5 ENVIRONMENTAL CONSEQUENCES

This chapter discusses the potential environmental consequences of the construction and operation of the Fuel Materials Facility (FMF) at the Savannah River Plant (SRP), including postulated facility accidents and the transportation of feed and product materials. Equivalent assessments were performed for the alternate site on the Oak Ridge Reservation (ORR); potential differences between the SRP and ORR sites are presented in Chapter 6.

5.1 CONSTRUCTION EFFECTS

This section describes the potential environmental effects that might be expected to result from the construction of the Fuel Materials Facility and the measures that will be implemented to control such effects.

5.1.1 Socioeconomics

The potential socioeconomic impacts of constructing the Fuel Materials Facility are related closely to assumptions concerning other major projects. Although the potential socioeconomic impacts expected from the construction of the facility are not considered significant, the potential composite impacts (Section 5.6.1) are considered to be greater than those from the Fuel Materials Facility by itself (discussed in this section). Major areas of potential impact include the effects of the inmigrating construction work force on schools, housing, police and fire protection, water and waste-water systems, traffic, and the local economy.

The construction of this facility is anticipated to begin during the last quarter of 1982 and to conclude by the end of 1985. A peak construction work force of 580 employees is expected to occur in mid-1984, as shown in Figure 5-1. In addition to this construction work force, approximately 80 prestart employees are expected to be hired during the peak construction period; thus, the total peak work force at the Savannah River Plant for the Fuel Materials Facility will be 660 employees.*

Using the latest composite construction employment projections (Section 5.6.1) and previous modeling scenarios of the SRP regional labor force (DOE, 1981), about 180 employees are assumed to relocate into a 110-kilometer (70-mile) area surrounding the Plant. The total population associated with these inmovers is expected to be about 445 persons. Table 5-1 summarizes potential socioeconomic impacts for the major areas analyzed.

The population associated with the projected construction inmovers and their distribution is not expected to affect the population growth trends of the six-county area. The inmigrating population will account for approximately 2 percent of the total indigenous population growth in the six-county

---

*FMF employment data were provided by E. I. du Pont de Nemours & Company, Savannah River Laboratory, September 24, 1981.

Table 5-1. Socioeconomic impact on the six-county SRP area from the construction of the Fuel Materials Facility

Demographic and school impacts

Location	Projected 1984 population	FMF work force		FMF population		School-age children of FMF workers	
		Commuters[a]	In-movers	Number	Percent of 1980-1984 indigenous growth	Number	Percent of 1980-1984 indigenous growth
South Carolina							
Aiken	111,775		80	195	3.2	40	1.8
Allendale	11,220		5	15	2.9	5	2.8
Bamberg	18,870		5	15	2.0	5	1.4
Barnwell	21,520		35	85	5.1	15	2.8
Georgia							
Columbia	44,870		10	25	0.5	5	0.3
Richmond	190,180		45	110	1.3	20	0.6
Total	398,435	455	180	445		90	
Weighted average					2.0		1.1

General impacts[b]

Housing: Minor impact where indigenous population growth has already caused a shortage.

Police and Fire Protection: Negligible impact due to the relationship of demand of the inmigrating population to demand caused by indigenous growth.

Water and Waste-Water Treatment: Negligible impact due to the size of demand and current excess capacity in selected existing systems.

Traffic: Minor impacts offsite that can be limited through administrative controls.

---

a. Jobs filled by existing residents in the 110-kilometer area surrounding the Savannah River Plant. Does not include jobs filled by those commuting more than 110 kilometers.

b. These conclusions are based on projected inmigrating population and data contained in DOE, 1981.

area between 1980 and 1984. Although school districts in Allendale and Barnwell Counties might experience capacity problems in 1984, the impact of the additional children in these districts is expected to be negligible. The total number of inmovers is not expected to affect housing appreciably except in those areas where a potential shortage in housing types and units might

occur because of indigenous population growth. Similarly, other public services, such as police and fire protection and water and waste-water treatment facilities, are not expected to be affected.

The construction of the Fuel Materials Facility will have a beneficial effect on the regional economy of the area. Using a technique similar to that used by the Bureau of Economic Analysis for calculating industrial multipliers to estimate the effects of new income and employment,* the multipliers listed in Table 5-2 were developed for a 15-county area surrounding the Savannah River Plant. An assessment using the construction multipliers indicates that about 46 cents in indirect income will be generated in the area for each dollar of direct labor expended for new industrial building construction. Similarly, for each million dollars of direct labor expended for new industrial building construction, about 18 new jobs are created indirectly.

