SRS, as shown in Table 3.7.6–1 in the *Storage and Disposition PEIS*. No critical habitat for threatened or endangered species exists on SRS (DOE 1996a:3-245).

3.5.8.2.2 Proposed Facility Locations

No federally listed threatened or endangered species are known to occur in F-Area or S-Area, but several species that may exist in the general vicinity of these areas are listed in Table 3–47. The American alligator, although listed as threatened (by virtue of similarity in appearance to the endangered crocodile) is fairly abundant on SRS. It was recently observed near F-Area, but its occurrence there is seen as uncommon. Furthermore, no State-listed protected species have been found in any developed area on SRS, and of the State-listed organisms known to occur, none would be expected to use any of the disturbed areas for extended periods (Mayer and Wike 1997:42).

The Pen Branch area, about 14 km (8.7 mi) southwest of the proposed sites, and an area south of Par Pond, about 12 km (7.5 mi) to the southeast, support active bald eagle nests. Wood storks have been observed about 21 km (13 mi) from the proposed site, near the Fourmile Branch delta. The closest colony of red-cockaded woodpeckers is about 5 km (3.1 mi) away, but suitable forage habitat exists on the proposed sites. The smooth purple coneflower, the only endangered plant species found on SRS, could be found on the proposed sites (DOE 1996a:3-245). Botanical surveys conducted by the Savannah River Forest Station in 1992 and 1994 identified three populations of Oconee azalea in the area northwest of F-Area. This State-listed rare plant species, was found on the steep slopes adjacent to the Upper Three Runs Creek floodplain (DOE 1995c:3-37).

3.5.9 Cultural and Paleontological Resources

Cultural resources are human imprints on the landscape and are defined and protected by a series of Federal laws, regulations, and guidelines. Field studies conducted over the past two decades by the South Carolina Institute of Archaeology and Anthropology of the University of South Carolina have provided considerable information about the distribution and content of cultural resources at SRS. About 60 percent of SRS has been surveyed, and 858 archaeological (historic and prehistoric) sites have been identified (DOE 1995c). There are 67 sites considered potentially eligible for listing on the National Register; most of the sites have not yet been

[9] The Federal Government defines threatened and endangered species in the Endangered Species Act, and wetlands in 33 CFR 328.3.

Table 3–47. Threatened and Endangered Species, Species of Concern, and Sensitive Species Occurring or Potentially Occurring in the Vicinity of F-Area and S-Area

Common Name	Scientific Name	Federal Status	State Status
Birds			
Bald eagle	*Haliaeetus leucocephalus*	Threatened	Endangered
Red-cockaded woodpecker	*Picoides borealis*	Endangered	Endangered
Wood stork	*Mycteria americana*	Endangered	Endangered
Plants			
Oconee azalea	*Rhododendron flammeum*	Not listed	Species of Concern
Smooth purple coneflower	*Echinacea laevigata*	Endangered	Endangered
Reptiles			
American alligator	*Alligator mississippiensis*	Threatened (S/A)[a]	Not listed

[a] Protected under the Similarity of Appearance Provision of the Endangered Species Act.

Source: DOE 1996a:3-245–3-248; EuDaly 1998; Mayer and Wike 1997:9–14, 42.

evaluated (DOE 1996a:3-249). No SRS nuclear production facilities have been nominated for the National Register, and there are no plans for nominations. Existing SRS facilities lack architectural integrity and do not contribute to the broad historic theme of the Manhattan Project and the production of World War II era nuclear materials (DOE 1995c:vol. I, 3-53, 3-54).

Cultural sites are often occupied continuously or intermittently over substantial time spans. For this reason, a single location (sites) may contain evidence of use during both historic and prehistoric periods. In the discussions that follow, the numbers of prehistoric and historic resources are presented; the sum of these resources may be greater than the total number of sites reported due to this dual-use history at sites. Therefore, where the total number of sites reported is less than the sum of prehistoric and historic sites certain locations were used during both periods.

Cultural resources at SRS are managed under the terms of a programmatic memorandum of agreement among the DOE Savannah River Operations Office, the South Carolina State Historic Preservation Officer, and the Advisory Council on Historic Preservation, dated August 24, 1990 (WSRC 1997b:sec. 2.6). Guidance on the management of cultural resources at SRS is included in the *Archaeological Resources Management Plan of the Savannah River Archaeological Research Program* (SRARP 1989).

3.5.9.1 Prehistoric Resources

Prehistoric resources are physical properties that remain from human activities that predate written records.

3.5.9.1.1 General Site Description

Prehistoric resources at SRS consist of villages, base camps, limited-activity sites, quarries, and workshops. An extensive archaeological survey program begun at SRS in 1974 includes numerous field studies such as reconnaissance surveys, shovel test transects, and intensive site testing and excavation. There is prehistoric evidence of more than 800 sites, some of which may fall in the vicinity of the proposed facilities. Fewer than 8 percent of these sites have been evaluated for National Register eligibility (DOE 1996a:3-249).

3.5.9.1.2 Proposed Facility Locations

Within F-Area, land areas have been disturbed over the past 46 years by activities associated with construction and operation of the extant facilities. Although no archaeological surveys have been conducted within the boundary of F-Area, no prehistoric cultural materials have been, or are expected to be, identified within this industrial area.

The proposed construction area adjacent to F-Area has been surveyed for prehistoric and historic archaeological resources. A number of archaeological sites within this area contain prehistoric materials considered potentially | eligible for nomination to the National Register (Cabak, Sassaman, and Gillam 1996:199–312; SRARP 1997; | Stephenson and King 1999). Prior to any activity with potential impact on the sites in this area, a consultation | process would be initiated with the South Carolina State Historic Preservation Officer to formally determine the eligibility of specific sites and to determine necessary and appropriate mitigation measures.

A survey of S-Area prior to construction of DWPF revealed no archaeological resources potentially eligible for nomination to the National Register.

3.5.9.2 Historic Resources

Historic resources consist of physical properties that postdate the existence of written records. In the United States, historic resources are generally considered to be those that date no earlier than 1492.

3.5.9.2.1 General Site Description

Types of historic sites include farmsteads, tenant dwellings, mills, plantations and slave quarters, rice farm dikes, dams, cattle pens, ferry locations, towns, churches, schools, cemeteries, commercial building locations, and roads. About 400 historic sites or sites with historic components have been identified within SRS, and some of these may fall within the locations of the proposed facilities. To date, about 10 percent of the historic sites have been evaluated for National Register eligibility. Most pre-SRS era historic structures were demolished during the initial establishment of SRS in 1950. Two SRS era buildings built in 1951 remain in use. From a Cold War perspective, SRS has been involved in tritium operations and other nuclear material production for more than 40 years; therefore, some existing facilities and engineering records may have significant historical and scientific content (DOE 1996a:3-249).

3.5.9.2.2 Proposed Facility Locations

Within F-Area, land areas have been disturbed over the past 46 years by activities associated with the construction and operation of the extant facilities. Although no surveys have been conducted within the boundary of F-Area, no historic resources are expected to be identified with the possible exception of surviving facilities and engineering records from the Cold War era (DOE 1996a:3-249).

The proposed construction area adjacent to and northeast of F-Area has been surveyed for prehistoric and historic archaeological resources. Four known archaeological resources containing historic materials are considered potentially eligible for nomination to the National Register (Cabak, Sassaman, and Gillam 1996:199–312). Prior to any activity with potential impact on the sites in this area, a consultation process would be initiated with the South Carolina State Historic Preservation Officer to formally determine the eligibility of specific sites and to determine necessary and appropriate mitigation measures.

A survey of S-Area in conjunction with the 1982 DWPF EIS revealed no archaeological resources potentially eligible for nomination to the National Register (DOE 1994c:3–37).

3.5.9.3 Native American Resources

Native American resources are sites, areas, and materials important to Native Americans for religious or heritage reasons. In addition, cultural values are placed on natural resources such as plants, which have multiple purposes within various Native American groups. Of primary concern are concepts of sacred space that create the potential for land-use conflicts.

3.5.9.3.1 General Site Description

Native American groups with traditional ties to the area include the Apalachee, Cherokee, Chickasaw, Creek, Shawnee, Westo, and Yuchi. At different times, each of these groups was encouraged by the English to settle in the area to provide protection from the French, Spanish, or other Native American groups. Main villages of both the Cherokee and Creek were located southwest and northwest of SRS, respectively, but both groups may have used the area for hunting and gathering activities. During the early 1800s, most of the remaining Native Americans residing in the region were relocated to the Oklahoma Territory (DOE 1996a:3-249).

Native American resources in the region include remains of villages or townsites, ceremonial lodges, burials, cemeteries, and natural areas containing traditional plants used in religious ceremonies. Literature reviews and consultations with Native American representatives have revealed concerns related to the American Indian Religious Freedom Act within the central Savannah River valley, including some sensitive Native American resources and several plants traditionally used in ceremonies (DOE 1996a:3-249).

3.5.9.3.2 Proposed Facility Locations

In 1991, DOE conducted a survey of Native American concerns about religious rights in the central Savannah River valley. During this study, three Native American groups, the Yuchi Tribal Organization, the National Council of Muskogee Creek, and the Indian People's Muskogee Tribal Town Confederacy, expressed continuing interest in the SRS region with regard to the practice of their traditional religious beliefs. The Yuchi Tribal Organization and the National Council of Muskogee Creek have expressed concerns that several plant species—for example, redroot (*Lachnanthese carolinianum*), button snakeroot (*Eryngium yuccifolium*), and American ginseng (*Panax quinquefolium*)—traditionally used in tribal ceremonies could exist on SRS. Redroot and button snakeroot are known to occur on SRS, but are typically found in wet, sandy areas such as evergreen shrub bogs and savannas. Neither species is likely to be found in F-Area or S-Area due to clearing prior to the establishment of SRS in the 1950s (DOE 1994c:3-37). Consultations (see Chapter 5 and Appendix O) were initiated with appropriate Native American groups to determine any concerns associated with the actions evaluated in this SPD EIS.

3.5.9.4 Paleontological Resources

Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geological age.

3.5.9.4.1 General Site Description

Paleontological materials from the SRS area date largely from the Eocene Age (54 to 39 million years ago) and include fossil plants, numerous invertebrate fossils, giant oysters (*Crassostrea gigantissima*), other mollusks, and bryozoa. With the exception of the giant oysters, all other fossils are fairly widespread and common; therefore, the assemblages have low research potential or scientific value (DOE 1996a:3-249).

3.5.9.4.2 Proposed Facility Locations

No paleontological resources have been recorded for either F-Area or S-Area.

3.5.10 Land Use and Visual Resources

3.5.10.1 Land Use

Land may be characterized by its potential for the location of human activities (land use). Natural resource attributes and other environmental characteristics could make a site more suitable for some land uses than for others. Changes in land use may have both beneficial and adverse effects on other resources (biological, cultural, geological, aquatic, and atmospheric).

Located in southwestern South Carolina, SRS occupies an area of about 800 km^2 (310 mi^2) in a generally rural area about 40 km (25 mi) southeast of Augusta, Georgia, and 19 km (12 mi) south of Aiken, South Carolina, the nearest population centers (DOE 1996a:3-228). The site is owned by the Federal Government and is administered, managed, and controlled by DOE (DOE 1996a:3-230). It is bordered by the Savannah River to the southwest and includes portions of three South Carolina counties: Aiken, Allendale, and Barnwell (DOE 1996a:3-230).

3.5.10.1.1 General Site Description

Forest and agricultural land predominate in the areas bordering SRS. There are also significant open water and nonforested wetlands along the Savannah River Valley. Incorporated and industrial areas are the only other significant land uses. There is limited urban and residential development bordering SRS. The three counties in which SRS is located have not zoned any of the site land. The only adjacent area with any zoning is the town of New Ellenton, which has lands in two zoning categories bordering SRS: urban development and residential development. The closest residences are to the west, north, and northeast, within 60 m (200 ft) of the site boundary (DOE 1996a:3-230).

Various industrial, manufacturing, medical, and farming operations are conducted in areas around the site. Major industrial and manufacturing facilities in the area include textile mills, plants producing polystyrene foam and paper products, chemical processing plants, and a commercial nuclear power plant. Farming is diversified in the region; it includes crops such as peaches, watermelon, cotton, soybeans, corn, and small grains (DOE 1995b:vol. 1, app. C, 4-2).

Outdoor public recreation facilities are plentiful and varied in the SRS region. Included are the Sumter National Forest, 75 km (47 mi) to the northwest; Santee National Wildlife Refuge, 80 km (50 mi) to the east; and Clarks Hill/Strom Thurmond Reservoir, 70 km (43 mi) to the northwest. There are also a number of State, county, and local parks in the region, most notably Redcliffe Plantation, Rivers Bridge, Barnwell and Aiken County State Parks in South Carolina, and Mistletoe State Park in Georgia (DOE 1995b:vol. I, app. C, 4-2). The Crackerneck Wildlife Management Area, which extends over 1,930 ha (4,770 acres) of SRS adjacent to the Savannah River, is open to the public for hunting and fishing. Public hunts are allowed under DOE Order 4300.1C, which states that "all installations having suitable land and water areas will have programs for the harvesting of fish and wildlife by the public" (Noah 1995:48). SRS is a controlled area, public access being limited to through traffic on South Carolina Highway 125 (SRS Road A), U.S. Highway 278 (SRS Road 1), and the CSX railway line (DOE 1995b:vol. 1, app. C, 4-2).

