5.2.8.2 Surface-water usage

At the Savannah River Plant, the Savannah River supplies water for cooling two production reactors, makeup water for Par Pond (the source of cooling water for P-Reactor), and for use in the coal-fired power plants. For the 3-year period from 1974 to 1976, the maximum withdrawal rate was 26 cubic meters per second. When L-Reactor operation resumes, water withdrawal from the river will increase by about 11 cubic meters per second; the total withdrawal rate for the Plant will be about 37 cubic meters per second. Under 7-day, 10-year, low-flow conditions (159 cubic meters per second; Section 3.4.1), the Savannah River Plant will withdraw about 23 percent of the river flow; under average flow conditions, the Plant will withdraw about 13 percent for all its operations.

Essentially all water withdrawn from the river is returned to the river. The estimated consumption of water will be about 1.25 cubic meters per second for L-Reactor (Neill and Babcock, 1971). This compares with a consumption of about 1.25 cubic meters per second for Par Pond; the consumption for C- and K-Reactors is about 0.85 cubic meter per second each.

Two neighboring facilities will also use Savannah River water for cooling. The South Carolina Electric and Gas Company's Urquhart Steam Station, located above the SRP, uses about 7.4 cubic meters per second as once-through cooling water. The Vogtle Nuclear Power Plant, near Hancock Landing, Georgia, is now under construction. When completed, it will use a few cubic meters of river water per second as makeup water for its cooling towers.

5.2.8.3 Ground-water use

Current projections of ground-water requirements are less than 0.75 cubic meter per minute for the DWPF and 0.2 cubic meter per minute for the FMF. The upward head differential between the Tuscaloosa and Congaree Formations will decrease beneath the F-Area basins and will become increasingly downward beneath the other basins in H- and M-Areas (see Table 5-7) as the result of this increased pumping.

The cumulative ground-water consumption from the Tuscaloosa as the result of SRP operations is estimated to be 0.95 cubic meter per minute. Thus, the total SRP consumption will be about 26.4 cubic meters per minute, including all L-Reactor-related and cumulative usage. This projected usage represents an 11-percent increase over the 1982 SRP withdrawal from the Tuscaloosa of 23.8 cubic meters per minute, but a slight decrease from the 1983 withdrawal rate of 27.0 cubic meters per minute (see Table F-10). Cumulative impacts on offsite water levels are expected to be small (Table 5-8), about 0.4 meter at Jackson and at the site boundary opposite the A-Area. As shown in Table 5-8, the cumulative drawdowns resulting from pumping at SRP are not expected to increase in relation to the incremental drawdowns. This is because the additional pumping for the FMF and the DWPF will be from locations that are long distances from the nearest site boundary relative to the pumping rate (Siple, 1967).

Operating experience at the SRP over the past 30 years has demonstrated that subsidence is not a problem. Available leveling data in the vicinity of

SRP do not indicate subsidence (DOE, 1982b). Based on anticipated needs over the next few years, subsidence from the withdrawal of ground water from the Tuscaloosa Formation is not expected to affect operations at SRP.

5.2.8.4 Thermal discharge

Wetlands

Steel Creek and its main tributary, Meyers Branch, have more wetlands acres (3073) and a more varied thermal discharge history than Pen Branch or Four Mile Creek. Steel Creek received a wide range of thermal effluent quantities from both P- and L-Reactors from 1954 to 1968. The bottomland hardwood wetlands that were affected during those years have partially recovered. About 790 acres of bottomland hardwood exist along the Steel Creek corridor from L-Reactor to the swamp. Most of this area (16 percent of the Steel Creek system) was also previously affected by reactor discharges and has partially recovered to a diverse ecological state. The planned restart of L-Reactor will produce renewed adverse impacts on most of this floodplain corridor.

Currently, about 1400 acres (7 percent) of wetlands associated with the five principal SRP stream corridors receive thermal impacts due to SRP operations (Table 5-18). The restart of L-Reactor will impact an additional 520 to 680 acres of wetlands and 775 acres of uplands. The cumulative total acreage of wetlands along streams affected by all SRP operations (including L-Reactor) is approximately 2135 to 2415 acres.

The Savannah River floodplain between Augusta, Georgia (River Mile 195), and Ebenezer Landing, Georgia (River Mile 45), contains approximately 130,000 acres of wetlands. The Savannah River swamp provides approximately 10,400 acres of palustrine wetland habitat; it is seasonally separated from the waters of the Savannah River by a 3-meter-high natural levee (Smith et al., 1981) and receives the waters of several SRP streams. In 1951, before the discharge of any thermal effluents, a closed canopy of second-growth forest extended over the 10,369-acre swamp (Sharitz et al., 1974). Following the release of heated effluents into the swamp via tributary streams, some trees died in about two-thirds of the area (Figure 5-2).

The historic growth of the Steel Creek delta in the Savannah River swamp, as measured by computer digitization of aerial photographs taken from 1943 to 1982, shows that thermal discharges first affected the canopy between 1955 and 1956; this was more than 1 year after both P- and L-Reactors began releasing hot water to Steel Creek. In 1966, the impact area was nearly maximum at 314 acres (Table 5-19). When L-Reactor discontinued operations in 1968, the swamp canopy began to recover. From 1968 to 1982, about 40 acres of impact zone recovered and new canopy cover was established. Partial canopy recovery occurred in an additional 67 acres of former tree kill.

With the preferred cooling-water alternative, between 215 and 335 acres of the Savannah River swamp at and adjacent to the Steel Creek delta, respectively, will be impacted by the flow caused by discharges from the cooling lake. Cumulative thermal impacts to the swamp following the resumption of L-Reactor operation should affect about 40 percent of the total swamp wetlands at SRP.

Savannah River

As the result of water storage in the Clarks Hill Reservoir above Augusta, Georgia, and its mode of discharge, the temperature of the Savannah River is as much as 8°C below the temperature that would occur in the summertime if the reservoir did not exist (Neill and Babcock, 1971). The temperature of the river water generally increases naturally as the water flows from Clarks Hill Reservoir past the Savannah River Plant. The Urquhart Steam Station above the Savannah River Plant discharges about 7.4 cubic meters per second of cooling-water effluent at temperatures as high as 6°C above ambient river temperature; this effluent raises the temperature of the river by about 0.3°C on the average and by as much as 0.5°C in the summer (Boswell, 1972).

At present, once-through cooling-water effluent is discharged from the Savannah River Plant via three streams--Beaver Dam Creek, Four Mile Creek, and Pen Branch/Steel Creek--to the Savannah River. Beaver Dam Creek receives the smallest amount of thermal effluent, which originates about equally in D- and C-Areas. In the future, SRP will also discharge thermal blowdown from the small cooling towers servicing the Fuel Materials Facility and the Defense Waste Processing Facility; this will not affect the Savannah River.

Pen Branch receives once-through cooling-water effluent from K-Reactor. This effluent is discharged to the Savannah River through the mouth of Steel Creek. The temperature of the water released at about 15.6 cubic meters per second from the mouth of Steel Creek typically is less than 5.6°C above the water temperature of the river during spring and summer. When both K-Reactor and L-Reactor (preferred alternative) discharge via the mouth of Steel Creek, the temperature will be about 4°C, but the flow rate to the river will average about 27.4 cubic meters per second. TC

Analyses of upstream and downstream water temperature data for the 11-year period since L-Reactor was placed on standby (1968 to 1978) suggest that, once in 10 years, a maximum increase of 1.6°C resulting from SRP operations will occur in the (fully mixed) water temperature of the Savannah River. With the addition of L-Reactor thermal effluent, the once-in-10-year maximum increase is not projected to change. With the preferred cooling-water alternative, the temperature at the mouth of Steel Creek contributed by L-Reactor will only be within about 1°C of ambient in the summer.

The Vogtle Nuclear Power Plant will use natural-draft cooling towers to dissipate the heat generated by its two reactor units. The heated cooling-tower blowdown will be discharged to the Savannah River at temperatures below 33°C (Georgia Power Company, 1973). The contribution of heat to the river by the Vogtle Plant will be very small compared to the contribution from C-Reactor via the mouth of Four Mile Creek. No thermal blockage of the Savannah River by any interaction of the Vogtle Plant and Four Mile Creek plumes is anticipated.

In conclusion, a zone of passage for anadromous fish and other aquatic organisms will exist in the Savannah River from Steel Creek to Beech Island. Thermal blockage will not occur.

5.2.8.5 Fisheries

The preferred alternative (a 1000-acre lake) would not pose any adverse thermal impacts to fishes in the delta area or at the mouth of Steel Creek during spring or summer months, because the temperatures would be 1°C to 3°C above ambient. Warmer conditions during the winter months from Road A to the mouth of Steel Creek (7°C to 9°C above ambient) could concentrate fish near the mouth of the creek. This alternative would not adversely affect access and spawning of riverine and anadromous fishes in the Savannah River swamp below the Steel Creek delta.

Currently, heated effluents from C- and K-Reactors and the D-Area powerhouse are discharged into Four Mile Creek, Pen Branch, and Beaver Dam Creek, respectively, rendering these areas unsuitable for spawning by anadromous fishes under normal river flow conditions. With the preferred alternative, fish access for spawning will be limited only in the Steel Creek corridor, not in the swamp. Studies in the area have shown that suitable spawning habitat exists in other streams along the Savannah River. In addition, the spawning of many anadromous species (e.g., American shad, striped bass) occurs primarily in the Savannah River itself and will not be affected by the thermal discharge from L-Reactor. Thermal effluent from L-Reactor will not block the movement of fish past the Plant in the river.

Because there will be no interaction of the L-Reactor plume with that from C-Reactor or from Vogtle Nuclear Power Plant, the cumulative impact from these sources will be negligible.

5.2.8.6 Entrainment

Based on ichthyoplankton investigations conducted at the site (see Appendix C), an estimated 17.9×10^6 fish larvae and 18.1×10^6 fish eggs were entrained by SRP cooling-water intakes during 1982. During 1983, these totals were 9.1×10^6 eggs and 28.1×10^6 larvae. This represents about 13 percent of the ichthyoplankton passing the intake canals in the river during 1982, and 7.7 percent in 1983. Under present operating conditions, the flow of cooling water withdrawn from the river is about 26 cubic meters per second. An additional flow of about 11 cubic meters per second will be required by the L-Reactor. Entrainment losses will increase proportionately. Table 4-1 summarizes projections of cumulative entrainment impacts based on studies conducted in 1977, 1982, and 1983.

The estimated cumulative percentage of fish eggs and larvae passing the Savannah River Plant in the river that will be lost to entrainment by the combined operation of C-, K-, and L-Reactors is about 19 percent.