Table 5-2. SRP regional multipliers[a]

	Industrial sectors affected by the FMF				
Multipliers	New building construction	New warehouse construction	Industrial organic and inorganic chemicals	Special industry equipment[b]	Engineering, accounting, legal, and related services
Income	2.13	2.10	1.63	1.58	1.29
Employment	1.88	1.94	2.79	1.74	1.18

a. Region defined as the following 15 counties: in Georgia--Burke, Richmond, Columbia, Jefferson, Jenkins, and Screven; in South Carolina--Aiken, Allendale, Bamberg, Barnwell, Edgefield, Hampton, Lexington, Orangeburg, and Saluda.

b. Not included in the other sectors.

Table 5-3 indicates that, during the peak year of FMF construction, the project is expected to have total local expenditures on materials and services of approximately 7.3 million dollars. This expenditure is expected to result in the creation of about 150 direct and 130 indirect local jobs throughout the region. This same expenditure of 7.3 million dollars also is anticipated to produce additional direct and indirect payroll income of approximately 6.3 million dollars. The total economic benefit to the region during the peak year of construction is calculated to create about 900 direct and indirect jobs, 35.2 million dollars in direct and indirect payroll, and 7.3 million dollars in direct expenditures on materials and services.

*For a description of the Bureau of Economic Analysis technique, see Industry-Specific Gross Output Multipliers for BEA Economic Area, U.S. Department of Commerce, Bureau of Economic Analysis, January 1977.

Table 5-3. FMF construction economic impact analysis

Categories of cost and employment	1981	1982	1983	1984	1985
		Prestart[a]			
Direct employment	20	30	35	80	200
Additional direct employment	5	7	7	4	8
Indirect employment	1	2	1	1	2
Local expenditures on materials and services[b]	125	180	165	95	200
Additional direct income[b]	94	135	123	71	150
Indirect income[b]	27	39	36	21	43
		Construction[c]			
Direct employment		80	330	580	205
Additional direct employment		34	68	145	148
Indirect employment		30	61	127	132
Local expenditures on materials and services[b]		1700	3400	7200	7400
Additional direct income[b]		700	1400	2900	400
Indirect income[b]		800	1500	3300	3400

a. Prestart costs include liaison, computer software development, technology transfer, and engineering and environmental support activities. Prestart costs and employment are calculated for fiscal years.

b. Values are in thousands of current dollars.

c. Construction costs and employment are calculated for mid-year periods, with the exception of 1982, for which the last quarter is used.

These estimated contributions to the economy of the SRP area will go directly toward the payment of local and state government services via income, property, sales and license taxes, and user fees. These economic benefits can be used by government jurisdictions to pay for any increased services to the inmover population.

5.1.2 Land use

Approximately 6.4 acres of land will be used for the construction of the Fuel Materials Facility at the Savannah River Plant. Because the proposed site is in an existing SRP operating area, no direct land-use impacts will occur. No impacts on historic or archaeological sites are expected, because the land was previously cleared and graded.

Indirect land-use impacts, primarily caused by the relocation of construction workers and ancillary development outside the Savannah River Plant, are expected to be minor in relation to land-use changes caused by indigenous population growth. This conclusion is based on the negligible population size increase, as indicated in Section 5.1.1.

5.1.3 Water quality and ecology

An extensive erosion control plan that meets the requirements of State of South Carolina and county sediment control programs will be implemented to mitigate potential erosion and sediment impacts from the construction of the Fuel Materials Facility. Two types of control--the stabilization and retention of materials in place and the entrapment of transported materials before their discharge from the site area--will be used. In-situ erosion control will include the use of one or more of the following methods: (1) vegetative cover; (2) mulches, including stone, wood chips, fiber, straw, or other suitable materials; (3) tackifiers, including asphalt emulsions or chemical stabilizers; (4) netting, anchors, riprap, or similar physical restraints; and (5) controlled surface flow by interceptor or diversion ditches, check dams, or similar structures. Transported materials can be trapped by sediment basins, filters, flocculents, or similar measures. By adopting the measures in the control plan, impacts to the environment from erosion or sedimentation are expected to be minor and of short duration.

Ground water usage from the Tuscaloosa Formation during construction will be less than a few thousand cubic meters per day for construction activities, dust control, etc. This amount is markedly less than the large volumes of ground water used each day by the Savannah River Plant. The total withdrawal of water from the Tuscaloosa Formation by the Plant, at an average rate of more than 22,700 cubic meters per day, has had no discernible effect on water levels in area wells over the past 25 years. Careful attention will be given to the condition and manner of disposal of construction waste water. When required, such methods as settling ponds and water treatment will be used to delay water release, remove undesirable constituents, and reduce the suspended particulate load. A plan for the disposal of construction waste water will be prepared; this plan will be approved by the State of South Carolina before it is implemented.