Land use at SRS can be classified into three major categories: forest/undeveloped, water/wetlands, and developed facilities. Generalized land uses at SRS and vicinity are shown on Figure 3–33. Approximately

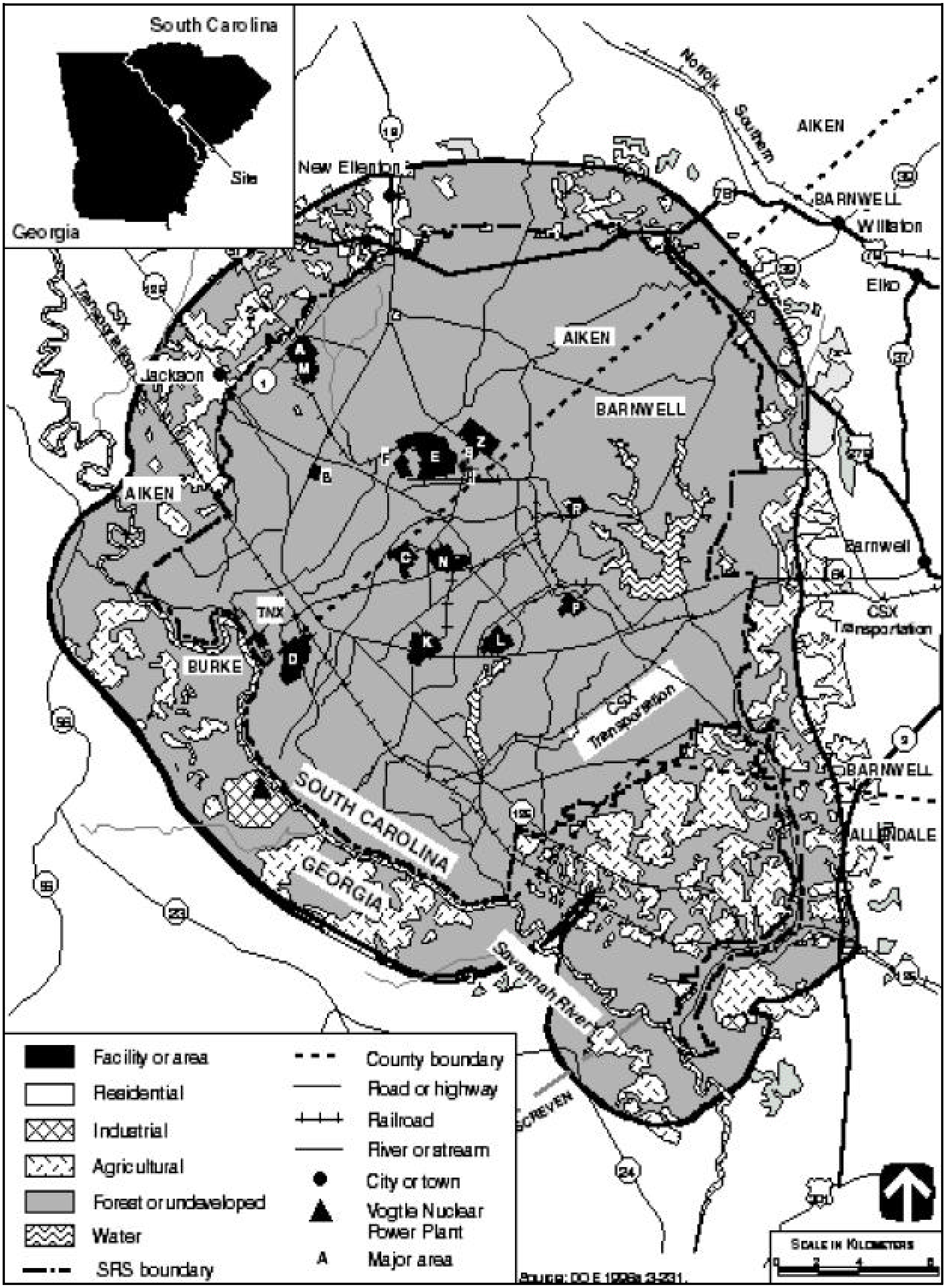

Figure 3–33. Generalized Land Use at SRS and Vicinity

585 km^2 (226 mi^2) of SRS—i.e., 73 percent of the area—is undeveloped (DOE 1996a:3-230). Wetlands, streams, and lakes account for 180 km^2 (70 mi^2) or 22 percent of the site, while developed facilities including production and support areas, roads, and utility corridors only make up approximately 5 percent or 40 km^2 (15 mi^2) of SRS (DOE 1996a:3-230). The woodlands area is primarily in revenue-producing, managed timber production. The U.S. Forest Service, under an interagency agreement with DOE, harvests about 7.3 km^2 (2.8 mi^2) of timber from SRS each year (DOE 1997e:4-57). Soil map units that meet the requirements for prime farmland soils exist on the site. However, the U.S. Department of Agriculture, Natural Resources Conservation Service, does not identify these as prime farmlands because the land is not available for agricultural production (DOE 1996a:3-230).

In 1972, DOE designated all of SRS as a National Environmental Research Park. The National Environmental Research Park is used by the national scientific community to study the impacts of human activities on the cypress swamp and hardwood forest ecosystems (DOE 1996a:3-230). DOE has set aside approximately 57 km^2 (22 mi^2) of SRS exclusively for nondestructive environmental research (DOE 1997e:4-57). A portion of SRS is open to the public for hunting and fishing.

Decisions on future land uses at SRS are made by DOE through the site development, land use, and future planning processes. SRS has established a Land Use Technical Committee composed of representatives from DOE, Westinghouse Savannah River Company, and other SRS organizations. DOE prepared the *FY 1994 Draft Site Development Plan*, which describes the current SRS mission and facilities, evaluates possible future missions and requirements, and outlines a master development plan that is now being prepared. In January 1996a, DOE published the *SRS Future Use Project Report*, which summarizes stakeholder-preferred future use recommendations that DOE considers throughout future planning and decisionmaking activities (DOE 1997e:4-57).

The State of South Carolina, through Act 489, as amended in 1994, requires local jurisdictions to undertake comprehensive planning. Regional-level planning also occurs within the State, with the State divided into 10 planning districts guided by regional advisory councils (DOE 1996a:3-230). The counties of Aiken, Allendale, and Barnwell together constitute part of the Lower Savannah River Council of Governments. Private lands bordering SRS are subject to the planning regulations of these three counties.

No onsite areas are subject to Native American Treaty Rights. However, five Native American groups, the Yuchi Tribal Organization, the National Council of Muskogee Creek, the Indian Peoples Muskogee Tribal Town Confederacy, the Pee Dee Indian Association, and the Ma Chis Lower Alabama Creek Indian Tribe, have expressed concern over sites and items of religious significance on SRS. DOE routinely notifies these organizations about major planned actions at SRS and asks them to comment on SRS documents prepared in accordance with NEPA.

3.5.10.1.2 Proposed Facility Locations

Many buildings are situated within F-Area. Included is Building 221–F, one of the canyons where plutonium was recovered from targets during DOE's plutonium production phase. Land use at Building 221–F in F-Area is classified as heavy industrial. This 30-m (100-ft) concrete structure is designed for plutonium immobilization. F-Area occupies approximately 160 ha (395 acres) of the site; S-Area, 110 ha (272 acres). These areas are about 14 km (8.7 mi) and 10 km (6.2 mi), respectively, from the site boundary.

Also within F-Area will be the Actinide Packaging and Storage Facility (if built), a planned below-grade facility for receiving and storing Category I quantities of special nuclear material (UC 1999). For those alternatives that involve installing the plutonium conversion and immobilization facilities at SRS, DWPF in S-Area would provide the second-stage immobilization services (DOE 1994c:3-29).

3.5.10.2 Visual Resources

Visual resources are natural and human-created features that give a particular landscape its character and aesthetic quality. Landscape character is determined by the visual elements of form, line, color, and texture. All four elements are present in every landscape; however, they exert varying degrees of influence. The stronger the influence exerted by these elements in a landscape, the more interesting the landscape. The more visual variety that exists with harmony, the more aesthetically pleasing the landscape.

3.5.10.2.1 General Site Description

The dominant viewshed in the vicinity of SRS consists mainly of agricultural land and forest, with some limited residential and industrial areas. The SRS landscape is characterized by wetlands and upland hills. Vegetation is composed of bottomland hardwood forests, scrub oak and pine woodlands, and wetland forests. DOE facilities are scattered throughout SRS and are brightly lit at night. These facilities are generally not visible offsite, as views are limited by rolling terrain, normally hazy atmospheric conditions, and heavy vegetation. The only areas visually impacted by the DOE facilities are those within the view corridors of State Highway 125 and SRS Road 1.

The developed areas and utility corridors (transmission lines and aboveground pipelines) of SRS are consistent with a VRM Class IV designation. The remainder of SRS is consistent with VRM Class III or IV (DOE 1996a:3-230; DOI 1986a, 1986b).

3.5.10.2.2 Proposed Facility Locations

Industrial facilities within F-Area consist of large concrete structures, smaller administrative and support buildings, and parking lots (DOE 1994c:3-38). The structures range in height from 3 to 30 m (10 to 100 ft), with a few stacks and towers that reach 60 m (200 ft). The facilities in this area are brightly lit at night and visible when approached via SRS access roads. Visual resource conditions in F-Area are consistent with VRM Class IV (DOI 1986a, 1986b; Sessions 1997c:sec. 2.1, table 2-1). F-Area is about 7 km (4.3 mi) from State Highway 125 and 8.5 km (5.3 mi) from SRS Road 1. Public view of F-Area facilities is restricted by heavily wooded areas bordering segments of the SRS Road 1 system and site-crossing State Highway 125. Moreover, those facilities are not visible from the Savannah River, which is about 10 km (6.2 mi) to the west.

Industrial facilities within S-Area consist of large concrete buildings, smaller administrative and support buildings, and parking lots (DOE 1994c:3-38). The facilities in this area are brightly lit at night and visible when approached via SRS access roads. Visual resource conditions in S-Area are consistent with a VRM Class IV designation (DOI 1986a, 1986b; Sessions 1997c:sec. 2.1, table 2-1). S-Area is about 10 km (6.2 mi) from State Highway 125 and 11 km (6.8 mi) from SRS Road 1. Public view of S-Area facilities is restricted by heavily wooded areas bordering segments of the SRS Road 1 system and site-crossing State Highway 125. Moreover, those facilities are not visible from the Savannah River, which is about 15 km (9.3 mi) to the west.

3.5.11 Infrastructure

Site infrastructure includes those utilities and other resources required to support construction and continued operation of mission-related facilities identified under the various alternative actions.

3.5.11.1 General Site Description

SRS comprises numerous research, processing, and administrative facilities. An extensive infrastructure system supports these facilities, as shown in Table 3–48.

Table 3–48. SRS Sitewide Infrastructure Characteristics

Resource	Current Usage	Site Capacity
Transportation		
Roads (km)	230	230
Railroads (km)	103	103
Electricity		
Energy consumption (MWh/yr)	420,000	5,200,000
Peak load (MW)	70	330
Fuel		
Natural gas (m^3/yr)	NA	NA
Oil (l/yr)	28,400,000	NA[a]
Coal (t/yr)	210,000	NA[a]
Water (l/yr)	1,780,000,000	3,870,000,000

[a] As supplies get low, more can be supplied by truck or rail.
Key: NA, not applicable.
Source: Sessions 1997a:2.

3.5.11.1.1 Transportation

SRS has an extensive network—230 km (143 mi)—of roads to meet its onsite intrasite transportation requirements. The railroad infrastructure, which consists of 103 km (64 mi) of track, provides for deliveries of large volumes of coal and oversized structural components (Table 3–48).

3.5.11.1.2 Electricity

The SRS electrical grid is a 115-kV system in a ring arrangement that supplies power to operating areas, administrative areas, and independent and support function areas. That system includes about 160 km (100 mi) of transmission lines. Power is supplied to the grid by three South Carolina Electric & Gas Company (SCE&G) transmission lines. SRS is situated in, and draws its power from, the Virginia-Carolina Sub-Region, an electric power pool area that is a part of the Southeastern Electrical Reliability Council. Most of that power comes from offsite coal-fired and nuclear-powered generating plants (Sessions 1997c:sec. 2.8).

Current site electricity consumption is about 420,000 MWh/yr. Site capacity is about 5.2 million MWh/yr. The peak load capacity is 330 MW; the peak load usage, 70 MW (Sessions 1997c:sec. 2.8).

3.5.11.1.3 Fuel

Coal and oil are used at SRS primarily to power the steam plants. Steam generation facilities at SRS include coal-fired powerhouses at A-, D-, and H-Areas and two package steam boilers, which use number 2 fuel oil, in K-Area. Coal is delivered by rail and is stored in coal piles in A-, D- and H-Areas. Oil is delivered by truck to K-Area. Coal is used to fuel A-Area powerhouse that provides process and heating steam for the main administrative area at SRS. D-Area powerhouse provides most of the steam for the SRS process area (Sessions 1998a). Natural gas is not used at SRS.

3.5.11.1.4 Water

A new central domestic water system serves the majority of the site. The system includes three wells and a 17-million-l/day (4.5-million-gal/day) water treatment plant in A-Area; two wells and an 8.3-million-l/day (2.2-million-gal/day) backup water treatment plant in B-Area; three elevated storage tanks; and a 43-km (27-mi) piping loop (Sessions 1997c:sec. 2.8). The system's available flow capacity is approximately 13,060 1/min (3,450 gal/min) (DOE 1997f:3-35). Process water is provided to individual site areas. See Section 3.5.11.2.3 for more information.

3.5.11.1.5 Site Safety Services

The SRS fire department operates under a 12-hr rotational shift schedule, with three fire stations. Among the firefighters and officers are members of the SRS Hazardous Materials Response Team and the Rescue Team, responsible for rescues of all types. The fire department is supported by a fleet of 20 vehicles, including six pumpers, one pumper-tanker, one tanker, one aerial platform ladder truck, one light duty rescue vehicle, one mini-pumper for grass fires, one specially prepared emergency response step van and trailer for hazardous materials response, and two boats for waterway spill response and control. Inspections are performed periodically according to National Fire Protection Codes and Standards (WSRC 1994).

3.5.11.2 Proposed Facility Locations

A summary of the infrastructure characteristics for F-Area and S-Area is provided in Table 3–49.

Table 3–49. SRS Infrastructure Characteristics for F-Area and S-Area

	F-Area		S-Area	
Resource	**Current Usage**	**Capacity**	**Current Usage**	**Capacity**
Electricity				
Energy consumption (MWh/yr)	78,300	561,000	37,400	385,000
Peak load (MW)	14.5	64.0	6.0	14.5
Fuel				
Natural gas (m^3/yr)	NA	NA	NA	NA
Oil (l/yr)	NA	NA	NA	NA
Coal (t/yr)	NA	NA	NA	NA
Water (l/yr)	374,000,000	1,590,000,000	49,800,000	797,000,000

Key: NA, not applicable.
Source: Sessions 1997a.

3.5.11.2.1 Electricity

Electric power for F-Area is provided by the 200–F Power Loop, which is supplied by the 251–F electrical substation. This substation consists of two 115/13.8-kV, 24/32-MVA transformers and associated switchgear. The 13.8-kV power is distributed through a 2,000-A–rated bus (Sessions 1997c:sec. 2.8). F-Area electrical energy consumption is about 78,300 MWh/yr; F-Area electrical capacity, about 561,000 MWh/yr (Sessions 1997a).

Electric power for S-Area is provided by two 13.8-kV feeders supplied by the 251–H electrical substation. This substation consists of two 115/13.8-kV, 24/32-MVA transformers and associated switchgear. The 13.8-kV power is distributed through two 2,000-A–rated buses. The 13.8-kV bus tie breaker is normally closed. S-Area electrical energy consumption is about 37,400 MWh/yr; electrical capacity in S-Area, about 385,000 MWh/yr (Sessions 1997a; 1997c:sec. 2.8).

3.5.11.2.2 Fuel

Coal and oil are not required in F- or S-Area because steam is supplied from the central facility, and electricity is supplied from the site electrical grid system (Sessions 1998b).

3.5.11.2.3 Water

F-Area water usage of domestic water is about 374 million l/yr (100 million gal/yr) from the new central domestic water system. Currently available capacity for F-Area is about 1.6 billion l/yr (420 million gal/yr) (Sessions 1997a; 1997c:sec. 2.8).

S-Area has managed its supply of water until recently and has used an average of 50 million l/yr (13 million gal/yr). Now that it is connected to the new central domestic water system, the area has access to the system's excess capacity of 797 million l/yr (211 million gal/yr) (Sessions 1997a; 1997c:sec. 2.8).

Process and service water are supplied through deep-well systems within site areas. Wells 905-100F and 905-102F supply process and service water to F-Area; wells 905-1S and 905-2S to S-Area's DWPF. These wells are screened in the McQueen Branch (Lower Tuscaloosa) aquifer (Sessions 1997c:sec. 2.8). Each of these process water systems is capable of delivering 1,987 million 1/yr (525 million gal/yr) of water (Sessions 1997a; 1997c:sec 2.8). Current usage of process and service water in F-Area is 481 million 1/yr (127 million gal/yr) and about 3.79 million 1/yr (1 million gal/yr) in S-Area (Sessions 1997a).

| ## 3.6 LEAD ASSEMBLY FABRICATION AND POSTIRRADIATION EXAMINATION SITES

3.6.1 Hanford Overview

Hanford is located in the southeast portion of Washington State, occupying about 1,450 km^2 (560 mi^2). The 400 Area occupies 0.6 km^2 (0.2 km^2). Additional information on Hanford and the 400 Area is provided in Section 3.2.

| [Text deleted.]