5.2.8.7 Impingement

The results of the most recent impingement studies conducted at the 1G, 3G, and 5G pumphouses indicate that, under present operating conditions, an average of about 37 fish are impinged each day for an annual total of 13,505 individuals. The highest daily rates occur during periods of high river-water levels when as many as 540 fish have been impinged. The restart of L-Reactor will result in the impingement of an estimated 16 additional fish per day or 5840 per year. During periods of high water, the cumulative total impinged could reach about 104 fish per day, 31 of which would be due to L-Reactor operations.

Surveys of the recreational fishery in the freshwater portions of the Savannah River indicate that the species caught in greatest numbers by anglers are bream, catfish, and crappie. These species comprise about 37 percent of the total number of fish collected during the impingement studies. Using these data, estimates can be made of the numbers of these recreationally important fish that would be lost annually due to impingement. Table 5-21 summarizes these estimates.

Another important sport fish is the largemouth bass. It is the second-most sought-after freshwater species in the Savannah River. However, it is not often caught and, therefore, does not rank highly in the catch statistics. Largemouth bass are impinged at SRP only rarely, comprising 0.3 percent of the total fish collected (i.e., 2 individuals out of 684 total). The projection of annual losses under present operating conditions is 14 fish. The cumulative impingement loss once L-Reactor is operating would be about 21 individuals per year.

5.2.8.8 Radiological effects

Nuclear facilities within an 80-kilometer radius of the L-Reactor include other currently operating Savannah River Plant facilities, the Alvin W. Vogtle Nuclear Power Plant (under construction), the Barnwell Nuclear Fuel Plant (not now expected to operate), and the Chem-Nuclear Services, Inc., low-level radioactive disposal site. The existing and planned operations of these facilities were reviewed to determine the potential cumulative radiological effects of all the facilities operating together.

Facilities currently operating at the Savannah River Plant include three production reactors, two chemical separations areas, a fuel fabrication facility, waste management facilities, and other support facilities. Future projects include the construction and operation of the FMF to produce fuel forms for the naval reactor program, and the DWPF to immobilize high-level radioactive wastes currently stored in tanks at the Plant. The FMF and DWPF are not expected to become operational until the latter half of the 1980s; they will have no radiological impact during the initial startup of L-Reactor.

The cumulative offsite radiation dose is the sum of the doses from L-Reactor (under the preferred alternatives) and its support facilities, current SRP operation with three reactors, the planned Fuel Materials Facility and Defense Waste Processing Facility, and the Vogtle Nuclear Power Plant. The total-body doses to the maximally exposed offsite individual and to the population are summarized in Table 5-24 (compare with Table 5-22) for the operation of L-Reactor with the preferred cooling-water and disassembly-basin purge water alternatives. The maximum individual dose is conservative because the defined "composite" individual would have to be a permanent resident of several different locations to receive the dose. The doses shown are for the tenth year of

L-Reactor operation, when all described facilities are expected to be in operation and when radioactive releases from L-Reactor will have reached an equilibrium maximum.

The composite maximum individual dose of 3.5 millirem for operation with the preferred alternatives is 27 times less than the average dose of 93 millirem (Du Pont, 1982b) received by an individual living near the site from natural radiation. The composite population dose of 163 person-rem is about 0.15 percent of the exposure of about 109,000 person-rem from natural radiation sources to the population living within 80 kilometers of the Savannah River Plant and the Beaufort-Jasper and Port Wentworth drinking-water populations.

The potential radiation-induced health effects calculated from the operation of L-Reactor and other nuclear facilities within an 80-kilometer radius (from atmospheric and liquid releases of radioactive materials and redistribution of cobalt-60 and cesium-137 from Steel Creek and downstream water consumption) were calculated by multiplying the regional population doses (from Table 5-24) by the following risk estimators: 120 cancers and 257 genetic effects per 1,000,000 person-rem exposure. The projected health effects for operation with the preferred alternatives are a maximum of 0.02 excess cancer fatality from tenth-year operations and 0.04 genetic disorder in the tenth year of L-Reactor operation.

5.3 INCREMENTAL IMPACTS OF THE NO-ACTION ALTERNATIVE

K-Area would supply steam to L-Area as it is being maintained in a standby mode. K-Area would burn about 10 percent more coal and, consequently, the discharge to the K-Area ash basin will increase by about 10 percent over the L-Reactor standby phase. Leachate from the ash basin will enter the shallow ground-water system of the Barnwell Formation and migrate to Pen Branch.

The K-Area steam plant will use an additional 0.005 cubic meter of water per second from the Savannah River and an additional 0.002 cubic meter of ground water per second from the Tuscaloosa Formation to supply L-Area with steam.

Maintaining L-Reactor in a standby mode will have little or no effect on the operation of the SRP facilities (fuel fabrication, chemical separations, waste management, etc.) that support the operating reactors.

Table 5-24. Cumulative total-body doses from L-Reactor operation and other nearby nuclear facilities (preferred alternative)[a]

Source of exposure	Atmospheric releases	Liquid releases	Total
MAXIMUM INDIVIDUAL ADULT DOSE (millirem per year)			
Cs-137 and Co-60 redistribution from Steel Creek	--	0.31	0.31
L-Reactor and support facilities	0.24	0.12	0.36
Savannah River Plant - current operations	0.81	0.43	1.2
Fuel Materials Facility - SRP[b]	0.000063	--	0.000063
Defense Waste Processing Facility - SRP	0.0047	0.0077	0.012
Vogtle Nuclear Power Plant	0.0060	1.6	1.6
Total	1.1	2.5	3.5
REGIONAL POPULATION DOSE[c] (person-rem per year)			
Cs-137 and Co-60 redistribution from Steel Creek	--	0.87	0.87
L-Reactor and support facilities	17	16	33
Savannah River Plant - current operations	80	40	120
Fuel Materials Facility - SRP[b]	0.0026	--	0.0026
Defense Waste Processing Facility - SRP	0.23	1.2	1.4
Vogtle Nuclear Power Plant	0.024	7.8	7.8
Total	97	66	163

[a]During tenth year of L-Reactor operation.
[b]Adopted from DOE, 1982b.
[c]Includes doses from water consumed at Beaufort-Jasper and Port Wentworth.

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6 STUDIES AND MONITORING

Since 1951 (before the Savannah River Plant (SRP) began operation), an intensive surveillance program has been maintained to monitor the compositions of effluents from the SRP facility, to measure radioisotope concentrations in the plant environs, to assess the ecological health of the overall SRP environment, and to determine compliance with applicable standards. The results of these environmental monitoring programs are reported annually to the public (e.g., Du Pont, 1983a). Section 6.1 describes the scope of these ongoing programs; Figure 6-1 shows the locations of monitoring stations. In addition, Section 6.1 summarizes two special site-wide study programs that reflect commitments made under a Memorandum of Understanding between the U.S. Department of Energy (DOE) and the State of South Carolina. Environmental monitoring programs specifically related to restart and operation of the L-Reactor are described in Section 6.2.

6.1 SRP MONITORING PROGRAMS

6.1.1 Radiological monitoring programs

The program includes the monitoring of air on and off the site, water from SRP streams and the Savannah River, the SRP ground water, and samples of soil, vegetation, food, drinking water, animals, and fish for their radionuclide content. In addition, aerial radiological surveys of the Savannah River Plant and surrounding areas are conducted periodically by the DOE Remote Sensing Laboratory, operated by EG&G. Independent radiological monitoring programs are also conducted by the South Carolina Department of Health and Environmental Control (SCDHEC) and the Georgia Department of Natural Resources (GDNR). BF-3

Air

Concentrations of radioactive materials in the atmosphere and rainwater are measured at 13 monitoring stations near the SRP perimeter and at 12 stations approximately 40 kilometers from the center of the site. Additional air monitoring stations are located at Savannah and Macon, Georgia, and at Columbia and Greenville, South Carolina. These latter stations serve as reference points for determining background conditions. This system permits comprehensive surveillance of atmospheric radioactivity and makes it possible to differentiate between worldwide fallout and SRP releases.

SCDHEC independently monitors levels of alpha, beta, and gamma radioactivity on a biweekly frequency at six locations in the SRP vicinity. GDNR monitors concentrations of alpha, beta, and gamma radioactivity monthly at three locations. In addition, GDNR monitors quarterly for plutonium-strontium composite concentrations at these three locations. Air sample concentrations by both agencies are consistent with SRP data from comparable monitoring locations. BF-3

SRP measures radiation levels continuously with thermoluminescent dosimeters (TLDs) at 165 locations, in a 20,700-square-kilometer area around Savannah River Plant (Figure 6-2).