Due to the site's proximity to roads and utilities, the relocation of rights-of-way and associated facilities can be avoided or reduced, and the impacts associated with these activities should be negligible.

The FMF site, within the fenced 200-F Separations Area complex, was cleared and leveled during the development of the F-Area. The vegetation at the site consists of low grasses and herbaceous plants. Small mammals and birds are the primary types of wildlife that use the site. Because the FMF site offers marginal habitat and lies in the center of an industrial complex (e.g., adjacent buildings, high activity by man, etc.), no biota of importance are anticipated to be affected by construction activities. Although endangered biota have been documented on the Savannah River Plant, their habitat requirements and behavior are incompatible with present conditions at the FMF site; therefore, no adverse impacts are expected. In addition, no other important species or unique habitats will be impacted adversely by construction activities.

5.1.4 Air quality and noise

During the construction of the Fuel Materials Facility, the sources of air pollution will be construction equipment, which emit pollutants from their internal combustion engines, and the release of fugitive dust from

equipment operations. Other air pollutants might be released during the burning of construction debris and solid wastes, as permitted by applicable State of South Carolina air pollution regulations. Because clearing and excessive earthmoving are not required, minor air quality impacts are expected from these construction activities in neighboring communities.

The preparation of the FMF site might result in an additional release of fugitive dust from earthmoving activities. Dust emissions will be controlled by spraying the surface with water or chemical stabilizers. After the application of dust controls, the calculated annual average concentration of fugitive dust at the closest SRP boundary (10 kilometers) would be 2.2×10^{-2} microgram per cubic meter; this is significantly less than the annual primary standard of 75 micrograms per cubic meter. A maximum 24-hour concentration of 4.2 micrograms per cubic meter was calculated at the closest SRP boundary using worst-case meteorology; this is less than 2 percent of the national primary 24-hour standard for particulates.

Noise levels caused by the construction at the FMF site will be similar to those caused by the construction of other industrial projects. However, the long distance from the construction area to the SRP boundary will ensure that no increase in offsite sound levels occurs. Increased vehicular activity will cause a minimal increase in sound levels near the Savannah River Plant.

5.2 OPERATIONAL EFFECTS

5.2.1 Socioeconomics

The operational Fuel Materials Facility is expected to employ 280 persons. Approximately one-half of these employees, or 140, are anticipated to be inmovers to the six-county area surrounding the Savannah River Plant. These inmovers will reside in locations similar to those inhabited by present SRP employees. Because these inmovers (140) will number less than the construction phase inmovers (180), potential socioeconomic impacts during facility operations are expected to be insignificant and less than those discussed in Section 5.1.1.

During 1986, the first year of operation, approximately 13.8 million dollars (in 1986 dollars) are expected to be spent on direct salaries, wages, and benefits. An additional 5.3 million dollars are expected to be spent on shared facilities and services. A local expenditure of 1.1 million dollars is expected--using the input-output multipliers discussed in Section 5.1.1 to provide a total annual local economic benefit of 300 direct and indirect jobs and $780,000 in additional direct and indirect payroll income.

5.2.2 Land use

The generation of wastes from the operation of the Fuel Materials Facility will require approximately 0.06 acre of space at the present SRP Burial Ground per year compared to a Burial Ground use rate of about 3 acres per year by current SRP operations. No direct land-use impacts are expected to occur. No operational activities are expected to have an impact on historic or archaeological sites.

5.2.3 Water quality and aquatic ecology

No surface water will be used during the operation of the Fuel Materials Facility. All FMF water will be obtained from the Tuscaloosa Formation using the existing 200-F Area well field and water distribution system. The facility will use about 28.8×10^4 liters per day (small by comparison with the total SRP water withdrawal from the Tuscaloosa Formation, 22.7×10^6 liters per day) to satisfy its water demand. The withdrawal of ground water for the facility will not affect the water-production capabilities of the Tuscaloosa or other users of the aquifer. There will be no operational discharges from the Fuel Materials Facility to ground waters beneath the site.