The options proposed for lead assembly fabrication at Hanford would use existing employees and buildings; therefore, major facility modifications would not be required. For this reason, detailed descriptions of environmental resources such as geology and soils, water, ecological, cultural and paleontological, land use and visual, socioeconomics, and environmental justice are not required for the 400 Area. For additional information on the resource areas that could be impacted by lead assembly fabrication activities in the 400 Area, refer to Sections 3.2.1, 3.2.2, 3.2.4, and 3.2.11.

3.6.2 ANL–W Overview

Located in the southeast portion of INEEL is ANL–W. ANL–W is about 328 ha (820 acres). Atomic City, 29 km (18 mi) southwest, is the closest populated area to ANL–W; it has a population of 25. Idaho Falls, population of about 45,000, is 63 km (39 mi) east of ANL–W (see Figure 2–3). In 1997, about 700 employees worked at ANL–W (O'Connor et al. 1998b).

Established in the mid-1950s, the primary mission of the ANL–W was to support advanced liquid metal reactor research (DOE 1996h:Idaho 4). In 1995, ANL–W began a Redirected Nuclear Research and Development Program to conduct research in the treatment of DOE spent nuclear fuel and reactor decontamination and decommissioning technologies (O'Connor et al. 1998b).

| [Text deleted.]

| The options proposed for lead assembly fabrication and postirradiation examination at ANL–W would occur in existing facilities that would not require major modifications and would use existing employees. For this reason, detailed descriptions of environmental resources such as geology and soils, water, ecological, cultural and paleontological, land use and visual, socioeconomics, and environmental justice are not provided. For more information on these resource areas, refer to Section 3.3. The resource areas that could be impacted by lead assembly fabrication activities are air quality, waste management, existing human health risk, and infrastructure. These resource areas are described below.

3.6.2.1 Air Quality

The meteorological conditions at INEEL are considered to be representative for ANL–W. Emissions of criteria pollutants at ANL–W result from the ongoing operation of onsite boilers used to produce steam for heating. Existing ambient air pollutant concentrations at INEEL are in compliance with applicable guidelines and regulations. See Section 3.3.1 for additional information on air quality for areas surrounding INEEL.

3.6.2.2 Waste Management

ANL–W analyzes, stores, and ships TRU waste, hazardous waste, mixed waste, LLW, and nonhazardous waste generated by the numerous research and support facilities at INEEL (O'Connor et al. 1998b).

The Waste Characterization Area, in the ANL–W Hot Fuels Examination Facility, is a glovebox facility used for characterization of TRU. The Radioactive Scrap and Waste Facility, in the northeast corner of ANL–W, provides underground vault storage for remote-handled LLW, mixed LLW, and TRU waste. The Radioactive Scrap and Waste Facility is a State of Idaho RCRA-permitted facility (O'Connor et al. 1998b).

The Radioactive Sodium Storage Facility is in an ANL–W controlled access area. The Radioactive Sodium Storage Facility is a RCRA-permitted storage facility used to store radioactive and heavy metal contaminated debris along with sodium and sodium-potassium alloy mixed waste (O'Connor et al. 1998b).

The sanitary wastewater treatment facility, 6,057-m^3/yr (21,390-ft^3/yr) capacity, is the only waste treatment facility at ANL–W. Other forms of waste generated at ANL–W are treated and disposed of at INEEL waste facilities or shipped off the site (O'Connor et al. 1998b). More information on waste management activities at INEEL can be found in Section 3.3.2.

3.6.2.3 Existing Human Health Risk

See Section 3.3.4 for major sources and levels of background radiation, mean concentrations of radiological releases, and offsite estimated dose rates to individuals within the vicinity of INEEL. Site worker radiological exposure data at ANL–W for 1994–1996 is provided in Table 3–50. Worker exposure limits at ANL–W remain within applicable limits.

Table 3–50. Worker Exposure Data for ANL–W, 1994–1996

	Radiation Worker Dose		All Workers	
Year	**(mrem)**	**(person-rem)**	**(mrem)**	**(person-rem)**
1994	34	28	19	34
1995	50	41	27	43
1996	56	45	31	45

Key: ANL–W, Argonne National Laboratory–West.
Source: O'Connor et al. 1998b.

3.6.2.4 Infrastructure

The site infrastructure at ANL–W includes those utilities and other resources required to support construction and continued operation of mission-related facilities. Table 3–51 shows facility infrastructure information for the proposed facility location. An adequate infrastructure exists at ANL–W to support current activities. See Section 3.3.11 for more detailed information on INEEL's infrastructure.

3.6.3 LLNL Overview

LLNL is composed of two sites: Livermore Site and Site 300 (see Figure 2–31). The Livermore Site is about 80 km (50 mi) east of San Francisco and 6.4 km (4 mi) from downtown Livermore. It occupies about 332 ha (821 acres) of flat terrain in the Livermore Valley. Site 300 is about 24 km (15 mi) southeast of the Livermore Site (DOE 1996h:California 67; 1996i:4-328).

Table 3–51. ANL–W Infrastructure Characteristics

Resource	Current Usage
Electricity	
Energy consumption (MWh/yr)	4,200
Peak load (MWe)	5,088
Fuel	
Natural gas (m^3/yr)	0
Liquid (m^3)	0
Coal (t/yr)	0
Steam (kg/h)	690
Water	
Annual (l/yr)	1,500,000
Peak (l/yr)	2,000,000

Key: ANL–W, Argonne National Laboratory–West.

| **Source:** O'Connor et al. 1998b:S-10.

Originally used as a naval air training station, the Livermore Site was established in 1952 to conduct nuclear weapons research. Site 300 is a remote high-explosives testing facility. The current mission of LLNL is research, testing, and development that focuses on national defense and security, energy, the environment, and biomedicine (DOE 1996h:California 69). Within recent years, LLNL's mission has broadened to include global security, ecology, and mathematics and science education. In early 1998, LLNL had about 7,700 employees (O'Connor et al. 1998c).

| [Text deleted.]

The options proposed for lead assembly fabrication at LLNL would occur in existing facilities that would not require major modifications and would use existing employees. For this reason, detailed descriptions of environmental resources such as geology and soils, water, ecological, cultural and paleontological, land use and visual, socioeconomics, and environmental justice are not provided. For a detailed discussion of these resource areas, refer to the *Stockpile Stewardship and Management Final PEIS* (DOE 1996i). The resource areas that could be impacted by lead assembly fabrication activities are air quality, waste management, existing human health risk, and infrastructure. These resource areas are described below.

3.6.3.1 Air Quality

The Livermore Site is in the San Francisco Bay Area Air Quality Management District. This area is designated | as attainment for all criteria pollutants with respect to attainment of the NAAQS (EPA 1998b); however, EPA has recently redesignated the area as nonattainment for ozone (EPA 1998c). The emissions of criteria air pollutants at the Livermore Site result from the ongoing operation of numerous boilers for heating; solvent cleaning operations; emergency generators; and various experimental, testing, and process sources. The Bay Area Air Quality Management District and the San Joaquin Valley Unified Air Pollution Control District requested that the Livermore Site assess the impact of toxic air emissions on the surrounding area. The risks at the Livermore Site were found to be below the threshold values used to determine the need for additional evaluation (DOE 1996i:4-334). For a detailed discussion of this resource area, refer to Section 4.7.2.3 of the *Stockpile Stewardship and Management Final PEIS* (DOE 1996i:4-333).

3.6.3.2 Waste Management

LLNL was added to EPA's National Priorities List in July 1987 based on the presence of volatile organic compounds in the groundwater. In November 1988, DOE, EPA, the California Department of Health Services, and the Bay Area Regional Water Quality Control Board signed an FFCA to facilitate compliance with CERCLA, the Superfund Amendments and Reauthorization Act, and applicable State laws. In a remedial investigation/feasibility study prepared pursuant to CERCLA, DOE outlined its cleanup strategy for the LLNL Livermore Site. A ROD issued on July 15, 1992, included an announcement of DOE's decision to pump and treat contaminated groundwater and construct approximately seven small treatment facilities. The selected remedies address the principal concerns at LLNL by removing the contaminants from soil and groundwater and treating the effluents to the extent necessary for protection of human health and the environment (O'Connor et al. 1998c:3).

Through its research and operation activities, LLNL treats, stores, packages, and prepares TRU, low-level, mixed low-level, hazardous, and nonhazardous wastes for transport. Waste is treated and stored on the site and then shipped off the site for additional treatment and disposal. No disposal of waste occurs at the Livermore Site (DOE 1996h:California 78). LLNL waste generation rates and inventories are shown in Table 3–52. Table 3–53 provides information on waste management facilities at LLNL.

Table 3–52. Waste Generation Rates and Inventories at LLNL

Waste Type	Generation Rate (m^3/yr)	Inventory (m^3)
TRU[a] Contact-handled	27	257
LLW	124	644
Mixed LLW[b]	353	454
Hazardous	579	NA[c]
Nonhazardous		
Liquid	456,000	NA[c]
Solid	4,280	NA[c]

[a] Includes mixed TRU waste.
[b] Includes TSCA mixed LLW.
[c] Generally, hazardous and nonhazardous wastes are not held in long-term storage.

Key: LLNL, Lawrence Livermore National Laboratory; LLW, low-level waste; NA, not applicable; TRU, transuranic; TSCA, Toxic Substances Control Act.

Source: DOE 1996i:4-400 for hazardous and nonhazardous waste; DOE 1996d:15, 16 for all other wastes.

For a more detailed discussion of waste management activities at the Livermore Site, refer to Section 4.7.2.10 of the *Stockpile Stewardship and Management Final PEIS* (DOE 1996i:4-358) or Section 4.15.2 of the *Final EIS and Environmental Impact Report for Continued Operation of LLNL and Sandia National Laboratories, Livermore* (DOE 1992:4-239).

Table 3–53. Waste Management Facilities at LLNL

Facility Name/Description	Capacity	Status	TRU	LLW	Mixed LLW	Haz	Non-Haz
Treatment facilities (m^3/yr)							
LLW size reduction	771	Online		X			
Building 513 and 514 Waste Treatment Facility[a]	2,012	Online		X	X	X	X
Decontamination and waste treatment facility	Not determined	Planned	X	X	X	X	X
Storage facilities (m^3)							
Building 233, 625	217	Online	X	X	X	X	X
Building 280	513	Online	X	X			X
Building 513, 514, area 612–2	222	Online		X	X	X	X
Area 612–1	1,086	Online	X	X	X	X	X
Area 612–4	169	Online	X	X	X	X	X
Area 612–5	760	Online	X	X	X	X	X
Area 612 tanks	57	Online		X	X	X	X
Building 612 lab packaging unit	16	Online		X	X	X	X
Building 614, 693	298	Online	X	X	X	X	X
612 yard, area 612–3	1,327	Online		X			X
Building 696	590	Online	X	X			X
Disposal facilities (m^3/yr)							
LLNL sanitary sewer	2,327,800	Online					X

[a] Treatment methods employed in Building 513 are solidification and shredding. Methods used in Building 514 are evaporation, blending, separation, gas adsorption, silver recovery, and wastewater treatment (Kielusiak 1998a).

Key: Haz, hazardous; LLNL, Lawrence Livermore National Laboratory; LLW, low-level waste; TRU, transuranic.

Source: Kielusiak 1998b.

3.6.3.3 Existing Human Health Risk

Major sources and levels of background radiation exposure to individuals in the vicinity of LLNL are shown in Table 3–54. Annual background radiation doses to individuals are expected to remain constant over time. Total dose to the population changes as population size changes. Background radiation doses are unrelated to LLNL operations.

Release of radionuclides to the environment from LLNL operations provides another source of radiation exposure to the population in the vicinity. Doses to the public resulting from these releases are shown in Table 3–55. These doses fall within regulatory limits (DOE 1993a) and are small when compared with background radiation exposure.

Using a risk estimator of 500 cancer deaths per 1 million person-rem (5×10^{-4} fatal cancer per person-rem) to the public (see Appendix F.10), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from LLNL operations in 1996 is estimated to be 4.7×10^{-8}. That is, the estimated probability of this person dying from cancer from radiation exposure from 1 year of LLNL operations is slightly less than 5 chances in 100 million.

Table 3–54. Sources of Radiation Exposure to Individuals in the LLNL Vicinity Unrelated to LLNL Operations

Source	Effective Dose Equivalent (mrem/yr)
Natural background radiation	
Internal terrestrial radiation	40
Cosmic radiation	30
External terrestrial radiation	30
Radon in homes (inhaled)	200
Other background radiation	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Nuclear fuel cycle	<1
Total	354

Key: LLNL, Lawrence Livermore National Laboratory.
Note: Values for radon and weapons test fallout are averages for the United States.
Source: Harrach et al.:12-18.

Table 3–55. Radiation Doses to the Public From Normal LLNL Operations in 1996 (Total Effective Dose Equivalent)

Members of the Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Maximally exposed individual (mrem)[a]	10	0.093	4	0	100	0.093
Population within 80 km (person-rem)[b]	None	1.1	None	0	100	1.1
Average exposed individual within 80 km (mrem)[c]	None	0.000175	None	0	None	0.000175

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10-mrem/yr limit for airborne emissions is required by the Clean Air Act. The 4-mrem/yr limit is required by the Safe Drinking Water Act; for this SPD EIS, the 4-mrem/yr value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 mrem/yr is the limit from all combined pathways. The 100-person-rem value for the population is given in proposed 10 CFR 834 (DOE 1993b).
[b] In 1996, this population was about 6.3 million.
[c] Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site.
Key: LLNL, Lawrence Livermore National Laboratory.
Source: Harrach et al.:12-18.

According to the same risk estimator, 5.5×10^{-4} excess fatal cancer per year is projected in the population living within 80 km (50 mi) of LLNL. For perspective, this number can be compared with the number of fatal cancers expected in this population from all causes. The 1996 mortality rate associated with cancer for the entire population was 0.2 percent per year. Based on this national rate, the number of fatal cancers from all causes expected during 1996 in the population living within 80 km (50 mi) of LLNL was 13,000. This number of expected fatal cancers is much higher than the estimated 5.5×10^{-4} fatal cancer that could result from LLNL operations in 1996.

Workers at LLNL receive the same dose as the general public from background radiation; however, they receive an additional dose from normal operations. Table 3–56 includes average, maximally exposed, and total occupational doses to LLNL workers from operations in 1997. These doses fall within radiological limits. Based on a dose-to-risk conversion factor of 400 fatal cancers per 1 million person-rem (4×10^{-4} fatal cancer

Table 3–56. Radiation Doses to Onsite Workers From Normal LLNL Operations in 1997 (Total Effective Dose Equivalent)

	Onsite Releases and Direct Radiation	
Occupational Personnel	**Standard[a]**	**Actual**
Average radiation worker (mrem)	None[b]	2.5
Maximally exposed worker (mrem)	5,000	1,144
Total workers (person-rem)[c]	None	18.2

[a] The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995a:para. 835.202); however, DOE's goal is to maintain radiological exposures as low as is reasonably achievable. Therefore, DOE has established an administrative control level of 2,000 mrem/yr (DOE 1994a:2-3); DOE must make reasonable attempts to maintain worker doses below this level.