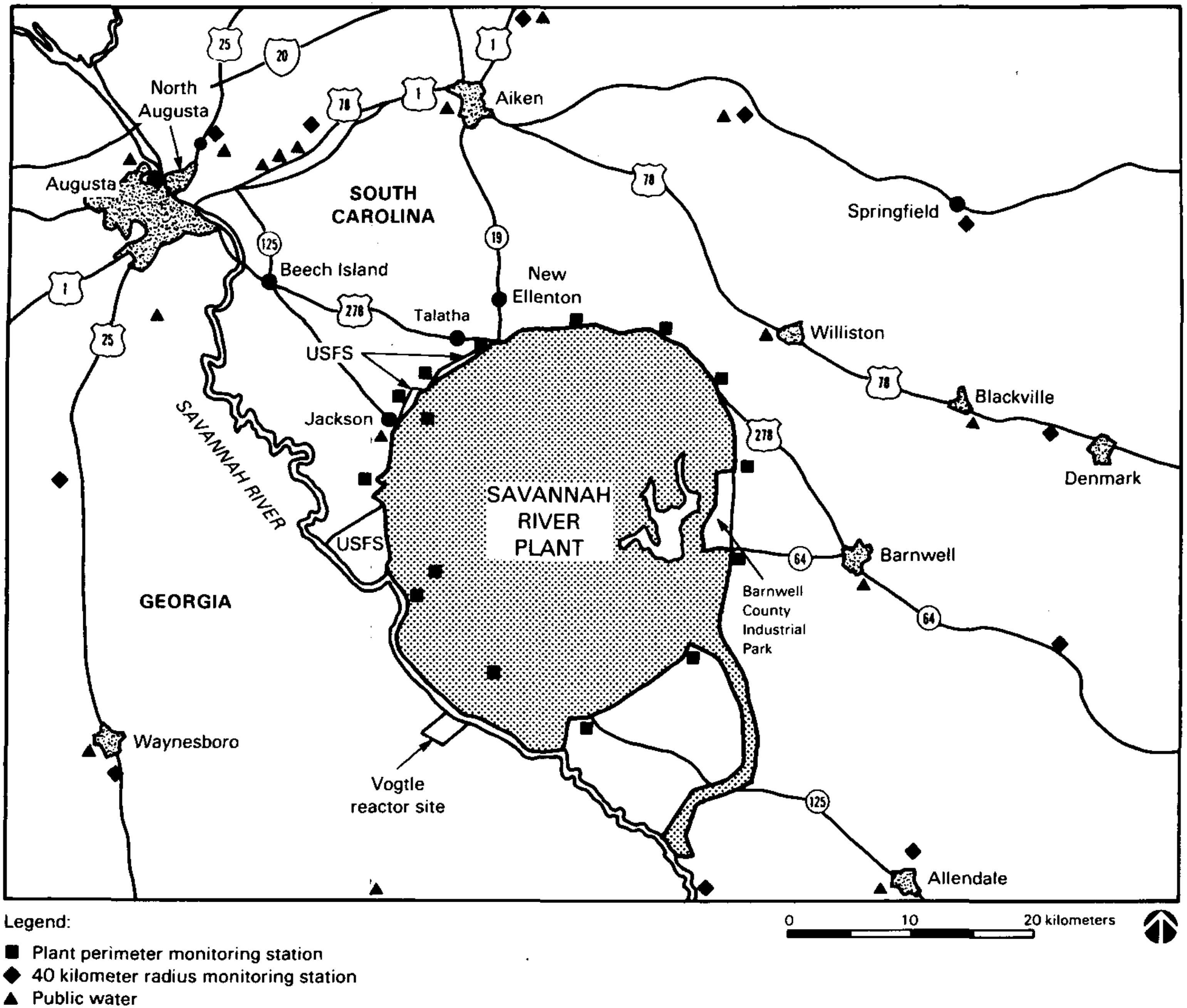

Figure 6-1. Continuous air monitoring stations and public water sample locations.

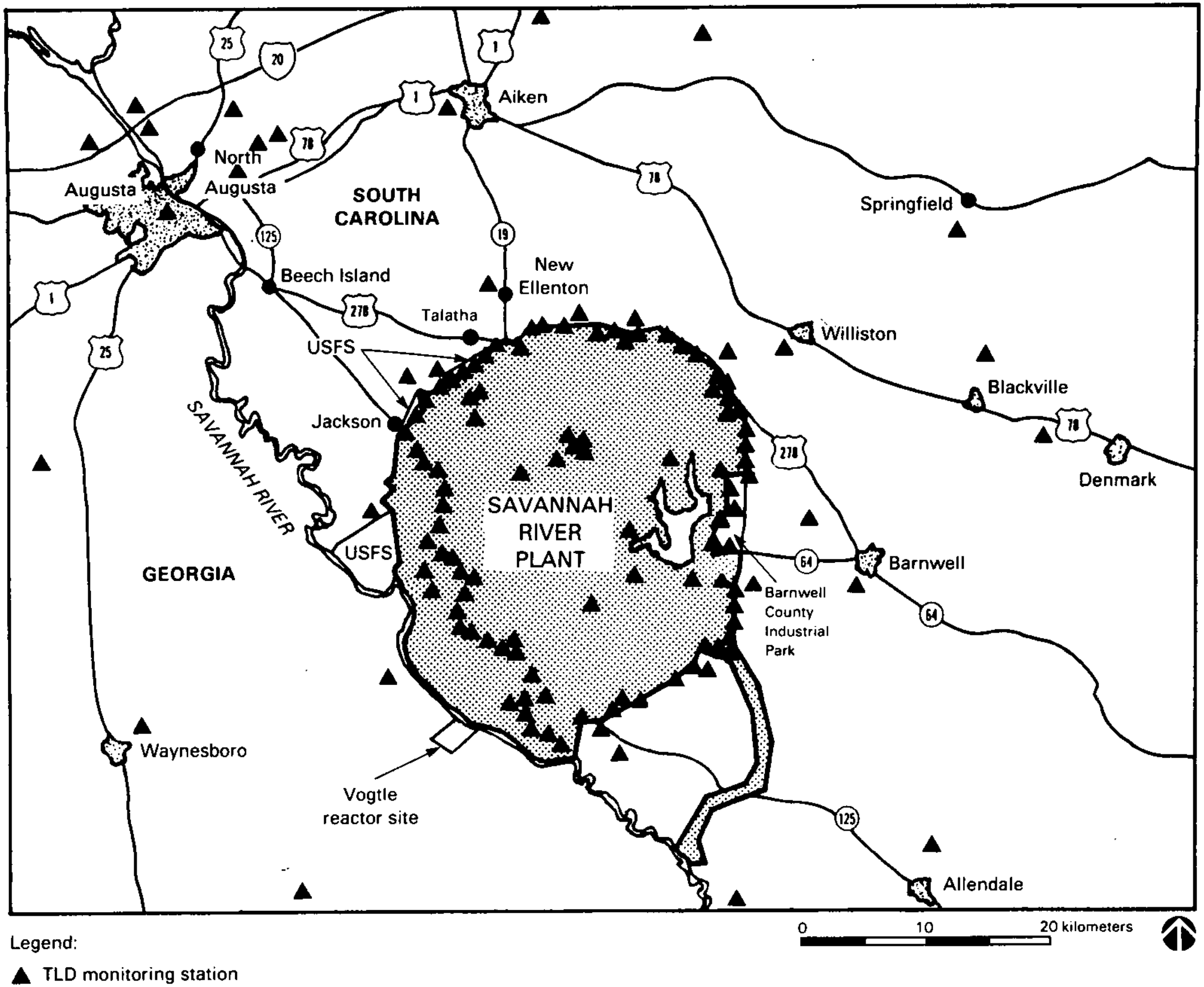

Figure 6-2. TLD monitoring stations.

Additional TLD measurements are made by SCDHEC at 27 locations, principally around the Chem-Nuclear Services, Inc., facility near Barnwell. TLD measurements made quarterly by SCDHEC were consistent with SRP data at select locations from 1974 to 1982.

BF-3 GDNR measures TLD values on a quarterly frequency in Georgia near SRP at 25 locations. TLD measurements made by GDNR during the 1980-1982 period were approximately 60 percent lower than TLD measurements by SRP. These discrepancies can be attributed to the locations of the dosimeters or to the type of dosimeter. GDNR intends to correct these reported TLD measurements (GDNR, 1983).

Savannah River

The site is drained by five streams that flow to the Savannah River. Releases to these onsite streams are monitored for radioactivity. Weekly water samples are collected at five river locations above, adjacent to, and below Savannah River Plant. The samples are analyzed for alpha, nonvolatile beta, and a large number of specific radioisotopes, including tritium and cesium-137.

SCDHEC collects samples at six river locations ranging from North Augusta, South Carolina, to the Beaufort-Jasper water-treatment facility below SRP; these samples are monitored at varying frequencies for concentrations of alpha, nonvolatile beta, gamma, and tritium. Tritium concentrations in the Savannah River at the U.S. Highway 301 bridge and at the Beaufort-Jasper Water Treatment Plant were consistent with SRP data from 1975 to 1982.

BF-3

GDNR monitors river water quarterly for concentrations of alpha, nonvolatile beta, and tritium at seven locations from Augusta, Georgia, to the Highway 301 bridge. GDNR data for tritium in surface water are comparable with SRP results. GDNR has made special surveys along the Savannah River at additional sampling locations. Tritium levels in river water were comparable to levels found at SRP.

Savannah River and onsite stream floodplain sediment

Since 1975, sediment samples have been collected in floodplain areas of the Savannah River at six locations above, adjacent to, and below the Savannah River Plant. Sediment sample collection points were selected at strategic locations to obtain an estimate of the maximum accumulation of radioactivity in the river bed. Following rigorous analyses for various radionuclides, sediment results are useful in the determination of potential changes in radioactivity transport in the river.

GDNR analyzes river sediment samples annually at multiple river locations for gamma activity. These values were determined to be within the range of SRP data. Specific radionuclides are analyzed based on initial gamma results.

BF-3 Since 1977, sediment samples have been collected from onsite SRP stream floodplain areas. Samples are collected along these streams at multiple transects and composited for radioanalysis. These floodplain sediment data from onsite streams provide an annual accounting of sediment radioactivity from SRP sources, global fallout, and other sources.

Swamp

Comprehensive surveys were conducted annually in the Savannah River swamp between Steel Creek Landing and Little Hell Landing from 1974 to 1977. These surveys included soil, vegetation, animals, fish, and TLD-radiation measurements along 10 trails transecting the swamp. These annual surveys did not show any change in radiological conditions, and their frequency was reduced to once every 5 years, although annual TLD measurements were continued. A comprehensive survey was conducted in 1982, and another comprehensive survey will be conducted to determine any changes in radiological conditions during the first year after restart of L-Reactor operation.

Soil

Since 1973, soil samples have been collected at both the SRP boundary at strategic perimeter locations and off the site at two locations. Composited sediment samples are analyzed for individual radionuclide dry-weight concentrations and for cumulative deposition of radioactivity by individual radionuclides. The two offsite locations, which are about 160 kilometers from the center of the plant, serve as control locations.

Additional terrestrial sediments are collected from eight onsite locations encompassing the Separations Areas; these sediments are analyzed for radionuclide concentrations and cumulative deposition, similar to the plant perimeter samples. BF-3

GDNR collects sediment samples in Georgia near the SRP on a quarterly basis. These samples are analyzed for gamma activity; they have been found to be within the range of SRP data.

Ground water

Ground-water samples from a large number of monitoring wells are collected and analyzed for radioactivity content (Du Pont, 1979). Drinking-water supplies at 23 onsite facilities and 14 surrounding towns are analyzed semiannually for alpha, nonvolatile beta, and tritium. The remaining samples of ground water are collected from wells installed in the vicinity of production and waste-management facilities. Monitoring-well samples from SRP production and waste-management facilities are also analyzed for alpha, nonvolatile beta, and tritium.

SCDHEC monitors for concentrations of alpha, nonvolatile beta, and tritium in ground water from wells in six nearby communities and from additional wells around the Barnwell Nuclear Fuel Plant. GDNR monitors for the same parameters at 10 Georgia locations. Both State programs are on a quarterly frequency. BF-3

Vegetation and food

Grass samples (generally Bermuda) are collected routinely during the growing season at all air monitoring locations. Samples are analyzed individually for alpha, nonvolatile beta, and tritium, and are composited monthly for specific gamma analyses. Other vegetation samples are collected and analyzed as part of the general survey program as well as when an unusual release of radioactivity is suspected.