Table 5-4 lists low concentrations of chemical discharges predicted to be present in the FMF waste water discharged from the process water-treatment facility. Other liquid discharges include steam condensate, heat exchanger blowdown, and processed sanitary waste. The total discharge, including that from the process waste-water treatment facility, will be at a rate of approximately 190 liters per minute. The liquid effluents from the FMF operation will be in compliance with the limitations and monitoring requirements prescribed by the National Pollutant Discharge Elimination System (NPDES) permit. Table 5-4 compares the concentrations of the chemicals discharged in the FMF waste water with drinking water standards and the concentrations in Upper Three Runs Creek and Four Mile Creek at Road A. Because the flow rates of these creeks are at least three orders of magnitude greater than that of the discharge stream (7 liters per minute versus greater than 1.0×10^4 liters per minute for the creeks), the incremental increase in pollutant concentrations will be negligible.

5.2.4 Air quality and terrestrial ecology

Pollutants that will be released to the atmosphere during routine operation of the Fuel Materials Facility include halides, ammonia, and nitrogen oxides. Release rates and maximum ground-level concentrations are listed in Tables 5-5 and 5-6, respectively.

Maximum ground-level concentrations of fluoride (a halide) both on and off the site are calculated to be six orders of magnitude less than State standards (SCDHEC, 1980). This is appreciably lower than the human perception level (100 micrograms per cubic meter) and the level above which involuntary human reflexes pick up hydrogen fluoride (30 micrograms per cubic meter) (Stern, 1968). Recommended safe levels of fluoride in the total ration of dairy and beef cattle range from 20 to 50 parts per million. Exposing alfalfa to a fluoride concentration of 0.3 microgram per cubic meter for a period of 2 months will produce plant fluoride concentrations of 40 parts per million (NAS, 1971).

The maximum ground-level concentration of ammonia that is estimated to be released is 2.4×10^{-2} microgram per cubic meter; this compares to 6 micrograms per cubic meter for background (ambient) mid-latitude concentrations of ammonium compounds in the lower troposphere (Miner, 1969). The lowest known concentration to affect vegetation is 1×10^3 micrograms per cubic meter, which impairs photosynthesis (Jacobson et al., 1966, cited by DOE, 1981). This threshold concentration is below the natural background level and the human olfactory perception level of 5×10^3 micrograms per

Table 5-4. Chemical characteristics of FMF process waste water and comparative values

Chemical	FMF process waste water, estimated effluent concentration[a] (ppm)	Comparative values: Concentration in stream on SRP — Upper Three Runs Creek[b]	Comparative values: Concentration in stream on SRP — Four Mile Creek[b]	Comparative values: EPA drinking water standard[c] (ppm)
NO_3^-	1.0	0.15	0.18	10
Cl^-	0.3	2.4	5.2	250[d]
F^-	0.1	ND[e]	ND	1.0
NH_4^+	0.3	0.02	0.03	No standard[f]
Al^{+3}	0.03	< 0.5	< 0.5	No standard
TBP-ultrasene	Trace	ND	ND	No standard
Na^+	1.0	3.1	6.2	500[g]

a. The process waste water effluent, which is released at 7 liters per minute, will be diluted by three orders of magnitude when it is discharged to SRP streams. No detectable effects on the chemical characteristics of the stream are expected.

b. Annual averages at Road A.

c. 40 CFR 141 and 143.

d. Secondary standards.

e. ND = not determined.

f. 0.02 parts per million (as un-ionized ammonia - NH_3) for fresh-water aquatic life.

g. As total dissolved solids.

Table 5-5. Air pollutant emission rates

Pollutant	Grams per second	Tons per year
NO_x	2.8×10^{-3}	1.0×10^{-1}
HCl	1.4×10^{-3}	5.0×10^{-2}
NH_3	1.9×10^{-3}	7.0×10^{-2}
HF	4.2×10^{-7}	1.5×10^{-5}

Table 5-6. Air pollutant concentrations at ground level

Pollutant	Maximum concentration: Distance (km)	Maximum concentration: Concentrations ($\mu g/m^3$)	Maximum concentration: Concentrations (ppm)	Concentration at closest site boundary (10 km) ($\mu g/m^3$)	Concentration at closest site boundary (10 km) (ppm)
NO_x	5.3	3.6×10^{-2}	1.9×10^{-5}	3.3×10^{-2}	1.7×10^{-5}
HCl	5.3	1.8×10^{-2}	1.2×10^{-5}	1.6×10^{-2}	1.1×10^{-5}
NH_3	5.3	2.4×10^{-2}	3.5×10^{-5}	2.2×10^{-2}	3.2×10^{-5}
HF	5.3	5.4×10^{-6}	6.8×10^{-9}	4.9×10^{-6}	6.2×10^{-9}

cubic meter (Stern, 1968). The lowest ammonia concentration found to affect experimental animals was 2×10^3 micrograms per cubic meter (Miner, 1969).