[b] No standard is specified for an "average radiation worker"; however, the maximum dose that this worker may receive is limited to that given in footnote "a."

[c] The total number of badged workers at the site in 1997 was 7,300.

Key: LLNL, Lawrence Livermore National Laboratory.

Source: Zahn 1998.

per person-rem) among workers (see Appendix F), the number of excess fatal cancers to LLNL workers from normal operations in 1997 is estimated to be 0.0073.

More detailed information of the radiation environment, including background exposures and radiological releases and doses, is presented in the *LLNL Environmental Report for 1996* (Harrach et al. 1997). Concentrations of radioactivity in various environmental media (e.g., air and water) and animal tissues in the site region are also presented in the same reference.

3.6.3.4 Infrastructure

A summary of the infrastructure characteristics of LLNL is presented in Table 3–57. An adequate infrastructure exists at LLNL to support current activities.

Table 3–57. LLNL Infrastructure Characteristics

Resource	Current Usage[a]	Site Capacity
Electricity		
Energy consumption (MWh/yr)	295,919	100 MW peak
Fuel		
Natural gas (m^3/yr)	13,017,173	4,400 m^3/hr peak
Liquid (1/yr)	1,257,699	NA[b]
Coal (t/yr)	0	0
Water		
Annual (l/yr)	874,138,983	10,977,660 1/day peak

[a] Five-year average for FY93–97.
[b] As supplies get low, more can be supplied by truck.
Key: LLNL, Lawrence Livermore National Laboratory; NA, not applicable.
Source: O'Connor et al. 1998c.

3.6.4 LANL Overview

LANL occupies 11,300 ha (28,000 acres) of land in northern New Mexico (see Figure 2–29). Situated on the Pajarito plateau in the Jemez mountains, the closest population centers are the city of Los Alamos (population 12,000) and White Rock (population 8,000). The closest metropolitan area is Santa Fe (population 50,000), about 40 km (25 mi) southeast of LANL. In 1997, LANL had about 9,200 workers (DOE 1996a:3-304).

The laboratory was established in 1943 to design, develop, and test nuclear weapons. LANL's mission has expanded from the primary task of designing nuclear weapons to include nonnuclear defense programs and a broad array of nondefense programs. Current programs include R&D of nuclear safeguards and security, space nuclear systems, biomedicine, computational science, and lasers (DOE 1996a:3-304). LANL consists primarily of Technical Areas (TAs), of which 49 are actively in use (DOE 1997g:1). |

[Text deleted.] |

The options proposed for lead assembly fabrication at LANL would occur in existing facilities that would not require major modifications and would use existing employees. For this reason, detailed descriptions of environmental resources such as geology and soils, water, ecological, cultural and paleontological, land use and visual, socioeconomics, and environmental justice are not provided. For more information on these resource areas, refer to the *Storage and Disposition PEIS* (DOE 1996a). The resource areas that could be impacted by lead assembly fabrication activities are air quality, waste management, existing human health risk, and infrastructure. These resource areas are described below.

3.6.4.1 Air Quality

LANL is within the New Mexico Intrastate AQCR 157. None of the areas within LANL and its surrounding communities are designated as nonattainment areas with respect to any of the NAAQS (EPA 1997h). The criteria pollutants, nitrogen dioxide, carbon monoxide, volatile organic hydrocarbons, particulate matter, and sulphur dioxide make up about 79 percent of the stationary source emissions at LANL. The sources of these criteria pollutants are power plants, steam plants, asphalt plants, and space heaters. Toxic and other hazardous pollutants comprise the remaining 21 percent of emissions from stationary sources at LANL. These emissions are generated by equipment cleaning, coating processes, and acid baths. Concentrations of criteria and hazardous and toxic air pollutants are in compliance with applicable guidelines and regulations (DOE 1996a:3-310). For a detailed discussion of this resource area, refer to Section 3.9.3 of the *Storage and Disposition PEIS* (DOE 1996a:3–310).

3.6.4.2 Waste Management

Although not listed on the National Priorities List, LANL adheres to the CERCLA guidelines for environmental restoration projects that involve certain hazardous substances not covered by RCRA. LANL's environmental restoration program originally consisted of approximately 2,100 potential release sites. At the end of FY97, there remained only about 756 sites requiring investigation or remediation and 118 buildings awaiting decontamination and decommissioning. LANL's environmental restoration program is scheduled for completion in 2006 (LANL 1998:21).

Through its research and operation activities, LANL manages the following waste categories generated at 33 technical areas: TRU, low-level, mixed low-level, hazardous, and nonhazardous wastes (DOE 1996h:New Mexico 38; 1996i:4-272). LANL waste generation rates and inventories are presented in Table 3–58.

Table 3–58. Waste Generation Rates and Inventories at LANL

Waste Type	Generation Rate (m^3/yr)	Inventory (m^3)
TRU[a]		
Contact-handled	262	11,262
LLW	1,585	NA[c]
Mixed LLW[b]	90	6,801
Hazardous	942	NA[c]
Nonhazardous		
Liquid	692,857	
Solid	5,453	NA[c]

[a] Includes mixed TRU waste.
[b] Includes TSCA mixed LLW.
[c] Generally, LLW, hazardous, and nonhazardous wastes are not held in long-term storage.

Key: LANL, Los Alamos National Laboratory; LLW, low-level waste; NA, not applicable; TRU, transuranic; TSCA, Toxic Substances Control Act.

Source: DOE 1996a:3-339 for hazardous and nonhazardous waste; DOE 1996d:15, 16 for all other wastes.

LANL currently stores TRU waste on the site pending shipment to WIPP for disposal. The site also treats and disposes of LLW on the site. Mixed LLW is stored on the site pending treatment at a combination of onsite and offsite facilities. Hazardous waste is treated and stored on the site for offsite disposal. Nonhazardous solid wastes are shipped off the site for treatment and disposal. Nonhazardous liquid wastes are treated and disposed of on the site (DOE 1996a:3-337, 3-340, 3-341). See Table 3–59 for information on selected treatment, storage, and disposal facilities at LANL.

Table 3–59. Selected Waste Management Facilities at LANL

Facility Name/Description	Capacity	Status	Applicable Waste Types: TRU	Mixed TRU	LLW	Mixed LLW	Haz	Non-Haz
Treatment facilities (m^3/yr)								
TRU waste volume reduction	1,080	Online	X	X				
RAMROD & RANT facilities	1,050	Online	X	X				
LLW compaction	76	Online			X			
Sanitary Wastewater Treatment Plant	1,060,063	Online						X
Storage facilities (m^3)								
TA–54 TRU waste storage	24,355	Online	X	X				
LLW storage	663	Online			X			
Mixed LLW storage	583	Online				X		
Hazardous waste storage	1,864	Online					X	
Disposal facilities (m^3)								
TA–54 Area G LLW Disposal	252,500 [a]	Online			X			
Sanitary tile fields (m^3/yr)	567,750	Online						X

[a] Current inventory of 250,000 m^3 (8.8 million ft^3), therefore, capacity will be exhausted in the next 2 to 5 years (O'Connor et al. 1998d). The *LANL Site-Wide Final EIS* (DOE 1999b) evaluates alternatives for LLW disposal.

Key: Haz, hazardous; LANL, Los Alamos National Laboratory; LLW, low-level waste; RAMROD, Radioactive Materials Research, Operations, and Demonstration; RANT, Radioactive Assay and Nondestructive Test; TRU, transuranic.

Source: DOE 1996a:3-337–3-341; Triay 1999.

For a more detailed description of this resource area, see Section 3.9.10 of the *Storage and Disposition PEIS* (DOE 1996a), or Sections 2.2.2.14 and 2.2.2.15 of the *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory* (DOE 1999b).

3.6.4.3 Existing Human Health Risk

Major sources and levels of background radiation exposure to individuals within the vicinity of LANL are shown in Table 3–60. Annual background radiation doses to individuals are expected to remain constant over time. Total dose to the population changes as population size changes. Background radiation doses are unrelated to LANL operations (DOE 1996a:3-334).

Table 3–60. Sources of Radiation Exposure to Individuals in the LANL Vicinity Unrelated to LANL Operations

Source	Effective Dose Equivalent (mrem/yr)
Natural background radiation	
Cosmic radiation	48
External terrestrial radiation	44
Neutron cosmic radiation	10
Internal terrestrial	40
Radon in homes (inhaled)	200
Other background radiation	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	407

Key: LANL, Los Alamos National Laboratory.
Note: Value for radon is an average for the United States.
Source: DOE 1996a:3-333.

Release of radionuclides to the environment from LANL operations provides another source of radiation exposure to the population in the vicinity. The doses to the public resulting from these releases are shown in Table 3–61. These doses fall within regulatory limits (DOE 1993a) and are small when compared with background radiation exposure.

Using a risk estimator of 500 cancer deaths per 1 million person-rem (5×10^{-4} fatal cancer per person-rem) to the public (see Appendix F.10), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from LANL operations in 1995 is estimated to be 2.9×10^{-6}. That is, the estimated probability of this person dying from cancer from radiation exposure from 1 year of LANL operations is about three chances in one million (DOE 1998g:3-77).

According to the same risk estimator, 1.6×10^{-3} excess fatal cancer per year is projected in the population living within 80 km (50 mi) of LANL in 1995. For perspective, this number can be compared with the number of fatal cancers expected in this population from all causes. The 1996 mortality rate associated with cancer for the entire population was 0.2 percent per year. Based on this national rate, the number of fatal cancers from all causes expected during 1995 in the population living within 80 km (50 mi) of LANL was 482. This number of expected fatal cancers is much higher than the estimated 1.6×10^{-3} fatal cancers that could result from LANL operations in 1995 (DOE 1998g:3-77).

Table 3–61. Radiation Doses to the Public From Normal LANL Operations in 1995 (Total Effective Dose Equivalent)

	Atmospheric Releases		Liquid Releases		Total	
Members of the Public	**Standard[a]**	**Actual**	**Standard[a]**	**Actual[b]**	**Standard[a]**	**Actual[b]**
Maximally exposed individual (mrem)	10	5.1	4	0.58	100	5.7
Population within 80 km (person-rem)[c]	None	3.2	None	Negligible	100	3.2
Average individual within 80 km (mrem)[d]	None	0.013	None	Negligible	None	0.013

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10-mrem/yr limit from airborne emissions is required by the Clean Air Act. The 4-mrem/yr limit is required by the Safe Drinking Water Act; for this SPD EIS, the 4-mrem/yr value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 mrem/yr is the limit from all combined pathways. The 100-person-rem value for the population is given in proposed 10 CFR 834 (DOE 1993b).

[b] Actual dose values given in this column conservatively include all water pathways, not just drinking water.

[c] In 1995, this population was about 241,000.

[d] Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site.

Key: LANL, Los Alamos National Laboratory.

Source: DOE 1998g:3-77.

Workers at LANL receive the same dose as the general public from background radiation; however, they receive an additional dose from normal operations. Table 3–62 includes average, maximally exposed, and total occupational doses to LANL workers from operations in 1991–1995. Based on a risk estimator of 400 fatal cancers per 1 million person-rem (4×10^{-4} fatal cancer per person-rem) among workers (see Appendix F), the average annual number of fatal cancers to LANL workers from normal operations during the 1991–1995 timeframe is estimated to be 0.066 (DOE 1998g:3-77).

Table 3–62. Radiation Doses to Onsite Workers From Normal Operations at LANL, 1991–1995 (Total Effective Dose Equivalent)

	Onsite Releases and Direct Radiation	
Occupational Personnel	**Standard[a]**	**Actual[b]**
Average radiation worker (mrem)	None[c]	16
Maximally exposed worker (mrem)	5,000	2,000
Total workers (person-rem)	None	165

[a] The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995a:para. 835.202); however, DOE's goal is to maintain radiological exposures as low as is reasonably achievable. Therefore, DOE has established an administrative control level of 2,000 mrem/yr (DOE 1994a:2-3); DOE must make reasonable attempts to maintain worker doses below this level.

[b] Annual doses are averaged over the 5-year period.

[c] No standard is specified for an "average radiation worker"; however, the maximum dose that this worker may receive is limited to that given in footnote "a."

Key: LANL, Los Alamos National Laboratory.

Source: DOE 1998g:3-77.

More detailed information of the radiation environment at LANL is presented in *Environmental Surveillance at Los Alamos During 1995* (UC 1996). Concentrations of radioactivity in various environmental media (e.g., air and water) and animal tissues in the site region are also presented in the same reference.

3.6.4.4 Infrastructure

A summary of the infrastructure characteristics of LANL is presented in Table 3–63. An adequate infrastructure exists at LANL to support current activities.

Table 3–63. LANL Infrastructure Characteristics

Resource	Current Usage
Electricity	
Energy consumption (MWh/yr)	372,145
Fuel	
Natural gas (m^3/yr)	43,414,560
Fuel oil (l/yr)	0
Steam (kg/h)	33,554
Water	
Annual (l/yr)[a]	5,490,000,000

[a] In 1994, LANL's water system had an annual demand of 80 percent of its current allotment of 6,830 million l/yr (1,804 million gal/yr) (DOE 1999b:4-182). Demand includes use by Los Alamos County and National Park Service. LANL alone used 1,843 million l (approximately 487 million gal).

Key: LANL, Los Alamos National Laboratory.

Source: DOE 1996a:3-308, 1999b:4-181, 4-182.

3.6.5 SRS Overview

SRS occupies about 806 km^2 (310 mi^2) in the southern portion of South Carolina, about 19 km (12 mi) south of Aiken, South Carolina (see Figure 2–5) (DOE 1996a:3-228). Additional information on SRS is presented in Section 3.5.

[Text deleted.]

The options proposed for lead assembly fabrication at SRS would use existing employees and buildings; therefore, major facility modifications would not be required. For this reason, detailed descriptions of environmental resources such as geology and soils, water, ecological, cultural and paleontological, land use and visual, socioeconomics, and environmental justice are not provided. The resource areas that could be impacted by lead assembly fabrication activities are air quality, waste management, existing human health risk, and infrastructure. These resource areas are described below.

3.6.5.1 Air Quality

The meteorological conditions at H-Area are considered to be representative for SRS. Existing ambient air pollutant concentrations at SRS are in compliance with applicable guidelines and regulations. See Section 3.5.1 for additional information on air quality for areas surrounding SRS.

3.6.5.2 Waste Management

TRU, low-level, mixed low-level, hazardous, and nonhazardous wastes are generated by R&D, production, and decontamination activities in H-Area. These wastes are managed at SRS facilities and at offsite locations, as appropriate. The total quantities of waste generated and the inventories in storage at SRS are presented in Section 3.5.2. Three of the major waste management facilities located in H-Area are described below. Additional SRS waste management facilities are described in Section 3.5.2.

The Consolidated Incineration Facility is designed to incinerate solid and liquid LLW, mixed LLW, and hazardous waste. This H-Area facility has a capacity of 4,630 m^3/yr (6,056 yd^3/yr) of liquid waste and 17,830 m^3/yr (23,322 yd^3/yr) of solid waste (DOE 1996a:E-109).