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SCDHEC collects vegetation samples annually at six locations around the Chem-Nuclear Services, Inc., facility and measures them for gamma activity. GDNR collected quarterly vegetation samples at eight locations during the 1980-1982 period; these samples were measured for gamma activity and specific radionuclide analyses.

Milk is sampled routinely at six local dairies within a 40-kilometer radius of Savannah River Plant, and samples are also obtained from a major distributor (from milk produced in the area and sold by the distributor). These samples are analyzed for tritium, iodine-131, cesium-137, and strontium-90. Over 60 samples of farm produce representing the food categories of leafy vegetables, fruit, grain, poultry, eggs, and meat are collected at 14 locations in the six counties surrounding Savannah River Plant. Six locations are near the SRP perimeter and eight at a distance of approximately 40 kilometers. With the exception of grains, all foods are prepared as though for human consumption and then are subjected to radioanalysis.

BF-3

SCDHEC and GDNR each monitor milk samples from at least three local dairies in the area surrounding SRP. SCDHEC monitors total strontium, iodine-131, cesium-137, and tritium on a quarterly frequency. GDNR monitors strontium-89, strontium-90, cesium-137, and tritium on a monthly frequency. The range of strontium-90 and cesium-137 milk concentrations reported by SCDHEC and SRP is consistent for the 1979-1982 period, although the sampling locations were different. GDNR data for tritium in milk samples from dairies near SRP were comparable with SRP results during the 1980-1982 period.

Fish are trapped routinely in the Savannah River upstream, adjacent to, and downstream of Savannah River Plant for radioanalysis. Fish from the river are also supplied for analysis by the Georgia Department of Natural Resources each year. Crabs and oysters from the Savannah River near the seacoast are analyzed for gamma emitters, including cesium-137, and for strontium-90.

Savannah River Plant conducts annual hunts for controlling onsite deer and hog populations. All deer and hogs are monitored for cesium-137 before being released to the hunters for consumption.

Drinking water

Communities near Savannah River Plant get drinking water from deep wells or surface streams. Public water supplies from 14 surrounding towns are sampled and analyzed semiannually.

Two water-treatment plants downstream from Savannah River Plant supply treated Savannah River water to customers in Beaufort and Jasper Counties in South Carolina, and Port Wentworth, Georgia. The Cherokee Hill Water Treatment Plant at Port Wentworth (Savannah) has been treating Savannah River water during the entire period of operation of Savannah River Plant. The Beaufort-Jasper Water Treatment Plant near Hardeeville, South Carolina, has been in operation since January 1965. The Beaufort-Jasper plant serves a consumer population of approximately 50,000. Treated water from the Port Wentworth, Georgia, plant is used primarily for industrial and manufacturing purposes in an industrial complex near Savannah, Georgia. The Port Wentworth Water Treatment Plant has an effective consumer population of about 20,000. Samples of raw and finished water at both these plants were collected daily and composited for monthly alpha, nonvolatile beta, tritium, and cesium-137 analyses.

SCDHEC performs independent tritium and nonvolatile beta analyses from water samples at the Beaufort-Jasper treatment facility. These analyses are made at varying frequencies and are comparable with SRP data, although SCDHEC data do not match the sophisticated detection limits attainable by SRP. GDNR collects similar drinking-water samples from the water-treatment facility on a monthly basis and analyzes for alpha, nonvolatile beta, and tritium concentrations. BF-3

6.1.2 Nonradiological monitoring programs

Monitoring the water quality and biota of the Savannah River has been continuing since 1951; SRP stream-water quality has been monitored since 1972.

Air

Wind data are measured at seven 61-meter meteorological towers on the SRP site and at the 366-meter WJBF-TV tower located off the site. Temperature data are also measured at the television tower and at one onsite station that records continuous temperature, maximum and minimum temperature, daily rainfall, relative humidity, and barometric pressure. Rainfall is monitored at the seven meteorological towers at Savannah River Plant.

Ambient air quality measurements at Savannah River Plant include determinations of sulphur dioxide (SO_2), nitrogen oxide (NO_x), ozone (O_3), and total suspended particulates. The SRP air monitoring program and instrumentation meet the requirements for a Prevention of Significant Deterioration monitoring program. In addition, South Carolina and Georgia each have implemented air sampling networks. There are eight sampling locations in the states' networks in the vicinity of Savannah River Plant. SCDHEC and GDNR both monitor for suspended particulates, sulfur dioxide (SO_2), and nitrogen dioxide (NO_2). BF-3

Surface water

Savannah River water is collected monthly at two locations, above and below Savannah River Plant, and analyzed for 24 water-quality parameters. Fecal coliform in water is analyzed from the same locations weekly. A semiannual water sample from the river adjacent to Savannah River Plant is sent to the Georgia Department of Natural Resources for analyses of 14 water-quality parameters, including standard parameters, nutrients, major ions, and fecal coliform counts. GDNR completed additional monthly water-quality analyses at river pumphouse locations in the early 1970s. Concentrations of 32 pesticides or herbicides and PCB are determined at these locations annually. Sediment samples from these locations are analyzed for PCB, herbicides, and pesticides. BF-3

The Academy of Natural Sciences of Philadelphia (ANSP) makes quarterly water-quality surveys at five stations in the Savannah River. Every 5 years, or as a result of major changes in the physiography of the river, ANSP also makes comprehensive surveys of the biota and chemical water quality above, adjacent to, and below Savannah River Plant to ascertain effects of SRP operations.

The U.S. Geological Survey continuously monitors the temperature and flow of the Savannah River above and below Savannah River Plant and at the mouths of Beaver Dam, Four Mile Creek, and Steel Creek. Measurements of the extent of thermal plumes in the river at the mouths of these creeks are made quarterly.

Aquatic biota

The Limnology Department of ANSP, under contract to Du Pont, has been performing a continuing survey of aquatic organisms in the Savannah River upstream, adjacent to, and downstream from Savannah River Plant since 1951 (Matthews, 1982). Diatoms have been and continue to be collected biweekly. Prior to 1982, other algae, invertebrates, and fish were sampled approximately quarterly. In the spring and summer of 1982, ANSP personnel performed a comprehensive baseline study of algae and invertebrates in the mouth of Steel Creek and in the Savannah River just below Steel Creek in conjunction with plans to restart L-Reactor. Another identical study will be completed in 1983. Similar comprehensive studies are tentatively planned for 1984 and 1985.

TC Mercury from industrial sources above SRP was first detected in fish in 1971. Individual fish were analyzed in 1972 on a quarterly basis by species composites (bream, bass, and catfish). From 1973 through 1975, species composites were analyzed semiannually; from 1976 through 1982, river fish were again analyzed individually. Currently, fish traps are checked weekly at five locations above and below SRP for mercury determination. Mercury levels in fish in 1982 were determined to be essentially the same as those detected in recent years.

Ground water

The quality of the ground water underlying the SRP site is determined by a continuing program of sample collection and analysis for nonradioactive parameters and constituents. Drinking-water supplies from the Tuscaloosa aquifer are sampled and analyzed for content of inorganic ions, organic substances, and metals. Monitoring wells have been installed at both inactive and active waste-disposal sites to gather information about the fate of materials discarded at these sites (Du Pont, 1983b).

Water samples are collected quarterly from ground-water monitoring wells that surround the sanitary landfill site and are analyzed for a number of water-quality parameters. Additionally, water samples are collected and analyzed for trace metals and other drinking-water contaminants once a year. The South Carolina Department of Health and Environmental Control (SCDHEC) has revised monitoring requirements for the sanitary landfills. After four quarters of comprehensive analyses, only semiannual sample collection is needed, with analysis for indicator parameters.

6.1.3 Comprehensive cooling-water study

In July 1983, DOE initiated a 2-year program to determine the environmental effects of cooling-water intake and discharge of the SRP production reactors (C, K, L, and P) and coal-fired power plant operations. This study also draws on the results of ongoing environmental monitoring programs at Savannah River

Plant. The State of South Carolina, the State of Georgia, the U.S. Environmental Protection Agency (Region IV), the U.S. Fish and Wildlife Service (Region IV), and the U.S. Army Corps of Engineers (South Atlantic Division) are participating in this study. The study area includes Par Pond, the SRP onsite streams, the Savannah River swamp, and the Savannah River from Augusta, Georgia, downstream to the area of salt-water intrusion.

Topics to be addressed in the cooling-water study include (1) effects on water usage and quality, (2) wetland effects, (3) effects on fisheries, (4) effects on endangered species, and (5) radionuclide and heavy-metal remobilization, deposition, and effects. Details of these study areas are given below.

Water quality

Water quality studies will provide monitoring data for an assessment of the potential effects of present and proposed SRP activities on the quality of the water used for cooling at the SRP site. The significance of any effects SRP operations have on cooling water will be determined. The quality of water in the Savannah River above and below the SRP, onsite streams, the swamp adjacent to the SRP, and Par Pond will be evaluated. TC

The assessment of thermal effects includes the description and interaction of thermal plumes in the Savannah River swamp along the Savannah River Plant and in the Savannah River from both SRP operations and other thermal effluent sources. These integrated studies are being conducted both upstream and downstream of the Savannah River Plant to facilitate comparisons of assessed values of wetlands, fish spawning, nursery areas, and water quality and to provide perspective concerning the significance of any SRP thermal impacts.

Effects on wetland

Wetlands studies are designed to provide ecological and environmental data for assessing the effects of the operation of the SRP reactors and the 400-D Area coal-fired powerhouse on the wetland ecosystems of the SRP site, including the swamp and onsite streams. The effects to be examined include changes in community structure and diversity, productivity, distribution, habitat use by various wildlife species, and historic changes in vegetation zones in the delta areas where the effluent streams enter the swamp. The comparison of thermally affected and nonthermally affected wetland areas will allow the evaluation of the consequences of releasing cooling water into the SRP streams and swamp system and the significance of those consequences. TC

Effects on fisheries

Ongoing entrainment and impingement studies at the SRP intakes are being incorporated into this comprehensive study. The studies will assess the effect of the withdrawal of fish eggs and larvae and will provide impingement-loss estimates at the intakes. Loss estimates from entrainment and impingement will be related to the relative abundance of river fish populations to determine the effect of SRP operations on the Savannah River system. Current fisheries studies have been expanded to determine the potential spawning areas at approximately 16-kilometer intervals along the Savannah River and near the mouth of named tributaries that enter the Savannah River from Augusta downstream to the area of salt-water intrusion (River Mile 40). Relative abundance of fish eggs and larvae will be compared to assess the importance of the area near Savannah River Plant as a spawning area relative to the Savannah River system.