The maximum ground-level concentration expected to result from the emission of nitrogen oxides from the facility is 3.6×10^{-2} microgram per cubic meter, which is well below the Federal and State standards of 100 micrograms per cubic meter. Furthermore, the predicted emission concentration is below the minimum levels shown to affect mammals adversely (EPA, 1971; Ziskind and Hausknecht, 1976, cited by Dvorak, 1978).

Comparisons with the ambient air quality concentrations in this SRP area and the State ambient air quality standards (Section 4.6) shows the projected FMF impacts on air quality to be minimal.

5.2.5 Radiological effects

The normal operation of the Fuel Materials Facility will have a very low radiological impact on the public off the SRP site and the workers on the SRP site. The enriched uranium in the effluents has a specific activity of only 1.15×10^{-4} curie per gram, with uranium-234 contributing about 98 percent of the activity. This activity is very low when compared to other SRP products. The annual radioactive effluents due to normal operations are estimated to be less than 0.01 curie of uranium released to the atmosphere through the facility stack, less than 0.3 curie released in liquid discharges, and less than 0.6 curie in the form of solid waste. The radiological impact of these effluents at the SRP site is described below.

5.2.5.1 Maximum individual and population doses

The radiological doses to the maximally exposed individual member of the public at the SRP boundary, 10 kilometers from the Fuel Materials Facility, and to the general population have been calculated using the methods described in Appendix B. The dose commitments, summarized in Table 5-7, are extremely small (0.002 percent of the applicable radiation protection standard given in DOE Order 5480.1). Radiation doses due to atmospheric and liquid radioactive effluents are expected to result in a maximum individual pathway (atmospheric release) dose of 6.3×10^{-3} millirem per year to the whole body. The total population dose is estimated to be 0.09 man-rem per year. These values compare with background whole-body doses of about 9.5×10^1 millirem per year to the maximum individual and 4.4×10^4 man-rem per year to the population within 80 kilometers.

Solid radioactive wastes due to normal operations are expected to consist of less than 0.6 curie per year of uranium contained in 570 cubic meters of waste packed in boxes and 140 cubic meters of evaporator bottoms solidified in concrete and placed in drums. The solid waste will be buried in trenches in the existing SRP Burial Ground. The amount of FMF solid radioactive waste will be small in comparison to the total inventory of material in the SRP Burial Ground (Section 5.2.2). The operational effects of the existing burial ground were analyzed in the Savannah River Plant's waste management operations environmental impact statement (ERDA, 1977).

5.2.5.2 Occupational exposures and controls

Routine operations of the Fuel Materials Facility will result in small amounts of radiation exposure to the operating personnel. The maximum exposures allowed by DOE radiation protection standards are 5 rem to the whole body each year with a maximum of 3 rem in any calendar quarter. Extensive efforts are made to reduce worker exposures to amounts that are as low as reasonably achievable below these limits. These efforts include detailed planning of all work that involves potential radiation exposure to reduce exposure time, provide adequate shielding, and preclude radionuclide uptake. Such work is performed in accordance with approved procedures.

Occupational dose estimates for FMF normal operations were based on overall occupational doses experienced at the Savannah River Plant since 1965. Because the work that will be done in the Fuel Materials Facility will involve less potential for radiation exposure than most other SRP facilities, this approach is expected to overestimate occupational radiation exposures. The average occupational dose during FMF normal operation was estimated to be 0.28 rem per year, well within the Federal occupational limit of 5 rem per year. With 280 employees, the total occupational dose was estimated to be 78 man-rem per year.

5.3 FACILITY ACCIDENTS

This section summarizes the impacts to an offsite individual from postulated incidents and accidents. Because the offsite non-nuclear effects of accidents and incidents are negligible, only the radiological effects are described quantitatively. The term "dose risk," as used in this report, is the product of dose consequence from an incident or accident in terms of millirem exposure per event and the probability of occurrence in events per year. Maximum individual doses have been calculated using the methods described in Appendix B, except more conservative atmospheric dispersion parameters (fifth-percentile meteorology) were used. The results of the analyses are presented in Section 5.3.2.

5.3.1 FMF building and operations

Postulated incidents and accidents related to the Fuel Materials Facility are described below. Only those incidents and accidents that are expected to result in radioactive releases to the environment have been addressed.

Process incidents

- Fire - A fire in the process area results in a release of radioactivity to the environment of 2.7×10^{-4} curie of uranium via the facility stack. This accident has an estimated probability of 7.5×10^{-4} per year.