Liquid LLW and mixed LLW generated in H-Area are conveyed to the F- and H-Area Effluent Treatment Facility for treatment. This facility has a capacity of 1,930,000 m^3/yr (2,524,000 yd^3/yr). Treated effluents are discharged to Upper Three Runs Creek in compliance with permit limits. Treatment residuals are concentrated by evaporation and stored in the H-Area tank farm for eventual treatment in the Z-Area Saltstone Facility. In that facility, wastes are immobilized with grout for onsite disposal (DOE 1996a:E-98, E-109).

Sanitary wastewater from H-Area is conveyed to the Central Sanitary Wastewater Treatment Facility for treatment and disposal. The H-Area sanitary sewer has a capacity of 136,274 m^3/yr (178,246 yd^3/yr) (O'Connor et al. 1998e), and the Central Sanitary Wastewater Treatment Facility has a capacity of 1,030,000 m^3/yr (1,347,000 yd^3/yr) (Sessions 1997a). More information on waste management activities at SRS is presented in Section 3.5.2.

3.6.5.3 Existing Human Health Risk

See Section 3.5.4 for major sources and levels of background radiation, mean concentrations of radiological releases, and offsite estimated dose rates to individuals within the vicinity of SRS.

3.6.5.4 Infrastructure

The site infrastructure at Building 221–H includes those utilities and other resources required to conduct mission-related activities. A summary of the infrastructure characteristics at Building 221–H is presented in Table 3–64. An adequate infrastructure exists at this facility to support current activities. See Section 3.5.11 for more detailed information on the infrastructure at SRS.

Table 3–64. Infrastructure Characteristics of Building 221–H at SRS

Resource	Current Usage
Electricity	
Energy consumption (MWh/yr)	120,000
Fuel	
Natural gas (m^3/yr)	NA
Fuel oil (l/yr)	NA
Coal (t/yr)	0
Water (l/yr)	380,000,0000

Key: NA, not applicable.
Source: O'Connor et al. 1998e.

3.6.6 ORR Overview

ORR, established in 1943 as one of the three original Manhattan Project sites, occupies about 13,974 ha (34,516 acres) west of Knoxville, Tennessee, in and around the city of Oak Ridge, Tennessee (DOE 1999g:S-9). ORR is composed of three separate operations areas: East Tennessee Technology Park

(ETTP), ORNL, and Y–12. ETTP serves as an operations center for ORR's environmental restoration and waste management programs. Y–12 engages in national security activities and manufacturing outreach to U.S. industries.

ORNL is one of the country's largest multidisciplinary laboratories and research facilities. Its primary mission is to perform leading-edge nonweapons R&D in energy, health, and the environment. Other missions include production of radioactive and stable isotopes not available from other production sources; fundamental research in a variety of sciences; research involving hazardous and radioactive materials; and radioactive waste disposal. The facilities that would be used for postirradiation examination are located at ORNL.

The options proposed for postirradiation examination at ORNL would occur in existing facilities that would not require major modifications and would use existing employees. For this reason, detailed descriptions of environmental resources such as geology and soils, water, ecological, cultural and paleontological, land use and visual, socioeconomics, and environmental justice are not provided. For a detailed discussion of these resource areas, refer to the *Storage and Disposition PEIS* (DOE 1996a) and the *Final EIS, Construction and Operation of the Spallation Neutron Source* (DOE 1999g). The resource areas that are discussed include air quality, waste management, existing human health risk, and infrastructure.

3.6.6.1 Air Quality

ORR is in the Eastern Tennessee and Southwestern Virginia Interstate AQCR (DOE 1996a:3-192). This area is designated as attainment for all criteria pollutants with respect to the NAAQS (DOE 1999g:4-17). The primary sources of criteria air pollutants at ORR are the steam plants at ETTP, ORNL, and Y–12. Other emissions sources include the Toxic Substances Control Act incinerator, various process sources, vehicles, temporary emissions from construction activities, and fugitive particulate emissions from coal piles (DOE 1996a:3-192). For a detailed discussion of this resource area, refer to Section 4.1.3 of the *Final EIS, Construction and Operation of the Spallation Neutron Source* (DOE 1999g:4-14).

3.6.6.2 Waste Management

ORR was added to EPA's National Priorities List on November 21, 1989. In January 1, 1992, DOE, EPA, and the Tennessee Department of Environmental Conservation signed an FFCA to facilitate compliance with RCRA and applicable State laws. This agreement coordinates ORR inactive site assessment and remedial actions. In addition, portions of the FFCA are applicable to operating waste management systems (DOE 1996a:3-219).

Through its research and operation activities, ORR treats, stores, packages, and prepares for transport TRU, low-level, mixed low-level, hazardous, and nonhazardous wastes and spent nuclear fuel. Most waste is treated and stored on the site and then shipped off the site for additional treatment and disposal (DOE 1996a:3-219–3-227). ORR waste generation rates and inventories are shown in Table 3–65. Table 3–66 provides information on waste management facilities at ORR. For a more detailed discussion of waste management activities at ORR, refer to Sections 3.6.10 and E.2.5 of the *Storage and Disposition PEIS* (DOE 1996a:3-219, E-63).

Table 3–65. Waste Generation Rates and Inventories at ORR[a]

Waste Type	Generation Rate (m^3/yr)	Inventory (m^3)
TRU[b]		
Contact-handled	9	1,339
LLW	5,181	18,414
Mixed LLW[c]	1,122	48,763
Hazardous	34,048	NA[d]
Nonhazardous		
Liquid	2,406,300	NA[d]
Solid	49,470	NA[d]

[a] Includes ETTP, ORNL, and Y–12.
[b] Includes mixed TRU waste.
[c] Includes TSCA mixed LLW.
[d] Generally, hazardous and nonhazardous wastes are not held in long-term storage.

Key: ETTP, East Tennessee Technology Park; ORNL, Oak Ridge National Laboratory; ORR, Oak Ridge Reservation; LLW, low-level waste; NA, not applicable; TRU, transuranic; TSCA, Toxic Substances Control Act.

Source: DOE 1996a:3-220–3-225 for hazardous and nonhazardous waste; DOE 1996d:15, 16 for all other wastes.

Table 3–66. Selected Waste Management Facilities at ORR

Facility Name/Description	Capacity	Status	TRU	LLW	Mixed LLW	Haz	Non-Haz
Treatment facilities (m³/yr)							
TRU Waste Treatment Plant (ORNL)	620	Planned for 2001	X				
Waste Compactor Facility (ORNL)	11,300	Online		X			
TSCA Incinerator (ETTP)	15,700	Online			X	X	
Bldg K–1203 Sewage Treatment Plant	829,000	Online					X
Oak Ridge Sewage Treatment Plant	1,934,500	Online					X
Sanitary Wastewater Treatment Facility (ORNL)	414,000	Online					X
Storage facilities (m³)							
TRU Waste Storage (ORNL)	1,760	Online	X				
LLW Storage (ETTP and ORNL)	51,850	Online		X			
Mixed Waste Storage (ETTP, ORNL, and Y–12)	231,753	Online			X		
Hazardous Waste Storage (ORNL and Y–12)	1,051	Online				X	
Disposal facilities (m³)							
Industrial & sanitary landfill (Y–12)	1,100,000	Online					X

Key: ETTP, East Tennessee Technology Park; Haz, hazardous; ORNL, Oak Ridge National Laboratory; ORR, Oak Ridge Reservation; LLW, low-level waste; TRU, transuranic; TSCA, Toxic Substances Control Act.
Source: DOE 1996a:3-219–3-225, E-78–E-95.

3.6.6.3 Existing Human Health Risk

Major sources and levels of background radiation exposure to individuals in the vicinity of ORR are shown in Table 3–67. Annual background radiation doses to individuals are expected to remain constant over time. Total dose to the population changes as population size changes. Background radiation doses are unrelated to ORR operations.

Table 3–67. Sources of Radiation Exposure to Individuals in the ORR Vicinity Unrelated to ORR Operations

Source	Effective Dose Equivalent (mrem/yr)
Natural background radiation [a]	
Internal terrestrial radiation	40
Cosmic radiation	27
External terrestrial radiation	28
Radon in homes (inhaled)	200
Other background radiation [b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	360

Source	Effective Dose Equivalent (mrem/yr)

[a] Hamilton et al. 1998.
[b] NCRP 1987.
Key: ORR, Oak Ridge Reservation.
Note: Value for radon is an average for the United States.

Release of radionuclides to the environment from ORR operations provides another source of radiation exposure to the population in the vicinity. Doses to the public resulting from these releases are shown in Table 3–68. These doses fall within regulatory limits (DOE 1993a) and are small when compared with background radiation exposure.

Using a risk estimator of 500 cancer deaths per 1 million person-rem (5×10^{-4} fatal cancer per person-rem) to the public (see Appendix F.10), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from ORR operations in 1997 is estimated to be $1.4\text{x}10^{-6}$. That is, the estimated probability of this person dying from cancer from radiation exposure from 1 year of ORR operations is slightly more than one chance in one million.

According to the same risk estimator, 0.0079 excess fatal cancer per year is projected in the population living within 80 km (50 mi) of ORR. For perspective, this number can be compared with the number of fatal cancers expected in this population from all causes. The 1996 mortality rate associated with cancer for the entire population was 0.2 percent per year. Based on this national rate, the number of fatal cancers from all causes expected during 1996 in the population living within 80 km (50 mi) of ORR was 1,760. This number of expected fatal cancers is much higher than the estimated 0.0079 fatal cancers that could result from ORR operations in 1997.

Table 3–68. Radiation Doses to the Public From Normal ORR Operations in 1997 (Total Effective Dose Equivalent)

	Atmospheric Releases		Liquid Releases		Total	
Members of the Public	**Standard[a]**	**Actual**	**Standard[a]**	**Actual**	**Standard[a]**	**Actual**
Maximally exposed individual (mrem)	10	0.41	4	1.4 [b]	100	2.8 [c]
Population within 80 km (person-rem)[d]	None	10.0	None	5.7	100	15.7
Average exposed individual within 80 km (mrem)[e]	None	0.011	None	0.0065	None	0.018

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10-mrem/yr limit for airborne emissions is required by the Clean Air Act. The 4-mrem/yr limit is required by the Safe Drinking Water Act; for this SPD EIS, the 4-mrem/yr value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 mrem/yr is the limit from all combined pathways. The 100-person-rem value for the population is given in proposed 10 CFR 834 (DOE 1993b).
[b] These doses are mainly from drinking water and eating fish from the Clinch River section of Poplar Creek.
[c] This total dose includes a conservative value of 1 mrem/yr from direct radiation exposure to a cesium field near the Clinch River.
[d] In 1997, this population was about 880,000.
[e] Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site.
Key: ORR, Oak Ridge Reservation.
Source: Hamilton et al. 1998.

Workers at ORR receive the same dose as the general public from background radiation; however, they receive an additional dose from normal operations. Table 3–69 includes average, maximally exposed, and total occupational doses to ORR workers from operations in 1997. These doses fall within radiological limits. Based on a dose-to-risk conversion factor of 400 fatal cancers per 1 million person-rem (4×10^{-4} fatal cancer per person-rem) among workers (see Appendix F), the number of excess fatal cancers to ORR workers from normal operations in 1997 is estimated to be 0.031.

Table 3–69. Radiation Doses to Onsite Workers From Normal ORR Operations in 1997 (Total Effective Dose Equivalent)

	Onsite Releases and Direct Radiation	
Occupational Personnel	**Standard**[a]	**Actual**
Average radiation worker (mrem)	None[b]	48
Total workers (person-rem)[c]	None	78

[a] The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995a:para. 835.202); however, DOE's goal is to maintain radiological exposures as low as is reasonably achievable. Therefore, DOE has established an administrative control level of 2,000 mrem/yr (DOE 1994a:2-3); DOE must make reasonable attempts to maintain worker doses below this level.
[b] No standard is specified for an "average radiation worker"; however, the maximum dose that this worker may receive is limited to that given in footnote "a."
[c] The total number of badged workers at the site in 1997 was 1,614.
Key: ORR, Oak Ridge Reservation.
Source: DOE 1999h.

More detailed information of the radiation environment, including background exposures and radiological releases and doses, is presented in the *ORR Annual Site Environmental Report for 1997* (Hamilton et al. 1998), and Section 4.1.9.1 of the *Final EIS, Construction and Operation of the Spallation Neutron Source* (DOE 1999g:4-60). Concentrations of radioactivity in various environmental media (e.g., air and water) and animal tissues in the site region are also presented in the *ORR Annual Site Environmental Report for 1997*.

3.6.6.4 Infrastructure

A summary of the infrastructure characteristics of ORR is presented in Table 3–70. An adequate infrastructure exists at ORR to support current activities. For a more detailed discussion of the site infrastructure, refer to Section 4.2.10.2 of the *Final EIS, Construction and Operation of the Spallation Neutron Source* (DOE 1999g:4-144), and Sections 3.6.2 and 3.6.4 of the *Storage and Disposition PEIS* (DOE 1996a:3-190,3-194).

Table 3–70. ORR Infrastructure Characteristics

Resource	Current Usage[a]	Site Capacity
Electricity		
Energy consumption (MWh/yr)	726,000	13,880,000
Fuel		
Natural gas (m^3/yr)	95,000,000	250,760,000
Liquid (1/yr)	416,000	416,000 [a]
Coal (t/yr)	16,300	16,300 [a]
Water		
Annual (l/yr)	14,210,000,000	44,347,500,000

[a] As supplies get low, more can be supplied by truck.

Key: ORR, Oak Ridge Reservation.

Source: DOE 1996a:3-190, 3-194.

3.7 REACTOR SITES FOR MOX FUEL IRRADIATION

3.7.1 Catawba Units 1 and 2 Site Overview

The Catawba nuclear power plant occupies 158 ha (391 acres) in York County, South Carolina, 9.3 km (5.8 mi) north-northwest of Rock Hill, South Carolina, and 16.9 km (10.5 mi) west-southwest of Charlotte, North Carolina (see Figure 3–34). The site is on a peninsula bounded by Beaver Dam Creek to the north, Big Allison Creek to the south, Lake Wylie to the east, and private property to the west (Duke Power 1997:2-3). Lake Wylie has a surface area of 5,040 ha (12,455 acres), a shoreline of approximately 523 km (325 mi), and a volume of 3.46×10^8 m^3 (281,900 acre-ft). The towns of Mount Holly and Belmont, North Carolina, take their raw water supplies from Lake Wylie. The communities of Chester, Fort Lawn, Fort Mill, Great Falls, Lancaster, Mitford, Riverview, and Rock Hill, South Carolina, obtain at least a portion of their municipal water supplies from the Catawba River within 80 km (50 mi) downstream from the site (Duke Power 1997:2-41, table 2-52).

In 1997, the plant employed 1,232 persons (DOE 1999f). The Catawba reactors are operated by Duke Power Company. The operating licenses (Nos. NPF–35 and NPF–52) for Units 1 and 2 were granted in 1985 and 1986 and expire in 2024 and 2026, respectively (NRC 1997). The population within an 80-km (50-mi) radius of these reactors is estimated to be 1,656,093 (Duke Power 1997:table 2-13).

Reactor cooling is accomplished using mechanical draft cooling towers, with water obtained from Lake Wylie (Duke Power 1997). During normal operations of Catawba, cooling water is pumped from the Beaver Dam Creek arm of Lake Wylie at a rate of 266,680 million l/yr (70,450 million gal/yr) and returned to Big Allison Creek at a rate of 172,902 million l/yr (45,676 million gal/yr). The net difference in water (93,779 million l/yr [24,774 million gal/yr]) is due to evaporation in the cooling towers (DOE 1999f).