Fisheries studies currently being conducted on the Savannah River in the vicinity of Savannah River Plant are being continued and expanded to assess the thermal effects on representative important fish species, including any endangered species. These studies will include (1) assessment of effects on migratory fish by thermal plumes; (2) thermal plume attraction/avoidance, including assessment of over-wintering impacts on growth, cold shock, maturation, and disease and parasitism; (3) effects on spawning and nursery grounds; and (4) seasonal plume habitat modification.

Effects on endangered species

Studies on the effects of heated effluents on endangered species, particularly the American alligator and wood stork and their associated habitat along study-area streams, the Savannah River, and adjacent land areas in the vicinity of Savannah River Plant are being conducted (see Section 6.2.5).

Radionuclide and heavy-metal transport

The objective of this element of the study is to provide monitoring data that can be used to quantify and assess the significance of the release of radionuclides and heavy metals from SRP facilities via cooling water and the subsequent transport of these materials to Par Pond, the onsite stream/swamp areas, the Savannah River, and downriver water-treatment plant facilities.
EJ-3
Measurements will be made to determine on-plant and off-plant deposition sites of radionuclides and heavy metals and to evaluate current and future remobilization from these areas. Extensive measurements for radioactivity in water at the Beaufort-Jasper and Port Wentworth water-treatment plants will be made to assess the health significance of releases from SRP operations.

6.1.4 Thermal mitigation study

DOE is conducting an evaluation of alternative cooling concepts to mitigate impacts of thermal discharges from the currently operating SRP reactors (C, K, and P). This assessment will include alternative cooling methods (i.e., cooling towers, ponds or lakes, precooled ponds, and spray canals), potential modifications of plant operations and protection of representative and important species. The study will also consider energy recovery systems such as cogeneration and the operation of a fish hatchery as means to mitigate possible thermal effects.
FK-26

Information developed for each concept will include conceptual design data, capital and operating cost estimates, production loss estimates, effects on other SRP operations, construction schedules, NEPA compliance, and permit requirements. Cost-benefit procedures will be applied to each system to determine its relative value. Effects from current operations will be compared to information developed for alternative cooling concepts to determine if mitigative action is warranted and, if so, what action should be taken. The goals of the study are to complete and submit the thermal mitigation studies to SCDHEC within 9 months of the signing of the consent order and to implement the recommended thermal mitigation alternative approved by SCDHEC under a schedule to be established by SCDHEC in a subsequent order. DOE will submit and actively support appropriate funding requests to accomplish any actions resulting from the comprehensive thermal studies. FK-26

6.1.5 Epidemiological studies

Regional

Three separate health effects studies of cancer and infant death have been made in areas around Savannah River Plant and in counties using downstream river water (Sauer, 1975, 1976, 1979). These studies encompassed the period from 1949, before SRP startup, through 1976. A fourth study, currently in progress, will consolidate the three previous studies, fill in missing time periods, and update mortality rates through 1978, the most recent year for which mortality data were available from the National Center for Health Statistics. The studies concentrate on those types of cancer for which a proven causal relationship with radiation exposure has been demonstrated.

Occupational

The Occupational Epidemiology Section, Oak Ridge Associated Universities, and the Epidemiology Group, Los Alamos National Laboratory, are each conducting studies of SRP workers. Both the Oak Ridge morbidity and mortality studies of radiation workers and the Los Alamos health effects studies of plutonium workers are in the early data collection and validation phase. Because these are comprehensive studies, results will not be available for several years.

Future

The scope and results of ongoing epidemiological studies designed to assess any possible effects that SRP operations might have on human health were made available by DOE to a panel of experts, including participants from the Centers for Disease Control, the South Carolina Department of Health and Environmental Control, and the Division of Public Health of the Georgia Department of Human Resources. The panel of experts will determine if there is a need for additional epidemiological studies of SRP workers or the population around the Savannah River Plant. DOE will conduct public hearings on the panel's findings and initiate any required epidemiological study as a result of this process.

6.1.6 Ground-water protection

A draft "SRP Groundwater Protection Implementation Plan" was recently developed to examine strategies and schedules to implement mitigative actions required to protect the quality of the ground waters beneath SRP. In addition to the commitment for closing the M-Area seepage basin by April 1985, this sitewide plan considers other remedial actions, including discontinuing the use of seepage basins in F- and H-Areas and the use of the present SRP Burial Ground. AJ-1, DA-5, EN-42

Contingent on Congressional authorization and approval of a FY 1986 funding request, DOE plans to operate an effluent-treatment facility by October 1988 to process wastewater being discharged to the F- and H-Area seepage basins. The implementation of mitigative actions would be accomplished under DOE's hazardous waste management program; these actions would be compatible with the State of South Carolina hazardous waste management regulations.

AJ-1, DA-5, EN-42

The sitewide ground-water protection plan will be the subject of a separate NEPA review. Topics to be discussed in this review include the sitewide use of seepage basins, disposal pits, and the burial ground; remedial and mitigation measures; the decommissioning of currently operating facilities receiving hazardous wastes; occupational and offsite exposures; and effects of research and development activities. Appendix F contains additional details.

6.2 L-REACTOR MONITORING PROGRAMS

Many of the site-wide monitoring programs described in Section 6.1 provide information directly applicable to L-Reactor operation. Monitoring programs specifically related to L-Reactor will provide additional information on the disposition of effluents from L-Reactor. These programs are described below.

6.2.1 Nonradiological monitoring

In addition to the Savannah River measurements described in Section 6.1, the U.S. Geological Survey continuously monitors flow in Steel Creek at the Hattieville site and temperature at the mouth of the creek. Following L-Reactor restart, the dimensions (surface area and cross section) of the thermal plume downstream from the mouth of Steel Creek will be measured quarterly by sampling along river transects. In addition, airborne thermal infrared scanner data will be analyzed to supplement the surface-area measurements.

Savannah River Plant collects water samples monthly from Steel Creek near Cypress Bridge (Du Pont, 1979). These samples are analyzed for 23 water-quality parameters. Additional water-quality monitoring will be conducted in accordance with the National Pollutant Discharge Elimination System permit for L-Area effluents. In February 1983, a comprehensive water-quality monitoring program that includes biweekly sampling of 26 parameters at 8 sites in Steel Creek and several sites above and below Steel Creek in the Savannah River was initiated. Special water-quality sampling, including total residual chlorine monitoring, is planned for the L-Reactor flow test to be conducted prior to the restart.

The existing SRP air quality monitoring programs (Du Pont, 1979, 1983a) are considered adequate to monitor nonradioactive air pollutants from L-Area.

6.2.2 Radiological monitoring

To supplement the existing SRP radiological-monitoring program described in Section 6.1, thermoluminescent dosimeters (TLDs) were installed at the four corners of L-Area in 1981 and are changed every 3 months to measure the accumulated dose. Paddlewheel continuous samplers are located in the L-Reactor cooling-water effluent canal, above L-Reactor on Steel Creek, and below L-Reactor on Steel Creek near Hattieville. Representative composite samples are analyzed weekly for radionuclides.

See also Section 2.1.3 for a discussion of in-plant process and effluent monitoring.

6.2.3 Ground-water monitoring

The quality of ground water at the L-Reactor site will be monitored by four wells located around the L-Area low-level radioactive seepage basin. Water will be collected from these wells quarterly and analyzed for alpha, nonvolatile beta, and tritium as well as several water-quality parameters.

6.2.4 Radiocesium monitoring

DOE has established a comprehensive environmental monitoring program to determine the transport of cesium-137 from Savannah River Plant resulting from the startup of L-Reactor. The program consists of analyses of water samples from Steel Creek, Savannah River, and the downstream water supplies (Beaufort-Jasper, South Carolina, and Port Wentworth, Georgia). Cesium-137 is not detectable in upstream or downstream river samples by routine monitoring techniques that have minimum detection limits of about 1.0 picocurie per liter. The routine monitoring program has been in effect at the site for about 30 years. A special monitoring for cesium-137 and total suspended solids will be conducted for a minimum of 1 year following L-Reactor startup and operation.

Aerial radiological surveys of Savannah River Plant and surrounding areas were conducted by the DOE Remote Sensing Laboratory, operated by EG&G, Las Vegas, in 1974, 1979, 1982, and 1983. These surveys will continue after L-Reactor startup.

Special monitoring programs for cesium-137 and total suspended solids will be conducted during cooling-water cold-flow tests. These data will be used to evaluate releases from individual tests and to verify transport models used to estimate the remobilization of cesium during reactor operations. During tests of limited flow, weekly composite water samples will be taken at the mouth of Steel Creek and at Cypress Bridge. For the full-flow tests, daily composite water samples will be taken at multiple points along Steel Creek. Additional special sampling will be made to determine the amount of cesium-137 transported in the suspended sediments.

The drinking-water monitoring program will include measurements of both cesium-137 concentration in the Savannah River above and below Savannah River

Plant and water-treatment plant raw and finished water above and below Savannah River Plant. The Savannah River estuary and the Savannah River, as well as water-treatment sludge ponds, will be studied to determine potential cesium-137 buildup in sediments. These measurements started in March 1983, and will continue for at least 1 year following L-Reactor startup.

Measurements in the Savannah River will provide a material balance of the total cesium-137 discharged to and transported by the river. Measurements of raw river water and finished drinking water will provide cesium-137 concentrations to verify earlier estimates made for transport. Measurements of cesium-137 in the estuary will be compared to earlier measurements to determine long-term trends.

6.2.5 Ecology

Ecological monitoring plans following L-Reactor restart will emphasize changes in the status of Representative and Important Species (RIS) populations in the Steel Creek ecosystem. Vegetation studies will test for shifts in mortality, biomass, and species distributions in the delta and swamp regions; studies of changes in aquatic community structure will emphasize the lower regions of Steel Creek. Changes in patterns of utilization by selected resident avifauna will be examined with respect to alterations of preferred foraging and nesting areas. Monitoring studies will test for changes in the relative abundance of selected species of many amphibian and reptile species compared with the preoperational period.

Wetlands

The wetlands area affected and the delta growth rate will be monitored with both ground surveys and remote sensing. The ground surveys will be directed toward measuring the extent of effects on selected RIS. Remote sensing will be used to evaluate changes in vegetation patterns over larger survey areas and to estimate delta growth rates.

American alligator

Radiotelemetric studies have been conducted on adult male and female alligators in the Steel Creek corridor and delta since 1980 to evaluate their behavior and movements. Consultation with the U.S. Fish and Wildlife Service in the fall of 1982 outlined several steps to mitigate potential effects of L-Reactor startup on the Steel Creek alligator population.

The Steel Creek corridor will continue to be monitored to assess effects on the alligator population. Radiotelemetric studies, which have already been initiated with adult alligators, will continue at least through the winter following L-Reactor restart to determine the response of the Steel Creek alligator population to the startup.