- Explosion - An explosion is considered to be the most severe consequence in the uncontrolled chemical reaction category. The source term is estimated to release 4.5×10^{-3} curie to the atmosphere through the facility stack. This accident has an estimated probability of 8×10^{-3} per year.

- Nuclear criticality - The design basis for the plant provides a high degree of nuclear safety. All vessels, sumps, and containers designed for containing uranium are dimensionally safe; reliance is not placed on such administrative controls as mass, concentration control, or nuclear poisons. The resulting criticality reaction would be on the order of 2×10^{17} fissions. The probability for such an event is estimated to be 1×10^{-3} per year.

Natural events

- Earthquakes - The Fuel Materials Facility will be a high-resistance structure, but it is not designed to withstand structural damage from severe earthquakes. Based on historical records, a ground-shaking intensity of Imm = VII or greater is unlikely to occur within the assumed 35-year life of the facility (Algermissen and Perkins, 1976; O'Brien, Murphy, and Lahoud, 1977). An intensity of Imm = VII or less of ground motion is expected to cause little or no damage to the FMF process area, even allowing for some amplification within the soil column. The analysis indicates that uranium might be released as the result of an earthquake with an intensity greater than IX (Modified Mercalli scale). The resulting source term is estimated to be 16 curies, with a corresponding probability of 1×10^{-3}. More intense earthquakes are possible, but have lower probabilities.

- Tornadoes - Tornadoes with intensities of F-4 (Fujita scale) are calculated to result in a source term of 1.1×10^{-1} curie of uranium released to the atmosphere with a corresponding probability of 2.0×10^{-7}. More intense tornadoes would have a lower probability of occurrence.

Other events, such as airplane crashes, were considered, but the probabilities were so low (less than 10^{-7} per year) that such externally induced events were not considered credible and, thus, have not been analyzed. In addition, accidents associated with the solid-waste burial ground were not considered because of the very small FMF contributions to the burial ground's radioactive inventory.

5.3.2 Accident analysis results

The results of the risk analyses performed for the incidents and accident scenarios described above are summarized in Table 5-8. The overall impacts of incidents and accidents at the Fuel Materials Facility are small from a radiological viewpoint.

Some of these postulated accidents will result in the release of small quantities of chemical pollutants. As noted in Section 3.2.2.1, the total containment concept in the FMF design will minimize the accidental release of chemical pollutants. The magnitude of the accidentally released pollutants will be negligible. Therefore, the actual chemical releases were not developed for the accident scenarios identified.

Some chemicals might be released at the cold feed preparation area (see Figure 3-1) due to overflow, spills, and routine discards. Several chemicals stored in this area are controlled by the Clean Water Act and the Resource

Conservation and Recovery Act hazardous spill reporting requirements and guidelines. A spill control plan will be devised to cope with potential accidental spills. Such additional confinement as curbing will be employed as part of the plan. Chemical quantities handled at the area will be small, and potential spills should not pose a threat to the environment.

Table 5-8. Radiological impacts due to FMF incidents and accidents

Incident/ Accident	Probability (events/year)	Maximum individual dose[a] (mrem/event)	Dose risk[b] (mrem/year)
Fire	7.5×10^{-4}	4.1×10^{-2}	3.1×10^{-5}
Explosion	8.0×10^{-3}	6.8×10^{-1}	5.4×10^{-3}
Criticality	1.0×10^{-3}	6.9×10^{-1}	6.9×10^{-4}
Earthquakes	1.0×10^{-3}	2.2×10^{-1}	2.2×10^{-4}
Tornado	2.0×10^{-7}	1.9×10^{0}	3.8×10^{-7}

a. Background doses (whole body) are estimated to be 9.5×10^{1} millirem per year to the maximum individual.
b. Dose risk equals individual dose times probability.

5.4 TRANSPORTATION

Transportation will include offsite shipments of enriched uranium (as uranium hexafluoride) to the Fuel Materials Facility and shipments of the fuel material from the Fuel Materials Facility to the core manufacturers. Figure 2-1 shows the locations of the shipping and receiving facilities. Process chemicals will be shipped to the facility from offsite distribution points.

The uranium feed material and final product transported to and from the Fuel Materials Facility require safeguarding during offsite highway transit. Therefore, they will be transported in the Department of Energy's existing safe-secure transporter (SST) system with a courier escort. This transporter is essentially a mobile vault with built-in deterrent and disabling devices and special electronically coded locks set in vault-type doors. It is operated by carefully selected, specially trained personnel to provide the safe and secure transport of Government-owned special nuclear material (Sandia National Laboratories, 1978). The radioactive materials shipped to and from the Fuel Materials Facility will be packaged in containers that meet applicable Federal regulations governing the safe shipment of uranium hexafluoride and fuel materials. Additional containment is provided by the mobile vault.