New (unirradiated) fuel assemblies are dry stored in racks located in the two New Fuel Storage Buildings. Each New Fuel Storage Building is designed to accommodate 98 fuel assemblies (a total of 196 assemblies). Spent (irradiated) fuel assemblies are stored in two spent fuel pools in the two fuel buildings. The spent fuel storage pools have a total capacity of 2,836 assemblies (Duke Power 1997:9-3–9-6). Security at the site is provided in accordance with U.S. Nuclear Regulatory Commission (NRC) regulations and includes security checkpoints, barbed wire fencing, surveillance cameras, and intruder detection. More information about these reactors can be found at the NRC Web site at http://www.nrc.gov/OPA/finder.htm (NRC 1999) and in NRC Docket Nos. 50–413 and 50–414.

3.7.1.1 Air Quality

Catawba is within the Metropolitan Charlotte, North Carolina, AQCR #167. None of the areas within the site or York County are designated as nonattainment areas with respect to the NAAQS for criteria air pollutants (EPA 1998d).

Sources of criteria air pollutants from Catawba include five emergency diesel generators, a safe shutdown facility generator, and miscellaneous equipment such as trucks and forklifts. Table 3–71 provides a summary of criteria pollutant concentrations from operations of Catawba. The concentrations resulting from operations are well below the applicable ambient air quality standards even when background concentrations from other offsite sources are considered.

3.7.1.2 Waste Management

Table 3–72 presents the 5-year average annual waste generation rates for Catawba.

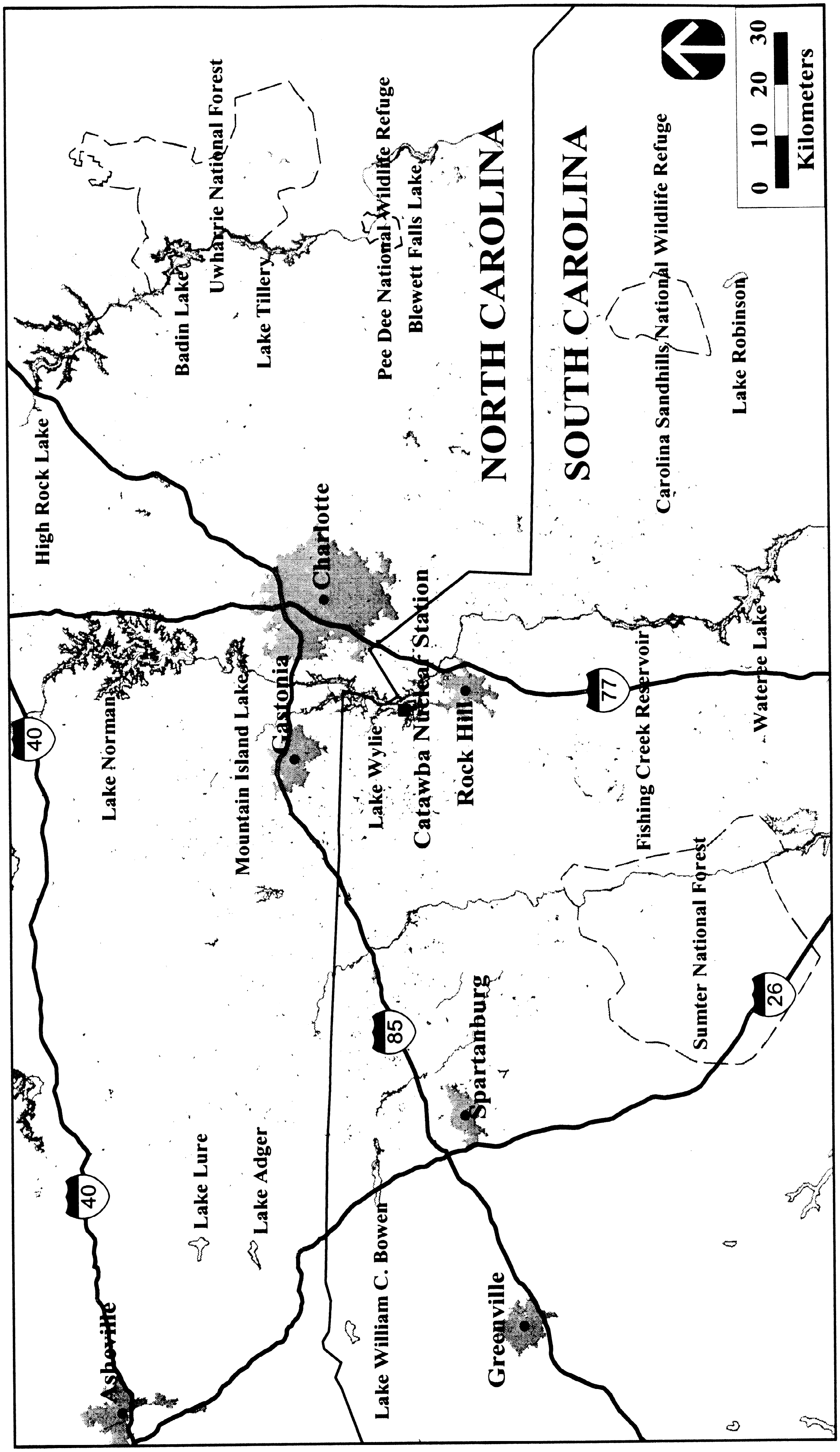

Figure 3–34. Catawba Nuclear Power Plant, South Carolina

Table 3–71. Comparison of Contribution to Nonradiological Ambient Air Pollutant Concentrations From Catawba Sources With National Ambient Air Quality Standards

Pollutant	Averaging Period	NAAQS (Fg/m^3)	Catawba (Fg/m^3)
Carbon monoxide	8 hours	10,000	978
	1 hour	40,000	1,400
Nitrogen dioxide	Annual	100	3.26
PM_{10}	Annual	50	0.102
	24 hours	150	65.9
$PM_{2.5}$	3-year annual	15	(a)
	24 hours (98th percentile over 3 years)	65	(a)
Sulfur dioxide	Annual	80	0.0418
	24 hours	365	26.9
	3 hours	1,300	60.4

[a] No data is available with which to assess $PM_{2.5}$ concentrations.
Key: NAAQS, National Ambient Air Quality Standards.
Note: Based on 1994–1995 emissions data for diesel generators.
Source: Modeled concentrations based on DOE 1999f; EPA 1997a.

Table 3–72. Annual Waste Generation for Catawba (m^3)

Waste Type	Generation Rate
LLW	50
Mixed LLW	0.6[a]
Hazardous waste	29[a]
Nonhazardous waste	
Liquid	60,794[b]
Solid	455[a]

[a] Values converted from kilograms assuming a waste density such that 1 m^3 = 1,000 kg.
[b] Assuming sanitary wastewater is generated at the same rate 365 days per year.
Key: LLW, low-level waste.
Source: DOE 1999f.

The waste disposal systems provide all equipment necessary to collect, process, store, and prepare for disposal of all radioactive liquid and solid wastes produced as a result of reactor operations. Potentially radioactive liquids may originate from a variety of sources, including the steam generator blowdown system, ventilation unit condensate system, drainage system sumps, laboratory drains, personnel decontamination area drains, decontamination system, sampling system, and laundry drains. Potentially radioactive liquid wastes are collected and characterized as to the level of contamination present. If contamination is below regulated levels, liquids may be discharged to the circulating water discharge outfall in accordance with the National Pollutant Discharge Elimination System (NPDES) permit. If liquids are determined to be radioactively contaminated, they are treated by filtration, evaporation, or mixing and settling, or are sent to the demineralizers, before being discharged. Continuous radiation monitoring is provided for treated liquid waste before its release to the circulating water discharge outfall. Liquid waste is analyzed and monitored to ensure that radionuclide concentrations are maintained as low as practical and well within the limits of applicable regulations and permits (Duke Power 1997:11-9–11-27).

The radioactive solid waste disposal system provides facilities for holdup, packaging, and storage of wastes before shipment to offsite licensed treatment and disposal facilities. Radioactive solid waste may include evaporator concentrates, spent demineralizer resins, spent filters, laboratory wastes, rags, gloves, boots, brooms, and other miscellaneous tools and apparel that become contaminated during normal plant operations and maintenance. Treatment on the site may include dewatering and compaction, or solidification using a contractor-supplied mobile unit. Materials that are compressible are placed in 208-l (55-gal) drums for compaction. Spent radioactive filter cartridges are packaged in either 114-l (30-gal) or 208-l (55-gal) drums. Packaged wastes are stored in the filter cartridge storage bunker, low-activity-waste storage room, high-activity-waste storage room, solidification area, and waste shipping area before being shipped to an offsite treatment or disposal facility (Duke Power 1997:11-53–11-61).

The small quantities of mixed low-level and hazardous wastes generated are accumulated on the site before being shipped for commercial treatment and disposal in offsite permitted facilities. Nonhazardous solid wastes are generated by typical industrial processes and housekeeping activities and are collected on the site and managed off the site at the local permitted sanitary landfill. Nonhazardous sanitary wastewater is treated in the onsite sanitary wastewater treatment facility and then discharged to Lake Wylie (Sadler 1997:6).

3.7.1.3 Existing Human Health Risk

Major sources and levels of background radiation exposure to individuals within the vicinity of Catawba are shown in Table 3–73. Annual background radiation doses to individuals are expected to remain constant over time. Total dose to the population changes as population size changes. Background radiation doses are unrelated to reactor operations.

Table 3–73. Sources of Radiation Exposure to Individuals in the Catawba Vicinity Unrelated to Catawba Operations

Source	Effective Dose Equivalent (mrem/yr)
Natural background radiation	
Cosmic and external and internal terrestrial radiation[a]	125
Radon in homes (inhaled)[b]	200[c]
Other background radiation[b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	390

[a] Virginia Power 1998:11B-3.
[b] NCRP 1987:11, 40, 53.
[c] An average for the United States.

Releases of radionuclides to the environment from normal reactor operations provide another source of radiation exposure to populations within the vicinity of the site. The doses to the public resulting from these releases are shown in Table 3–74. These doses fall within regulatory limits and are small when compared with background exposure.

Using a risk estimator of 500 cancer deaths per 1 million person-rem (5×10^{-4} fatal cancer per person-rem) to the public (see Appendix F.10), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from normal reactor operations in 1997 is estimated to be 7.8×10^{-8}. That is, the estimated

Table 3–74. Radiological Impacts on the Public From Catawba Operations in 1997 (Total Effective Dose Equivalent)

	Atmospheric Releases		Liquid Releases		Total	
Members of the Public	**Standard[a]**	**Actual**	**Standard[a]**	**Actual**	**Standard[a]**	**Actual**
Maximally exposed individual (mrem)	5	0.045	3	0.11	25	0.16
Population within 80 km (person-rem)[b]	NA	4.0	NA	4.3	NA	8.3

[a] The standards for individuals are given in 10 CFR 50, Appendix I. The standard for the maximally exposed offsite individual (25 mrem/yr total body from all pathways) is given in 40 CFR 190.

[b] Population used: 1,656,093; this population dose was estimated for the year 2000 and is assumed to be representative for the year 1997.

Key: NA, not applicable.

Source: DOE 1999f; Duke Power 1997:tables 2-13, 11-12, and 11-15.

probability of this person dying from cancer from radiation exposure from 1 year of normal reactor operations is about 1 chance in 13 million.

According to the same risk estimator, 0.0042 excess fatal cancer is projected among the population living within 80 km (50 mi) of Catawba in 1997. For perspective, this number can be compared with the number of fatal cancers expected in this population from all causes. The 1996 mortality rate associated with cancer for the entire population was 0.2 percent per year (Famighetti 1998:964). Based on this national rate, the number of fatal cancers from all causes expected during 1997 in the population living within 80 km (50 mi) of Catawba was about 3,300. This number of expected fatal cancers is much higher than the estimated 0.0042 fatal cancer that could result from normal reactor operations in 1997.

Workers at the reactors receive the same background radiation dose as the general public; however, they receive an additional dose from normal operations of the reactors. Table 3–75 includes average, maximally exposed, and total occupational doses to reactor workers from operations in 1997. Based on a risk estimator of 400 cancer deaths per 1 million person-rem (4×10^{-4} fatal cancer per person-rem) among workers, the number of fatal cancers to reactor workers from 1997 normal operations is estimated to be 0.11.

Table 3–75. Radiological Impacts on Involved Workers From Catawba Operations in 1997

Number of badged workers[a]	3,420
Total dose (person-rem/yr)	265
Annual latent fatal cancers	0.11
Average worker dose (mrem/yr)	78
Annual risk of latent fatal cancer	3.1×10^{-5}

[a] A badged worker is equipped with an individual dosimeter.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (10 CFR 20). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: DOE 1999f.

3.7.1.4 Environmental Justice

Environmental justice concerns the environmental impacts that proposed actions may have on minority and low-income populations, and whether such impacts are disproportionately high and adverse (CEQ 1997). In the case of Catawba, the potentially affected area includes parts of North Carolina and South Carolina.

The potentially affected area around Catawba is defined by a circle with an 80-km (50-mi) radius centered at these reactors (lat. 35E03N05O N, long. 81E04N10O W). The total population residing within that area in 1990 was 1,519,392. The proportion of the population that was considered minority was 20.7 percent. The same census data show that the percentage of minorities for the contiguous United States was 24.1, and the percentages of the States of North Carolina and South Carolina were 25.0 and 31.5, respectively (DOC 1992).

At the time of the 1990 census, Blacks were the largest minority group within the potentially affected area, constituting 19.0 percent of the total population. Asians and Hispanics contributed about 0.7 percent, and Native Americans made up about 0.3 percent of the population (DOC 1992).

A breakdown of incomes in the potentially affected area is also available from the 1990 census data (DOC 1992). At that time, the poverty threshold was $9,981 for a family of three with one related child under 18 years of age. A total of 159,956 persons (10.5 percent of the total population) residing within the potentially affected area around Catawba reported incomes below that threshold. Data obtained during the 1990 census also show that of the total population of the contiguous United States, 13.1 percent reported incomes below the poverty threshold and that the figures for North Carolina and South Carolina were 13.0 and 15.4 percent, respectively (DOC 1992).

3.7.2 McGuire Units 1 and 2 Site Overview

The McGuire nuclear power plant occupies 280 ha (700 acres) in northwestern Mecklenburg County, North Carolina, 27.4 km (17 mi) northwest of Charlotte, North Carolina (see Figure 3–35). The site is bounded to the west by the Catawba River and to the north by Lake Norman. Surrounding land is generally rural nonfarmland. Lake Norman, with a surface area of 13,156 ha (32,510 acres), a volume of 1,349 million m^3 (1,093,600 acre-ft) and a shoreline of 837 km (520 mi), stretches 54.7 km (34 mi) from Cowans Ford Dam to the tailrace of Lookout Lake. The Charlotte municipal water intake is 18 km (11.2 mi) downstream from the site (Duke Power 1996:2-3, 2-27, 2-28; Nesbit 1999; Ritchey 1996). In addition, the communities of Belmont, Gastonia, and Mount Holly, North Carolina, and Chester, Fort Lawn, Fort Mill, Lancaster, Mitford, Riverview, and Rock Hill, South Carolina, obtain at least a portion of their municipal water supplies from the Catawba River within 80 km (50 mi) downstream from the site (Duke Power 1997:2-41, table 2-52).