AP-6, AY-2, BA-6, CV-1 Earlier studies were based on L-Reactor restart with the direct discharge alternative. Because the preferred cooling-water alternative is now the 1000-acre lake, DOE has reinitiated consultations with FWS and has transmitted the most recent information on impact projections (Sires, 1984a).

Wood stork

The wood stork is listed as endangered by the U.S. Fish and Wildlife Service. Aerial surveys of the Savannah River swamp were conducted weekly from July 1981 to March 1982 and at irregular intervals from April to September 1982. Aerial surveys of the Birdsville rookery near Millen, Georgia, were conducted at irregular intervals from March to June 1982. Ground observations in the Steel Creek area have also been made (Appendix C). The field studies on the species have been expanded for summer 1983. Aerial and ground surveys will define the use of the SRP swamp system and any nearby rookeries, including the Birdsville rookery. In addition, use of other feeding areas by the Birdsville wood stork population will be evaluated. Previous survey information, along with these expanded studies, will be used to support consultation with the U.S. Fish and Wildlife Service on this species.

DOE has prepared a Biological Assessment for FWS review and use in formulating its *Biological Opinion (Sires, 1984b)*. DOE is continuing to conduct studies and will continue to apprise FWS of the results. AP-6, AY-2, BA-6, CV-1

Shortnose sturgeon

Sturgeon larvae were identified in samples taken near the SRP pumphouses at the Savannah River during the 1982-1983 biological measurements program. A few of these were determined to be the federally endangered shortnose sturgeon (Appendix C). A biological assessment and consultation process with the National Marine Fisheries Service (NMFS) has been completed for this species. The NMFS has concurred with the DOE determination that the population of the shortnose sturgeon in the Savannah River would not be jeopardized (Oravetz, 1983). AP-6, AY-2, BA-6, CV-1

6.2.6 Archeology

Five archeological sites have been identified that could be affected by L-Reactor restart (see Section 3.1.3). Each of the five sites will be monitored on a monthly basis during the first 2 years of the L-Reactor operation to determine whether erosion occurs. If no erosion is evident at the end of the 2-year monitoring period, then the sites should be considered sufficiently protected to assure preservation.

Active erosion protection will be undertaken in the event that adverse erosion threatens the integrity of any of the sites. If erosion barriers are ineffective, recovery and documentation of the archeological data would be carried out.

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7 FEDERAL AND STATE ENVIRONMENTAL REQUIREMENTS

This chapter summarizes the Federal and State of South Carolina requirements that are applicable to the resumption of L-Reactor operations. Table 7-1 lists the permits and other environmental approvals needed for L-Reactor to resume operation. The requirements related to the cooling-water discharge reference case (direct discharge) and the preferred cooling-water alternative (the 1000-acre lake) are listed in Table 7-1; requirements corresponding to other cooling-water discharge alternatives are discussed in Section 4.4.2. To ensure that the preferred cooling-water alternative is a viable option for the decision-maker consistent with the restart of L-Reactor as soon as practicable, the Department prepared and filed dredge and fill (404) and NPDES permit applications with the U.S. Army Corps of Engineers and the South Carolina Department of Health and Environmental Control (SCDHEC), respectively, before the completion of this Final EIS. The requirements emphasize air quality, water quality, the disposal of solid and hazardous wastes, the protection of critical wildlife habitats, and the preservation of cultural resources. TC

In addition to securing these permits and complying with applicable standards, as would be required for any similar large industrial facility, the Department of Energy (DOE), as a Federal agency, is also required to comply with a number of separate environmental requirements, such as the National Environmental Policy Act and wetlands/floodplains review requirements. DOE has established its own orders and regulations to assure the environmental, health, and safety protection of its facilities (Section 7.7).

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

The National Environmental Policy Act of 1969, as amended, requires "all agencies of the Federal Government" to prepare a detailed statement on the environmental effects of proposed "major Federal actions significantly affecting the quality of the human environment." Signed by President Reagan on July 14, 1983, the Energy and Water Development Appropriations Act of 1984 directed the Department of Energy to prepare an environmental impact statement (EIS) on L-Reactor on an "expedited" basis. On July 15, the Federal District Court of Washington, D.C., ruling on a lawsuit filed in November 1982, directed the Department of Energy to prepare an EIS on the proposed restart of the L-Reactor as soon as possible. This environmental impact statement has been prepared in accordance with the Council on Environmental Quality Regulations on Implementing National Environmental Policy Act (40 CFR 1500-1508) and DOE Guidelines for Compliance with the National Environmental Policy Act (45 FR 20694, March 28, 1980). TC

Atomic Energy Act of 1954, as amended (42 USC 2011 et seq.)

DOE is required to comply with radiation guidance pursuant to the Atomic Energy Act of 1954, as amended (42 USC 2021(h)). In accordance with the Energy Reorganization Act of 1974, DOE defense-related operations are not subject to the regulations of the Nuclear Regulatory Commission. DOE has issued extensive standards and requirements to ensure safe operations.

Table 7-1. Required regulatory permits and notifications

Activity/facility	Requirement(s)	Agency	Status
Water			
Process and sanitary-sewer outfalls	NPDES permit Construction permit	South Carolina Department of Health and Environmental Control, Industrial and Agricultural Wastewater Division	Discharges permitted Construction permitted
Domestic water supply system	Permit to construct ground-water wells, treatment and distribution systems	South Carolina Department of Health and Environmental Control, Water Supply Division	Domestic water-supply system construction permitted
Cooling-water discharge	316(a) (thermal impact) study	South Carolina Department of Health and Environmental Control, Industrial and Agricultural Wastewater Division	See Appendix L
Cooling-water discharge, preferred alternative (1000-acre lake)	NPDES permit	South Carolina Department of Health and Environmental Control, Industrial and Agricultural Wastewater Division	Pending completion of FEIS
	Dredge and fill permit (Section 404)	U.S. Army Corps of Engineers	Pending completion of FEIS
	Certification (Section 401)	South Carolina Department of Health and Environmental Control, Industrial and Agricultural Wastewater Division	Requested by COE as part of the dredge and fill permit process
Oil storage	Spill prevention, control and countermeasure plan	EPA/South Carolina Department of Health and Environmental Control	To be included in overall plan for SRP

TC

Table 7-1. Required regulatory permits and notifications (continued)

Activity/facility	Requirement(s)	Agency	Status
Air			
L-Area emergency diesel generators	Operation permits	South Carolina Department of Health and Environmental Control, Bureau of Air Quality Control	Permitted
F-, H, and M-Area process facilities	Operation permit amendments	South Carolina Department of Health and Environmental Control, Bureau of Air Quality Control	Application under review
K-Area powerhouse	Operation permit	South Carolina Department of Health and Environmental Control, Bureau of Air Quality Control	New permit not required
Endangered species	Consultation/ biological assessment	U.S. Fish and Wildlife Service and National Marine Fisheries Service	Consultations with FWS in process; consultations with NMFS completed
Fish and Wildlife Coordination Act	Consultation/ consideration of fish and wildlife resources	U.S. Fish and Wildlife Service	Consultations with FWS in progress
Migratory Bird Treaty Act	Consultation with FWS and development of mitigation plan	U.S. Fish and Wildlife Service	Consultation with FWS in progress
Anadromous Fish Conservation Act	Consultation with FWS and development of mitigation plan	U.S. Fish and Wildlife Service	Consultation with FWS in progress

Table 7-1. Required regulatory permits and notifications (continued)

Activity/facility	Requirement(s)	Agency	Status
Historic preservation	Archeological survey and assessment	South Carolina Historic Preservation Officer	1000-acre lake will require new survey compliance, etc.
Floodplain/wetlands	Assessment and determination	U.S. Department of Energy	To be updated based on FEIS
Hazardous wastes	Resource Conservation and Recovery Act Requirements	U.S. Department of Energy/ South Carolina Department of Health and Environmental Control/U.S. Environmental Protection Agency	RCRA Program Management Plan in place

TC

Executive Order 12088 (October 13, 1978)

This Executive Order requires Federal agencies to comply with applicable administrative and procedural pollution control standards established by, but not limited to, the following Federal laws:

1. Toxic Substances Control Act (15 USC 2601 et seq.)

2. Federal Water Pollution Control Act (33 USC 1251 et seq.)

3. Public Health Service Act, as amended by the Safe Drinking Water Act (42 USC 300 (f) et seq.)

4. Clean Air Act (42 USC 7401 et seq.)

5. Noise Control Act (42 USC 4901 et seq.)

6. Solid Waste Disposal Act (42 USC 6901 et seq.), also referred to as the Resource Conservation and Recovery Act.

Historic Preservation Act

No permits, certifications, or approvals related to historic preservation are required; however, DOE must provide the Advisory Council on Historic Preservation an opportunity for comment and consultation, as required by the Historic Preservation Act of 1966 (16 USC 470(f) et seq.). Section 106 of this Act requires any agency with jurisdiction over a Federal "undertaking" to provide the Council an opportunity to comment on the effect the activity might have on properties included in, or eligible for nomination to, the National Register of Historic Places.

In addition, Executive Order 11593 requires Federal agencies to locate, inventory, and nominate properties under their jurisdiction or control to the National Register of Historic Places if those properties qualify. Until this process is complete, the agency must provide the Advisory Council an opportunity to comment on the possible impacts of the proposed activities on the properties.

Executive Orders 11988 (Floodplain Management) and 11990 (Protection of Wetlands) (May 24, 1977)

These Executive Orders require governmental agencies to avoid to the extent practicable any short- and long-term adverse impacts on floodplains and wetlands wherever there is a practicable alternative. The DOE has issued regulations 10 CFR Part 1022, which establish DOE procedures for compliance with these Executive Orders.

Clean Air Act (42 USC 7401 et seq.) as amended by the Clean Air Act Amendments of 1977 (PL 95-95)

Section 118 requires that each Federal agency, such as DOE, having jurisdiction over any property or facility that might result in the discharge of air pollutants, comply with "all Federal, state, interstate, and local requirements" with regard to the control and abatement of air pollution. Authority for regulation of air emissions has been delegated by the U.S. Environmental Protection

Agency (EPA) to the South Carolina Department of Health and Environmental Control (SCDHEC), Bureau of Air Quality Control. The EPA has also proposed draft regulations for airborne radiation limits (40 CFR 61; 48 FR 15076).