Radiation exposures to the population and the maximally exposed individual along the shipping routes were estimated using the methods described in Appendix B. The radiation dose to the maximally exposed individual located along a route where incoming and outgoing shipments pass is about 2×10^{-4} millirem; this compares with about 125 millirem per year from natural background radiation. The radiation dose to the population due to transportation is estimated to be 6.5×10^{-4} man-rem per year.

The radiation exposure rate to the SST driver transporting the enriched uranium to the facility and the fuel material from the facility is estimated to be less than 0.04 millirem per hour above background (ERDA, 1976). The transporter will travel about 39,000 kilometers annually to and from the facility. The occupational exposure to each driver would be less than 40 millirem per year. This assumes an average speed of 55 kilometers per hour.

The risk of release of uranium hexafluoride or fuel materials during transportation is essentially zero. The shipping containers are designed and constructed to regulatory specifications that assure they will maintain their integrity during 99.9 percent of all hypothetical accidents. In addition, the safe-secure transporters are rugged, with armor plate and low-density foam equipment for safeguarding the cargo. This vehicle provides additional accident protection that is equal to that provided by the shipping containers. Even in an extreme accident during which the transporter might be damaged seriously, the shipping containers are expected to survive any impacts to which they are exposed. Therefore, the transportation system, consisting of shipping containers transported in a mobile vault-like SST vehicle, is expected to withstand any credible accident with no release of uranium hexafluoride or fuel materials.

5.5 DECONTAMINATION AND DECOMMISSIONING

FMF decommissioning is expected to be relatively straightforward compared to other SRP facilities because: (1) the levels of radioactivity of the materials being processed will be low; (2) there will be no significant source of neutrons to induce activity in building components; and (3) an FMF total containment design consideration will facilitate decontamination and decommissioning. These three factors will result in a minimal radiological impact.

5.6 COMPOSITE IMPACTS

5.6.1 Socioeconomics and land use*

The potential composite socioeconomic and land-use impacts arising from FMF construction and operation depend heavily on the schedule of other major projects at and near the Savannah River Plant. These projects include the Georgia Power Company's Vogtle Nuclear Power Plant in Burke County, Georgia, and SRP capital improvement projects, L-reactor startup,** and the proposed Defense Waste Processing Facility (DWPF) (DOE, 1981).

The average craft work force at the Vogtle project is expected to be 5100 workers in 1983 and to decline slightly in 1984, coinciding with the buildup of the work force for the Fuel Materials Facility. The SRP construction work force is expected to remain relatively constant until 1983 and then increase due to FMF construction, capital improvements, and the start of DWPF

---

*Employment data in this section were provided by E. I. du Pont de Nemours & Company, September 24, 1981.

**SRP capital improvements include new instrumentation, upgrading of facilities, etc.; L-reactor startup activities refer to refurbishment and reactivation of an existing production reactor on the SRP site.

construction. The total construction work force at the Plant, including that for the Fuel Materials Facility, is expected to increase from 2000 to 4200 employees by mid-1984.

The projected craft work force demand in the 110-kilometer area around the Plant will approach a level approximately 1.7 times the estimated 1979 craft work force. Assuming that the modeling results of a DWPF scenario (DOE, 1981)--reference immobilization alternative, with the Vogtle project having a 1985 peak--are applicable to the composite craft work force increase at the Plant, about 695 personnel are expected to relocate in the six-county area.

In addition to these 695 construction-related employees, approximately 255 new operating personnel, who will be employed in the restart of the L-reactor, will inmigrate to the six-county SRP area.* The composite work force that might relocate in the area, therefore, is 950. Table 5-9 lists the projected distributional pattern of the composite work force increase at the Plant, together with a summary of potential socioeconomic impacts for major areas of analysis.

The composite construction and operational work force increase at the Savannah River Plant by mid-1984 is not expected to affect the six-county area significantly. The inmigrating work force and its associated population will account for less than 1 percent of the total 1984 indigenous population. Minor impacts in the areas of housing, schools, and other public services and facilities might occur where existing or projected 1984 demands exceed current service capabilities; however, the demands placed on these services by the inmigrating project population are relatively small in relation to the total indigenous demand.