In 1997, the plant employed 1,238 persons (DOE 1999f). The McGuire reactors are operated by Duke Power Company. The operating licenses (Nos. NPF–9 and NPF–17) for these reactors were granted in 1981 and 1983, and expire in 2021 and 2023, respectively (NRC 1997). The population within an 80-km (50-mi) radius of these reactors is estimated to be 2,140,720 (Duke Power 1996:table 2-1). Reactor cooling is accomplished using a once-through cooling system. Cooling water is withdrawn from Lake Norman at a rate of 7,025,937 million l/yr (1,856,062 million gal/yr) and discharged back into Lake Norman at a rate of 6,966,567 million l/yr (1,840,378 million gal/yr). The net difference in water (59,370 million l/yr [15,684 million gal/yr]) is due to evaporation (DOE 1999f).

New (unirradiated) fuel assemblies are dry stored in racks located in the two New Fuel Storage Vaults. Each New Fuel Storage Vault is designed to accommodate 96 fuel assemblies (a total of 192 assemblies). Spent (irradiated) fuel assemblies are stored in two spent fuel pools in the two Auxiliary Buildings. The two spent fuel storage pools have a total capacity of 2,926 assemblies. New fuel can also be stored in the spent fuel pools (Duke Power 1996:9-3–9-8). Security at the site is provided in accordance with NRC regulations and includes security checkpoints, barbed wire fencing, surveillance cameras, and intruder detection. More information about these reactors can be found at the NRC Web site at http://www.nrc.gov/OPA/finder.htm (NRC 1999) and in NRC Docket Nos. 50–369 and 50–370.

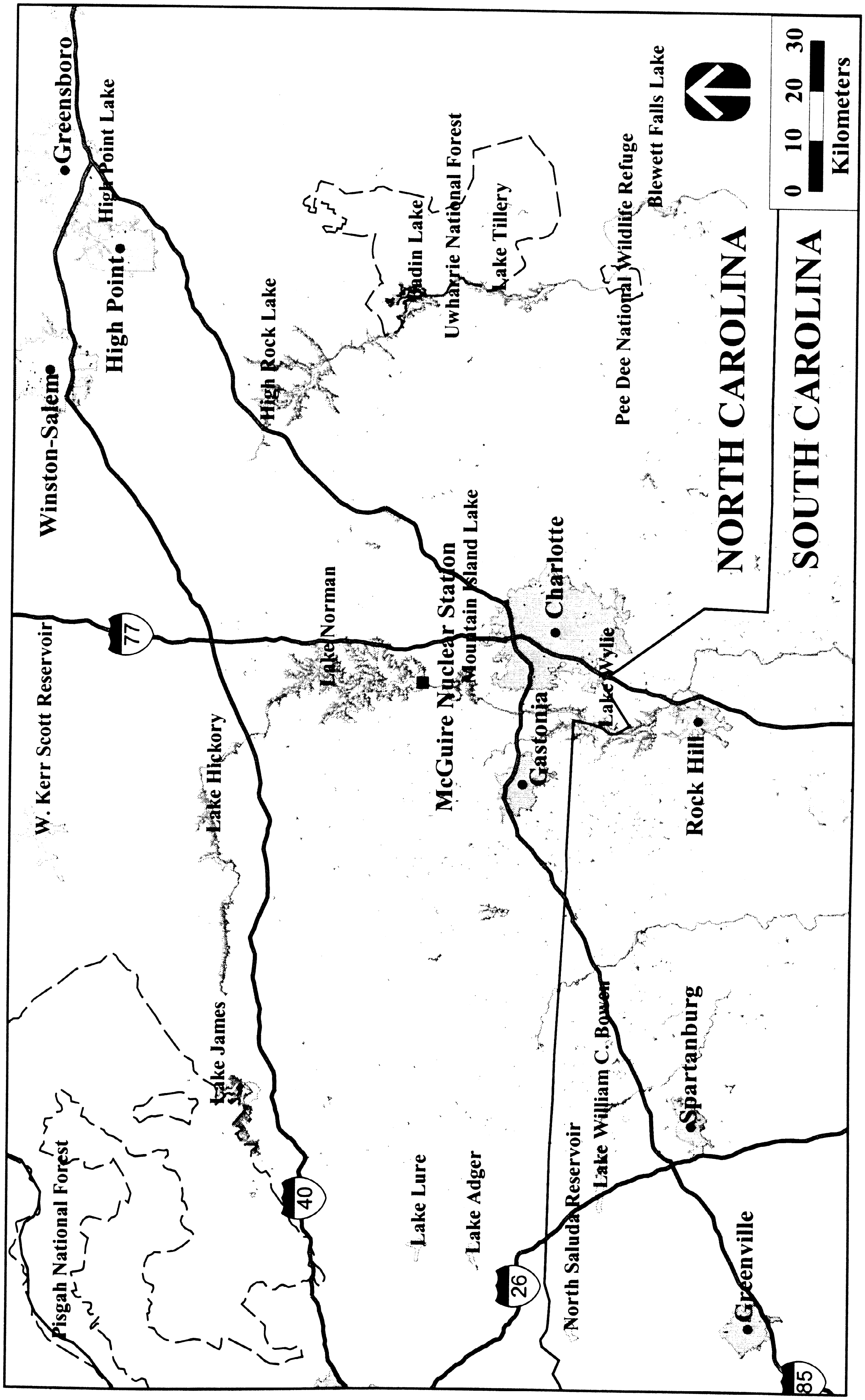

Figure 3–35. McGuire Nuclear Power Plant, North Carolina

3.7.2.1 Air Quality

McGuire is within the Metropolitan Charlotte AQCR #167. None of the areas within the site or Mecklenberg County are designated as nonattainment areas with respect to the NAAQS for criteria air pollutants (EPA 1998e).

Sources of criteria air pollutants from McGuire include five emergency diesel generators, a safe shutdown facility generator, and miscellaneous equipment such as trucks and forklifts. Table 3–76 provides a summary of criteria pollutant concentrations from operations of McGuire. The concentrations resulting from operations are well below the applicable ambient air quality standards even when background concentrations from other offsite sources are considered.

Table 3–76. Comparison of Contribution to Nonradiological Ambient Air Pollutant Concentrations From McGuire Sources With National Ambient Air Quality Standards

Pollutant	Averaging Period	NAAQS ($\mu g/m^3$)	McGuire ($\mu g/m^3$)
Carbon monoxide	8 hours	10,000	1,060
	1 hour	40,000	1,510
Nitrogen dioxide	Annual	100	2.55
PM_{10}	Annual	50	0.0799
	24 hours	150	71.2
$PM_{2.5}$	3-year annual	15	(a)
	24 hours (98th percentile over 3 years)	65	(a)
Sulfur dioxide	Annual	80	0.0336
	24 hours	365	29.9
	3 hours	1,300	67.4

[a] No data is available with which to assess $PM_{2.5}$ concentrations.
Key: NAAQS, National Ambient Air Quality Standards.
Note: Based on 1994–1997 emissions data for diesel generators.
Source: Modeled concentrations based on DOE 1999f; EPA 1997a.

3.7.2.2 Waste Management

Table 3–77 presents the 5-year average annual waste generation rates for McGuire.

The waste disposal systems provide all equipment necessary to collect, process, store, and prepare for disposal of all radioactive liquid and solid wastes produced as a result of reactor operations. Potentially radioactive liquids may originate from a variety of sources, including the steam generator blowdown system, ventilation unit condensate system, drainage system sumps, laboratory drains, personnel decontamination area drains, decontamination system, sampling system, and laundry drains. Potentially radioactive liquid wastes are collected and characterized as to the level of contamination present. If contamination is below regulated levels, liquids may be discharged to the circulating water discharge outfall in accordance with the NPDES permit. If liquids are determined to be radioactively contaminated, they are treated by filtration, evaporation, or mixing and settling, or are sent to the demineralizers, before being discharged. Continuous radiation monitoring is provided for treated waste before its release to the circulating water discharge outfall. Liquid waste is analyzed and monitored to ensure that radionuclide concentrations are maintained as low as practical and well within the limits of applicable regulations and permits (Duke Power 1996:11-9–11-26).

Table 3–77. Annual Waste Generation for McGuire (m^3)

Waste Type	Generation Rate
LLW	42.2
Mixed LLW	0.19[a]
Hazardous waste	28.6[a]
Nonhazardous waste	
Liquid	49,740[b]
Solid	568[a]

[a] Values converted from kilograms assuming a waste density such that 1 m^3 = 1,000 kg.
[b] Assuming sanitary wastewater is generated at the same rate 365 days per year.
Key: LLW, low-level waste.
Source: DOE 1999f.

The radioactive solid waste disposal system provides facilities for holdup, packaging, and storage of wastes before shipment to offsite licensed treatment and disposal facilities. Radioactive solid waste may include evaporator concentrates, spent demineralizer resins, spent filters, laboratory wastes, contaminated oils, rags, gloves, boots, sweepings, brooms, and other miscellaneous tools and apparel that become contaminated during normal plant operations and maintenance. Treatment on the site may include dewatering, or solidification using a contractor-supplied mobile unit. Low-activity solid wastes, such as rags, clothing, and sweepings, are loaded directly into storage containers for shipment to an offsite treatment or disposal facility. Spent radioactive filter cartridges are packaged in drums or other waste containers, with spent resin solidified, if required. The disposal of slightly contaminated sludge from the wastewater treatment plant is carried out by landspreading the sludge on a site contiguous to McGuire using a method approved by the State of North Carolina and NRC. Packaged wastes are stored in the filter storage bunker, solidified liner storage bunker, and the shielded storage bunker before being shipped to an offsite treatment or disposal facility (Duke Power 1996:11-49–11-56).

The small quantities of mixed LLW and hazardous waste generated are accumulated on the site before being shipped for commercial treatment and disposal in offsite permitted facilities. Nonhazardous solid wastes are generated by typical industrial processes and housekeeping activities and are collected on the site and managed off the site at the local permitted sanitary landfill. Nonhazardous sanitary wastewater is discharged to the Charlotte Mecklenburg Utility Department sanitary sewer system (Duke Power 1994).

3.7.2.3 Existing Human Health Risk

Major sources and levels of background radiation exposure to individuals within the vicinity of McGuire are shown in Table 3–78. Annual background radiation doses to individuals are expected to remain constant over time. Total dose to the population changes as population size changes. Background radiation doses are unrelated to reactor operations.

Releases of radionuclides to the environment from normal reactor operations provide another source of radiation exposure to populations within the vicinity of the site. The doses to the public resulting from these releases are shown in Table 3–79. These doses fall within regulatory limits and are small when compared with background exposure.

Using a risk estimator of 500 cancer deaths per 1 million person-rem (5×10^{-4} fatal cancer per person-rem) to the public (see Appendix F.10), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from normal reactor operations in 1997 is estimated to be 4.9×10^{-8}. That is, the estimated

Table 3–78. Sources of Radiation Exposure to Individuals in the McGuire Vicinity Unrelated to McGuire Operations

Source	Effective Dose Equivalent (mrem/yr)
Natural background radiation	
Cosmic and external and internal terrestrial radiation[a]	125
Radon in homes (inhaled)[b]	200[c]
Other background radiation[b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	390

[a] Virginia Power 1998:11B-3.
[b] NCRP 1987:11, 40, 53.
[c] An average for the United States.

Table 3–79. Radiological Impacts on the Public From McGuire Operations in 1997 (Total Effective Dose Equivalent)

	Atmospheric Releases		Liquid Releases		Total	
Members of the Public	**Standard[a]**	**Actual**	**Standard[a]**	**Actual**	**Standard[a]**	**Actual**
Maximally exposed individual (mrem)	5	0.033	3	0.065	25	0.098
Population within 80 km (person-rem)[b]	NA	2.8	NA	93	NA	96

[a] The standards for individuals are given in 10 CFR 50, Appendix I. The standard for maximally exposed offsite individual (25 mrem/yr total body from all pathways) is given in 40 CFR 190.
[b] Population used: 2,140,720; this population dose was estimated for the year 2000 and is assumed to be representative for the year 1997.
Key: NA, not applicable.
Source: DOE 1999f; Duke Power 1974:5.3-7, table 5.3.5-1; 1996:table 2-1.

probability of this person dying from cancer from radiation exposure from 1 year of normal reactor operations is about 1 chance in 20 million.

According to the same risk estimator, 0.048 excess fatal cancer is projected among the population living within 80 km (50 mi) of McGuire in 1997. For perspective, this number can be compared with the number of fatal cancers expected in this population from all causes. The 1996 mortality rate associated with cancer for the entire population was 0.2 percent per year (Famighetti 1998:964). Based on this national rate, the number of fatal cancers from all causes expected during 1997 in the population living within 80 km (50 mi) of McGuire was about 4,300. This number of expected fatal cancers is much higher than the estimated 0.048 fatal cancer that could result from normal reactor operations in 1997.

Workers at the reactors receive the same background radiation dose as the general public; however, they receive an additional dose from normal operations of the reactors. Table 3–80 includes average, maximally exposed, and total occupational doses to reactor workers from operations in 1997. Based on a risk estimator of 400 cancer deaths per 1 million person-rem (4×10^{-4} fatal cancer per person-rem) among workers, the number of fatal cancers to reactor workers from 1997 normal operations is estimated to be 0.20.

Table 3–80. Radiological Impacts on Involved Workers From McGuire Operations in 1997

Number of badged workers[a]	3992
Total dose (person-rem/yr)	492
Annual latent fatal cancers	0.20
Average worker dose (mrem/yr)	123
Annual risk of latent fatal cancer	4.9×10^{-5}

[a] A badged worker is equipped with an individual dosimeter.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (10 CFR 20). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: DOE 1999f.

3.7.2.4 Environmental Justice

Environmental justice concerns the environmental impacts that proposed actions may have on minority and low-income populations, and whether such impacts are disproportionately high and adverse (CEQ 1997). In the case of McGuire, the potentially affected area includes parts of North Carolina and South Carolina.

The potentially affected area around McGuire is defined by a circle with an 80-km (50-mi) radius centered at these reactors (lat. 35E25N59O N, long. 80E56N55O W). The total population residing within that area in 1990 was 1,738,966. The proportion of the population that was considered minority was 17.6 percent. The same census data show that the percentage of minorities for the contiguous United States was 24.1, and the percentages of the States of North and South Carolina were 25.0 and 31.5, respectively (DOC 1992).

At the time of the 1990 census, Blacks were the largest minority group within the potentially affected area, constituting 15.9 percent of the total population. Hispanics and Asians contributed about 0.7 percent, and Native Americans made up about 0.3 percent of the population (DOC 1992).

A breakdown of incomes in the potentially affected area is also available from the 1990 census data (DOC 1992). At that time, the poverty threshold was $9,981 for a family of three with one related child under 18 years of age. A total of 170,956 persons (9.8 percent of the total population) residing within the potentially affected area around McGuire reported incomes below that threshold. Data obtained during the 1990 census also show that of the total population of the contiguous United States, 13.1 percent reported incomes below the poverty threshold, and that the figures for North Carolina and South Carolina were 13.0 and 15.4 percent, respectively (DOC 1992).