Federal Water Pollution Control Act of 1972 [Section 316(a)]

Section 316(a) of the Federal Water Pollution Control Act of 1972 (PL 92-500) authorizes the Environmental Protection Agency Regional Administrator to set alternative effluent limitations on the thermal component of discharges if the owner/operator (Department of Energy) demonstrates to the satisfaction of the Regional Administrator that the proposed effluent limitations are "more stringent than necessary to assure the protection and propagation of a balanced, indigenous population of fish, shellfish and wildlife in or on a body of water into which the discharge is to be made." Such a demonstration will be made to the South Carolina Department of Health and Environmental Control, which has received the NPDES authority and is the decisionmaker, with program overview by EPA (Section 402 of PL 92-500). The owner/operator must demonstrate, for the cooling-water alternative to be implemented, that the critical functions of a particular trophic level are maintained in the water body as they existed before the introduction of heat and that the impact caused by the heated effluent will not result in appreciable harm to the balanced, indigenous community. Such a demonstration includes scientific evidence that a balanced biological community will be maintained; there will be no adverse impacts to threatened and endangered species; no unique or rare habitats will be destroyed; a zone of passage for representative, important species will be provided; and receiving water temperatures outside any (State-established) mixing zone will not exceed the upper temperature limits for survival, growth, and reproduction of any representative, important species occurring in the receiving water. DOE will comply with this law by conducting a 316(a) demonstration in accordance with negotiations with SCDHEC to assure that its proposed cooling-water alternative will meet the necessary thermal limitations for protection of a balanced biological community.

TC

Federal Water Pollution Control Act (Section 404), as amended by the Clean Water Act of 1977 (33 USC 1251 et seq.); River and Harbors Act of 1899

The Federal Water Pollution Control and Clean Water Acts require all branches of the Federal government engaged in any activity that might result in a discharge or runoff of pollutants to comply with Federal, state, interstate, and local requirements. Authority for implementation of these requirements has been given to the U.S. Army Corps of Engineers (COE) for dredge and fill permits (404 permits) and SCDHEC has been delegated authority by EPA to regulate wastewater discharges (NPDES permits). Individual (case-by-case) permits issued by the COE under Section 404 of the Clean Water Act are also reviewed by EPA (40 CFR 230). Dredge and fill activities in headwaters of creeks where the natural flow is 0.142 cubic meter per second or less are covered under a "nationwide" permit issued by COE.

TC

The River and Harbor Act of 1899 prohibits dredging, construction, or other work in or affecting navigable waters of the United States, except in compliance with Sections 9 and 10 of the Act. The COE has been empowered to issue permits specifying acceptable activities in navigable waters (33 CFR 320.4, 321, 322, and 325).

Federal Water Pollution Control Act (Section 401), as amended by the Clean Water Act of 1977

The public notice of the 404 application includes a paragraph that constitutes a request by the COE on behalf of DOE for certification by SCDHEC in accordance with Section 401 of the Clean Water Act. Section 401 requires certification from SCDHEC that construction and operation-related discharges into navigable waters will comply with the applicable effluent limitations and water-quality standards of the Clean Water Act. This certification is a prerequisite for the 404 permit. TC

Resource Conservation and Recovery Act (RCRA) of 1976 (42 USC 6901 et seq.)

This Act governs the generation, management, transportation, and disposal of solid and hazardous wastes. Currently, DOE is implementing Resource Conservation and Recovery Act (RCRA) requirements at the Savannah River Plant (SRP) pursuant to DOE Order 5480.2, "Hazardous and Radioactive Mixed Waste Management," issued on December 13, 1982. The SRP hazardous-waste management program meets the technical requirements of the EPA hazardous-waste regulations (40 CFR 260-265) and is compatible with SCDHEC requirements.

Since RCRA's enactment in 1976, DOE and one of its predecessors, the Energy Research and Development Administration, have taken the position that the regulatory scheme established by RCRA (including state permitting) does not supplant the regulatory scheme under the Atomic Energy Act that governs these facilities. This position is based on Section 1006(a) of RCRA, 42 U.S.C. 6905(a), that states that RCRA does not apply to "any activity or substance" that is "subject to" the Atomic Energy Act except to the extent that such application is not inconsistent with the requirements of the Atomic Energy Act. This position was communicated in writing to EPA in 1980; in 1982, EPA acquiesced in that view.

On June 22, 1983, the then Acting General Counsel of EPA disagreed with DOE's previously expressed views on the application of RCRA to these facilities. Although that analysis did not consider state permitting of Federal facilities generally authorized by RCRA, EPA seems to have taken the position that these facilities are subject to state permitting under RCRA, and therefore, their continued operation is dependent on permission granted by state officials or the annual facility-specific exemption authority provided to the President by Section 6001 of RCRA, 42 U.S.C. 6961. TC

On February 22, 1984, DOE and EPA signed a Memorandum of Understanding (MOU) for hazardous waste and radioactive mixed waste. This MOU establishes a management program for such waste that is comparable to the design and performance criteria, other technical requirements, and recordkeeping and recording requirements of the regulations (40 CFR 260-266 and 270) that EPA has adopted to implement the Resource Conservation and Recovery Act. The MOU covers the generation, transportation, treatment, storage, and disposal of hazardous waste and radioactive mixed waste at SRP and other DOE facilities operated under the Atomic Energy Act, but does not address responsibilities for implementing the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). However, the MOU does address coordination with State and community relations concerning hazardous waste and radioactive mixed waste.

TC A lawsuit was filed alleging noncompliance with RCRA by one of DOE's Atomic Energy Act (AEA) facilities [Legal Environmental Assistance Foundation, Inc. v. Hodel, C. A. No. 3-83-562 (E. D. Tenn., filed September 20, 1983)]. On April 13, 1984, the District Court decided that DOE AEA facilities are subject to Federal and State permitting requirements under RCRA with respect to the treatment, storage, and disposal of hazardous waste covered by RCRA. As of May 1, 1984, the Solicitor General of the United States had not decided whether to appeal the adverse decision. Should no appeal be taken, DOE will apply the rule of this case to all its facilities. In that event, the Department intends to handle chemical waste determined to be hazardous under the requirements of RCRA in a manner consistent with the court decision. Radioactive mixed waste and other wastes not subject to the requirements of RCRA will continue to be handled in accordance with the MOU.

Noise Control Act of 1972 (42 USC 4901 et seq.)

Section 4 of this Act directs all Federal agencies "to the fullest extent within their authority" to carry out programs within their jurisdiction in a manner that furthers a national policy of promoting an environment free from noise that jeopardizes health or welfare. The DOE will comply with such requirements to the fullest extent possible.

Endangered Species Act of 1973 (16 USC 1531 et seq.)

The Endangered Species Act of 1973, as amended, is intended to prevent the further decline of endangered and threatened species and to bring about the restoration of these species and their habitats. The Act, which is jointly administered by the Departments of Commerce and Interior, does not require a permit, certification, license, or other formal approval. Section 7 does, however, require consultation to determine whether endangered and threatened species are known to have critical habitats on or in the vicinity of the site. DOE will comply with this law by taking all necessary precautions to ensure that its proposed action will not jeopardize the continued existence of any threatened or endangered species and/or their critical habitats.

Fish and Wildlife Coordination Act (16 USC 661 et seq.)

TC The Fish and Wildlife Coordination Act requires that equal consideration be given to the conservation of fish and wildlife resources during the development of a water-related project. Specifically, the Act requires that consultation be carried out with the Fish and Wildlife Service and appropriate state wildlife agencies with a view to the conservation of wildlife resources by preventing loss of and damage to such resources and by providing for the development and improvement thereof in connection with the project. DOE is required to give full consideration to the Habitat Evaluation Procedures report and recommendations of the Secretary of the Interior and the State agency, and the project plan shall include such justifiable means and measures for wildlife purposes as the reporting agency finds should be adopted to obtain maximum overall project benefits. No permit is required by this Act. However, the Department of Energy, subsequent to its consultations with the FWS, will consider the mitigation of impacts to fish and wildlife resources in accordance with the FWS Mitigation Policy (USDOI, 1981).

Migratory Bird Treaty Act (16 USC 703-712)

The Migratory Bird Treaty Act was enacted primarily to protect birds that have common migration patterns between the United States and Canada, Mexico, Japan, and Russia. It regulates the harvest of migratory birds by specifying the mode of harvest, hunting seasons, bag limits, etc. The Act stipulates that it is unlawful at any time, by any means or in any manner to "kill...any migratory bird." Thus, avian mortality attributable to SRP operations (e.g., from chemical pollutants in seepage basins) would be unlawful under the provisions of this Act. Although no permit for this project is required under the Act, the Department of Energy is required to consult with the U.S. Fish and Wildlife Service regarding impacts to migratory birds, and to evaluate ways to avoid or minimize these effects in accordance with the FWS Mitigation Policy (USDOI, 1981). TC

Anadromous Fish Conservation Act (16 USC 757a-f)

The principal purpose of the Anadromous Fish Conservation Act is to enhance the conservation and development of the anadromous fishery resources of the United States that are subject to depletion from water resource development. Its applicability to the SRP is that populations of anadromous fishes are to be sustained and their movements unobstructed by plant operations. Although there is no permit required by this Act, the Department of Energy is required to consult with the U.S. Fish and Wildlife Service regarding impacts to anadromous fishes, and to evaluate ways to avoid or minimize these effects in accordance with the FWS Mitigation Policy (USDOI, 1981). When an anadromous fish is also an endangered species, the National Marine Fisheries Service (U.S. Department of Commerce) would be involved through the Endangered Species Act.

Safe Drinking Water Act of 1974, as amended

The L-Reactor public drinking water system is in compliance with the mandates of the Safe Drinking Water Act. The system received approval for startup from SCDHEC, which administers and enforces the Safe Drinking Water Act in the State. SCDHEC administration and enforcement consists of permits to construct, preliminary site inspections, final construction inspections, monthly sampling collections, and regular operations and maintenance inspections. Injection wells are not now and have not in the past been used for the disposal of wastewater.

7.1 HISTORIC PRESERVATION

An archeological and historic survey of the Steel Creek terrace and floodplain system was completed in February 1981. The survey revealed five sites that were nominated to the National Register of Historic Places (i.e., important and worthy of preservation from any adverse effects). A monitoring plan has been developed and implemented to protect these sites (Section 6.2.6).

A draft of the archeological survey report, which was prepared by the University of South Carolina's Institute of Archeology and Anthropology for DOE, was submitted to the South Carolina State Historic Preservation Officer (SCHPO). SCHPO representatives conducted a site visit in March 1982. DOE requested a concurrence in a determination of no adverse effect on the five sites from the Keeper of the National Register of Historic Places and the Advisory Council on Historic Preservation. The State Historic Preservation Officer concurred in July 1982 with DOE-SR (Savannah River Operations Office) that these sites will not be impacted by L-Reactor restart provided that the proper erosion monitoring program is adopted (see Section 3.1.3).