The most significant effect associated with the multiple projects at the Plant is the economic impact on the region. As listed in Table 5-10, these projects are expected to create an additional 4700 direct and indirect job opportunities and 42 million dollars in additional direct and indirect payroll income. These economic benefits, however, will be partially offset by local and state government expenditures for the composite inmigrating work force.

The incremental impacts of the Fuel Materials Facility are not considered major when viewed on a composite basis. With continued work at SRP beyond 1984 on facility upgrading projects and on the Defense Waste Processing Facility, the potential composite impacts presented are likely to occur regardless of the FMF project. Beyond mid-1984, these other projects should provide stability in employment not only for the work force associated with the FMF construction, but also for the work force at the Vogtle project, which will experience significant declines in employment beginning in 1985.

---

*The distribution of L-reactor operational employees is based on the assumption that 50 percent of the employees will inmigrate to the six-county SRP area and will reside in a pattern similar to that of the existing SRP work force.

Table 5-10. Composite SRP economic impact analysis, mid-1984[a]

Categories of cost and employment	FMF only[b]	Total SRP
Direct employment	580	2730
Additional direct employment	145	970
Indirect employment	127	870
Local expenditures on materials and services (current $ millions)	7	50
Additional direct income (current $ millions)	3	20
Indirect income (current $ millions)	3	22

a. Based on multipliers listed in Table 5-2.
b. From Table 5-3.

5.6.2 Radiological effects

Total 1980 SRP operations are estimated to have resulted in a maximum offsite individual dose of 1.2 millirem and a population dose of 1.1×10^2 man-rem. The FMF operation is expected to increase the estimated SRP dose by 0.5 percent and 0.07 percent for the maximum offsite individual and general population, respectively. Compared to background doses that are estimated to be 9.5×10^1 millirem per year to an individual and 4.4×10^4 man-rem per year to the population within 80 kilometers, the Fuel Materials Facility is considered to have a negligible radiological impact and will result in only a very small increment to doses from existing SRP operations.

REFERENCES FOR CHAPTER 5

Algermissen, S. T., and D. M. Perkins. 1976. A Probabilistic Estimate of Maximum Acceleration in Rock in the Contiguous United States. Open-File Report 76-416, U.S. Geological Survey, Reston, Virginia.

DOE (U.S. Department of Energy). 1980. Environmental Assessment of the Oak Ridge Gaseous-Diffusion Plant Site. DOE/EA-0106, Washington, D.C.

DOE (U.S. Department of Energy). 1981. Draft Environmental Impact Statement, Defense Waste Processing Facility, Savannah River Plant, Aiken, S.C. DOE/EIS-0082D, Washington, D.C.

Dvorak, A. J. 1978. Impacts of Coal-Fired Powerplants on Fish, Wildlife, and Their Habitats. FWS/OBS-78/29, U.S. Department of the Interior, Washington, D.C.

EPA (U.S. Environmental Protection Agency). 1971. Air Quality Criteria for Nitrogen Oxides. Air Pollution Control Office, Washington, D.C.

ERDA (U.S. Energy Research and Development Administration). 1976. Final Environmental Statement: U.S. Nuclear Power Export Activities. ERDA-1542, Vol. 1, Washington, D.C.

ERDA (U.S. Energy Research and Development Administration). 1977. Waste Management Operations: Savannah River Plant, Aiken, South Carolina. Final Environmental Impact Statement. ERDA-1537, Washington, D.C.

Jacobson, J. S. (coauthor). 1966. "The Accumulation of Fluorine by Plants." Journal of the Air Pollution Control Association. Vol. 16, pp. 412-417.

Miner, S. 1966. Preliminary Air Pollution Survey of Ammonia: A Literature Review. U.S. Department of Health, Education and Welfare, Washington, D.C.

NAS (National Academy of Sciences, National Academy of Health). 1971. Biological Effects of Atmospheric Pollutants: Fluorides. U.S. Government Printing Office, Washington, D.C.

O'Brien, L. J., J. R. Murphy, and J. A. Lahoud. 1977. The Correlation of Peak Ground Acceleration Amplitude with Seismic Intensity and Other Physical Parameters. NUREG-0143, prepared by Computer Sciences Corporation for the U.S. Nuclear Regulatory Commission, Washington, D.C.

Sandia National Laboratories. 1978. Transportation System for Nuclear Materials and the Role of State Law Enforcement Agencies. SAND 78-0150-6, Albuquerque, New Mexico.

Ziskind, R., and D. Hausknecht. 1976. Health Effects of Nitrogen Oxides. EPRI 571-A, prepared by Science Applications, Inc., for Electric Power Research Institute, Palo Alto, California.