3.7.3 North Anna Units 1 and 2 Site Overview

The North Anna nuclear power plant occupies 422 ha (1,043 acres) in Louisa County, Virginia, approximately 64.4 km (40 mi) north-northwest of Richmond, Virginia, and 113 km (70 mi) southwest of Washington, D.C. (see Figure 3–36). The largest community within 16 km (10 mi) of the site is the town of Mineral in Louisa County. The site is on a peninsula on the southern shore of Lake Anna. Lake Anna is approximately 27.4 km (17 mi) long, with a surface area of 5,260 ha (13,000 acres) and 322 km (200 mi) of shoreline. The reservoir contains approximately 380 billion l (100 billion gal) of water (Virginia Power 1998:2.1-1, 2.1-2).

In 1997, the plant employed 552 persons (DOE 1999f). The North Anna reactors are operated by the Virginia Power Company. The operating licenses (Nos. NPF–4 and NPF–7) for these reactors were granted in 1978 and 1980, and expire in 2018 and 2020, respectively (NRC 1997). It is estimated that the population within an 80-km (50-mi) radius of the reactor is 1,614,983 (Virginia Power 1998:2.1-21).

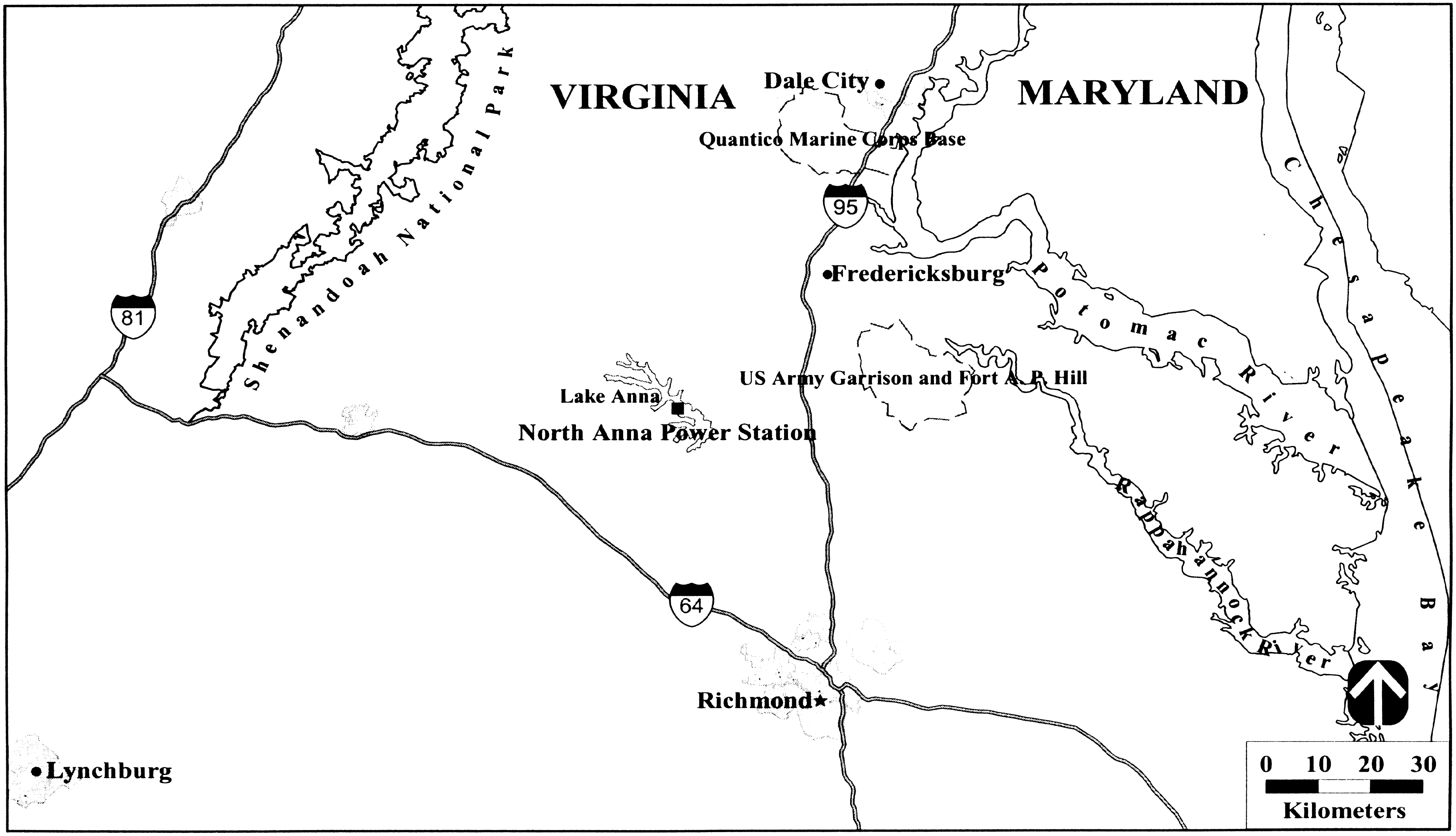

Figure 3–36. North Anna Nuclear Power Plant, Virginia

Reactor cooling is accomplished using a once-through cooling system with water obtained from Lake Anna (Virginia Power 1998:2.1-2). The rate of cooling water withdrawal is 5,564,000 million l/yr (1,470,000 million gal/yr), with all water returned to Lake Anna (DOE 1999f). There are no known industrial users downstream from the site until some 97 km (60 mi) downstream at West Point, where a large pulp and paper manufacturing plant is located. There are no known potable water withdrawals along the entire stretch of the river downstream to West Point, where the river becomes brackish (Virginia Power 1998:2.4-3).

New (unirradiated) fuel assemblies are dry stored in the new fuel storage area of the fuel building. The new fuel storage area has a capacity of 126 fuel assemblies. Spent (irradiated) fuel assemblies are stored under water in the spent fuel pit in the fuel building. The spent fuel storage pit has a capacity of 1,737 fuel assemblies (Virginia Power 1998:9.1-1, 9.1-2). Dry cask storage is being developed and is expected to have a capacity of an additional 1,824 assemblies (NRC 1998). Security at the site is provided in accordance with NRC regulations and includes security checkpoints, barbed wire fencing, surveillance cameras, and intruder detection. More information about these reactors can be found at the NRC Web site at http://www.nrc.gov/OPA/finder.htm (NRC 1999) and in NRC Docket Nos. 50–338 and 50–339.

3.7.3.1 Air Quality

North Anna is within the Northeastern Virginia AQCR #224. None of the areas within the site or Louisa County are designated as nonattainment areas with respect to the NAAQS for criteria air pollutants (EPA 1998f).

Sources of criteria air pollutants from North Anna include two auxiliary boilers, four emergency diesel generators, a station blackout generator, and miscellaneous equipment such as trucks and forklifts. Table 3–81 provides a summary of criteria pollutant concentrations from operations of North Anna. The concentrations resulting from operationsare well below the applicable ambient air quality standards even when background concentrations from other offsite sources are considered.

3.7.3.2 Waste Management

Table 3–82 presents the 5-year average annual waste generation rates for North Anna.

The waste disposal systems provide all equipment necessary to collect, process, store, and prepare for disposal of all radioactive liquid and solid wastes produced as a result of reactor operations. Potentially radioactive liquids may originate from a variety of sources, including the boron recovery system, steam generator blowdown system, drainage system sumps, laboratory drains, personnel decontamination area drains, decontamination system, sampling system, laundry drains, and spent resin flush system. Potentially radioactive liquid wastes are collected and characterized as to the level of contamination present. If contamination is below regulated levels, liquids may be discharged to the circulating water discharge outfall in accordance with the NPDES permit. If liquids are determined to be radioactively contaminated, they are treated by the ion exchange filtration system or demineralizers to reduce contamination before being discharged. Continuous radiation monitoring is provided for treated liquid waste before its release to the circulating water discharge outfall. Liquid waste is analyzed and monitored to ensure that radionuclide concentrations are maintained as low as practical and well within the limits of applicable regulations and permits (Virginia Power 1998:11.2-1, 11.2-2).

The radioactive solid waste disposal system provides facilities for holdup, packaging, and storage of wastes before shipment to offsite treatment and disposal facilities. Radioactive solid waste may include spent resin slurries, spent filter cartridges, rags, gloves, boots, brooms, and other miscellaneous tools and apparel that become contaminated during normal plant operations and maintenance. Contaminated solid materials resulting

Table 3–81. Comparison of Contribution to Nonradiological Ambient Air Pollutant Concentrations From North Anna Sources With National Ambient Air Quality Standards

Pollutant	Averaging Period	NAAQS (Fg/m^3)	North Anna (Fg/m^3)
Carbon monoxide	8 hours	10,000	416
	1 hour	40,000	594
Nitrogen dioxide	Annual	100	0.00504
PM_{10}	Annual	50	0.00407
	24 hours	150	15.4
$PM_{2.5}$	3-year annual	15	(a)
	24 hours (98th percentile over 3 years)	65	(a)
Sulfur dioxide	Annual	80	0.0167
	24 hours	365	63
	3 hours	1,300	142

[a] No data is available with which to assess $PM_{2.5}$ concentrations.
Key: NAAQS, National Ambient Air Quality Standards.
Note: Based on 1997 emissions data for diesel generators.
Source: Modeled concentrations based on DOE 1999f; EPA 1997a.

Table 3–82. Annual Waste Generation for North Anna (m^3)

Waste Type	Generation Rate
LLW	236.6[a]
Mixed LLW	0
Hazardous waste	11.4
Nonhazardous waste	
Liquid	681
Solid	10,400

[a] Two-year average (1996–1997).
Key: LLW, low-level waste.
Source: DOE 1999f.

from station maintenance are stored in specified areas of the auxiliary building and the decontamination building. Materials that are compressible are placed in 208-l (55-gal) drums for compaction at the bailing facility. Compressible materials and other contaminated solid materials that are not placed in drums are placed in 6.1-m (20-ft) seavans for shipment to offsite licensed treatment and disposal facilities. Contaminated metallic materials and highly contaminated solid objects are placed inside disposable containers for shipment to a disposal facility (Virginia Power 1998:11.5-1–11.5-3).

The small quantities of mixed LLW and hazardous waste generated are accumulated on the site before being shipped for commercial treatment and disposal in offsite permitted facilities. Nonhazardous solid wastes are generated by typical industrial processes and housekeeping activities and are collected on the site and managed off the site at the local permitted sanitary landfill. Nonhazardous sanitary wastewater is treated in the onsite sanitary wastewater treatment facility and then discharged to Lake Anna (VADEQ 1997:9, 28).

3.7.3.3 Existing Human Health Risk

Major sources and levels of background radiation exposure to individuals within the vicinity of North Anna are shown in Table 3–83. Annual background radiation doses to individuals are expected to remain constant over time. Total dose to the population changes as population size changes. Background radiation doses are unrelated to reactor operations.

Table 3–83. Sources of Radiation Exposure to Individuals in the North Anna Vicinity Unrelated to North Anna Operations

Source	Effective Dose Equivalent (mrem/yr)
Natural background radiation	
Cosmic and external and internal terrestrial radiation[a]	125
Radon in homes (inhaled)[b]	200[c]
Other background radiation[b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	390

[a] Virginia Power 1998:11B-3.
[b] NCRP 1987:11, 40, 53.
[c] An average for the United States.

Releases of radionuclides to the environment from normal reactor operations provide another source of radiation exposure to populations within the vicinity of the site. The doses to the public resulting from these releases are shown in Table 3–84. These doses fall within regulatory limits and are small when compared with background exposure.

Table 3–84. Radiological Impacts on the Public From North Anna Operations in 1997 (Total Effective Dose Equivalent)

Members of the Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Maximally exposed individual (mrem)	5	6.1×10^{-4}	3	0.28	25	0.28
Population within 80 km (person-rem)[b]	NA	6.0	NA	9.0	NA	15.0

[a] The standards for individuals are given in 10 CFR 50, Appendix I. The standard for the maximally exposed offsite individual (25 mrem/yr total body from all pathways) is given in 40 CFR 190.
[b] Population used: 1,614,983; this population dose was estimated for the year 2000 and is assumed to be representative for the year 1997. Population doses were ratioed to reflect latest census data projections.
Key: NA, not applicable.
Source: DOE 1999f; Virginia Power 1998:2.1-21, 11B-3, 11.3-13.

Using a risk estimator of 500 cancer deaths per 1 million person-rem (5×10^{-4} fatal cancer per person-rem) to the public (see Appendix F.10), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from normal reactor operations in 1997 is estimated to be 1.4×10^{-7}. That is, the estimated probability of this person dying from cancer from radiation exposure from 1 year of normal reactor operations is about one chance in seven million.

According to the same risk estimator, 0.0075 excess fatal cancer is projected among the population living within 80 km (50 mi) of North Anna in 1997. For perspective, this number can be compared with the number of fatal cancers expected in this population from all causes. The 1996 mortality rate associated with cancer for the entire population was 0.2 percent per year (Famighetti 1998:964). Based on this national rate, the number of fatal cancers from all causes expected during 1997 in the population living within 80 km (50 mi) of North Anna was about 3,200. This number of expected fatal cancers is much higher than the estimated 0.0075 fatal cancer that could result from normal reactor operations in 1997.

Workers at the reactors receive the same background radiation dose as the general public, however, they receive an additional dose from normal operations of the reactors. Table 3–85 includes average, maximally exposed, and total occupational doses to reactor workers from operations in 1997. Based on a risk estimator of 400 cancer deaths per 1 million person-rem (4×10^{-4} fatal cancer per person-rem) among workers, the number of fatal cancers to reactor workers from 1997 normal operations is estimated to be 0.041.

Table 3–85. Radiological Impacts on Involved Workers From North Anna Operations in 1997

Number of badged workers[a]	2,243
Total dose (person-rem/yr)	103
Annual latent fatal cancers	0.041
Average worker dose (mrem/yr)	46
Annual risk of latent fatal cancer	1.8×10^{-5}

[a] A badged worker is equipped with an individual dosimeter.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (10 CFR 20). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: DOE 1999f.

3.7.3.4 Environmental Justice

Environmental justice concerns the environmental impacts that proposed actions may have on minority and low-income populations, and whether such impacts are disproportionately high and adverse (CEQ 1997). In the case of North Anna, the potentially affected area includes parts of Maryland and Virginia.

The potentially affected area around North Anna is defined by a circle with an 80-km (50-mi) radius centered around these reactors (lat. 38E03N37O N, long. 77E47N24O W). The total population residing within that area in 1990 was 1,286,156. The proportion of the population that was considered minority was 21.9 percent. The same census data show that the percentages of minorities for the contiguous United States was 24.1, and the percentage of the States of Maryland and Virginia were 30.4 and 24.0, respectively (DOC 1992).

At the time of the 1990 census, Blacks were the largest minority group within the potentially affected area, constituting 18.8 percent of the total population. Asians contributed about 1.5 percent, and Hispanics, about 1.4 percent. Native Americans made up about 0.3 percent of the population (DOC 1992).

A breakdown of incomes in the potentially affected area is also available from the 1990 census data (DOC 1992). At that time, the poverty threshold was $9,981 for a family of three with one related child under 18 years of age. A total of 88,162 persons (6.9 percent of the total population) residing within the potentially affected area around North Anna reported incomes below that threshold. Data obtained during the 1990 census also show that of the total population of the contiguous United States, 13.1 percent reported incomes below the poverty threshold, and that the figures for Maryland and Virginia were 8.3 and 10.3 percent, respectively (DOC 1992).

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