TC DOE has initiated the reconsultation process with SHPO concerning the mitigation of any new sites of historic significance that might be inundated by the 1000-acre lake or discovered in additional surveys for the lake.

7.2 SOLID AND CHEMICAL WASTE DISPOSAL

L-Area restart activities have generated a variety of residuals defined as solid and chemical wastes under Federal and South Carolina law. Disposal will take place at Savannah River Plant. DOE has developed a RCRA Program Management Plan (Sires, 1984a) for nonradioactive solid and hazardous waste at Savannah River Plant based on EPA and SCDHEC regulations.

Rubble materials are considered nonburnable wastes. Broken concrete asphalt and other construction debris have been buried in a rubble pit near L-Area. Notification and inspection of the SRP rubble pits have been completed. The use of rubble pits was discontinued on August 12, 1983.

The SRP sanitary landfill is designed and operated according to SCDHEC guidelines for the purpose of receiving domestic waste from SRP construction and operational activities. The sanitary landfill site was recently expanded from 10 acres to 32 acres, which will easily accommodate additional waste from L-Area.

Domestic sanitary sewage sludge is disposed of in a lagoon in the Central Shops area, consistent with SCDHEC guidelines.

7.3 ENDANGERED SPECIES

AP-6, AY-2, BA-6, CV-1

The Endangered Species Act requires Federal agencies to ensure that none of their actions jeopardizes the continued existence of endangered or threatened species (or those that are proposed as such) or result in the destruction or adverse modification of designated critical habitat for such species. Federal agencies are required to consult with the U.S. Fish and Wildlife Service (FWS) and/or the National Marine Fisheries Service (NMFS) regarding the implementation of a proposed action. If FWS or NMFS indicates that an endangered or threatened species (or one that is proposed as such) or critical habitat could be present in the area of the proposed action, a biological assessment must be prepared. This assessment is used as a basis for evaluating the effects on Federally protected species through the formal consultation process.

The following sections summarize the status of the consultation process with the FWS and NMFS for four endangered species that would be affected by the direct discharge of cooling-water effluent into Steel Creek. Implementation of another cooling system (e.g., the preferred alternative) would require the reinitiation of the consultation process. AP-6, AY-2, BA-6, CV-1

7.3.1 American alligator

Formal consultation on the American alligator was held under the Endangered Species Act in September 1982 with representatives of DOE-SR, Du Pont, NUS Corporation, the Savannah River Ecology Laboratory (SREL), and the U.S. Fish and Wildlife Service (FWS). A Biological Opinion was received from the FWS in which FWS judged that protection of the lagoons at SRP Road A should provide sufficient mitigation for the American alligator potentially impacted by L-Reactor restart with the direct discharge alternative. Protection of these lagoons has been completed. Since the preferred cooling-water alternative is now the 1000-acre lake, DOE has reinitiated consultations with FWS. DOE has transmitted the most recent information on impact projections for this species (Sires, 1984b) to the FWS. DOE is awaiting a decision on its conclusion that the impacts resulting from the delayed restart of L-Reactor will not jeopardize the continued existence of this species. AP-6, AY-2, BA-6, CV-1

7.3.2 Red-cockaded woodpecker

The FWS has determined that the red-cockaded woodpecker will be unaffected by L-Area operations.

7.3.3 Shortnose sturgeon

Sturgeon larvae were identified in water samples taken near the SRP pumphouses at the Savannah River in 1982 and 1983. A few of these were determined to be the federally endangered shortnose sturgeon. A biological assessment and consultation process with the National Marine Fisheries Service (NMFS) has been completed for this species. NMFS has concurred with DOE determination that the population of the shortnose sturgeon in the Savannah River would not be jeopardized (Oravetz, 1983). AP-6, AY-2, BA-6, CV-1

7.3.4 Wood stork

The endangered wood stork forages at the Savannah River Plant, but does not breed on the site. The feeding individuals have been observed to be from the Birdsville Rookery some 50 kilometers away. DOE initiated informal consultation with FWS in July 1983 and in March 1984. DOE has prepared a Biological Assessment for FWS review and use in formulating its Biological Opinion (Sires, 1984c). DOE is continuing to conduct studies and apprise FWS of the results of continuing studies. AP-6, AY-2, BA-6, CV-1

7.4 WILDLIFE AND FISHERIES

Three regulations afford protection to wildlife and fisheries resources; they are the Fish and Wildlife Coordination Act, the Migratory Bird Treaty Act, and the Anadromous Fisheries Conservation Act. None of these acts requires the application or acquisition of a permit. Each act, however, requires that the Department of Energy consult with the U.S. Fish and Wildlife Service about impacts to fish and wildlife. Furthermore, DOE and FWS will undertake a cooperative effort that will mitigate impacts to fish and wildlife resources in accordance with the FWS Mitigation Policy. Consultations are currently underway with the FWS to ensure that DOE will comply fully with these three acts.

TC

The Department of Energy is working with the Department of the Interior to perform the Habitat Evaluation Procedure (HEP). The HEP will identify the value of habitat to be gained or lost with the implementation of the preferred cooling-water mitigation alternative for use in assessing further mitigation. DOE will implement additional mitigative measures that might be identified through the HEP process. If required, DOE will request Congressional authorization and appropriation for the additional mitigation measures.

7.5 WATER QUALITY

Section 402 of the Clean Water Act, as amended, is the basis for controlling "point source" discharges of pollutants into navigable waters of the United States through the National Pollutant Discharge Elimination System (NPDES); this system is administered by the EPA, which has delegated NPDES permitting authority in South Carolina to the State of South Carolina. DOE applied to the State in 1981 for renewal and consolidation of its original NPDES permits. All L-Area outfalls with the potential for future use were included in the NPDES permit renewal application. Between 1981 and 1983, negotiations between SCDHEC and DOE were held to resolve issues related to the L-Reactor NPDES permit.

On December 15, 1983, SCDHEC announced its determination to issue an NPDES permit to the DOE for Savannah River Plant effective January 1, 1984. Based on this permit and a mutually agreed upon consent order, all discharges except thermal discharge from L-Reactor would be permitted. Thermal discharges from the three operating SRP reactors (C, K, and P) would be permitted provided that DOE would:

1. Complete a comprehensive study of the thermal effects of all operations at Savannah River Plant.

TC

2. Complete and submit thermal mitigation studies to SCDHEC within nine (9) months of signing of the consent order.

3. Implement the recommended thermal mitigation alternative approved by SCDHEC under a schedule to be established by SCDHEC in a subsequent order.

4. Submit and actively support appropriate funding requests to accomplish any actions resulting from the thermal studies.

All L-Area non-reactor-cooling-water effluent discharges are permitted pursuant to the December 15, 1983, announcement, including the discharge of sanitary wastewater and various nonprocess cooling waters from the control building, pumphouse, offices, and the security building.

Since August 1982, SCDHEC has considered SRP onsite streams and ponds to be Class B waters of the State, and not as receptors of industrial cooling water. This interpretation would limit the temperature of thermal effluents from L-Reactor as follows [SCDHEC, 1981; Section C.(7)].

- Discharges to an onsite stream - The temperature of the discharge "shall not exceed a maximum temperature of 90°F (32.2°C) at any time nor shall a maximum temperature rise above temperatures existing under natural conditions exceed 5°F (2.8°C) as a result of the discharge of heated liquids unless an appropriate temperature criteria or mixing zone, as provided below, has been established. The water temperature at the inside boundary of the mixing zone shall not be more than 18°F (10°C) greater than that of water unaffected by the heated discharge. The appropriate temperature criteria or the size of the mixing zone shall be determined on an individual project basis and shall be based on biological, chemical, engineering and physical considerations. Any such determination shall assure the protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife in and on a body of water to which the heated discharge is made and shall allow passage of aquatic organisms."

- Discharge to a lake or reservoir - The temperature of the discharge "shall not exceed a weekly average temperature of 90°F (32.2°C) after adequate mixing as a result of heated liquids, nor shall a weekly average temperature rise of more than 5°F (2.8°C) above temperatures existing under natural conditions be allowed as a result of the discharge of heated liquids unless an appropriate temperature criteria or mixing zone, as provided below, has been established. The water temperature at the inside boundary of the mixing zone shall not be more than 18°F (10°C) greater than that of water unaffected by the heated discharge. The appropriate temperature criteria or the size of the mixing zone shall be determined on an individual project basis and shall be based on biological, chemical, engineering and physical considerations. Any such determination shall assure the protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife in and on a body of water to which the heated discharge is made and shall allow passage of aquatic organisms." TC

- Case-by-case determinations - "Upon a case-by-case determination by the Department and in accordance with the Act, the Clean Water Act (P.L. 92-500, 95-217), and related regulations, the above temperature criteria may not apply to cooling water bodies with a primary purpose of providing a source and/or being a receptor of industrial cooling water."

As noted in Section C.(8) of SCDHEC (1981), the temperature standards for Class B waters of the State are applicable when the flow rate is equal to or greater than the minimum 7-day average flow rate that occurs with an average frequency of once in 10 years. However, the temperature of the discharge cannot be so high that it interferes with water uses or is harmful to human, animal, plant, or aquatic life.

Section 4.4.2 describes alternative cooling-water systems for L-Reactor and indicates their ability to meet the Class B water-quality standards (discussed above). The preferred cooling-water alternative of the Department of Energy is to construct a 1000-acre lake before L-Reactor resumes operation, to redesign the reactor outfall, and to operate L-Reactor in a way that assures a balanced biological community in the lake (i.e., to maintain 32.2°C or less for about 50 percent of the lake). After L-Reactor is operating, DOE will conduct studies to determine the effectiveness of the cooling lake and to decide on the need for precooling devices to allow for greater operational flexibility. The preferred alternative, other alternative cooling-water systems, and other thermal mitigation measures have been the subject of ongoing discussions with SCDHEC. At the time of publication, discussions on these alternatives and mitigation methods
TC and on the incorporation of L-Reactor thermal discharge into the overall SRP NPDES permit were continuing.

In early December 1983, DOE also initiated discussions with the COE regarding dredge and fill permits under Sections 9 and 10 of the River and Harbor Act and Section 404 of the Clean Water Act. DOE has submitted its 404 application for the 1000-acre lake, and the public notice describing the proposed construction has been issued. The public notice of the 404 application also includes a paragraph that constitutes a request by the COE on behalf of DOE for certification by SCDHEC in accordance with Section 401 of the Clean Water Act. Section 401 requires certification from SCDHEC that construction and operation-related discharges into the navigable waters will comply with the applicable effluent limitations and water quality standards of the Clean Water Act. This certification is a prerequisite for the 404 permit approval from the Corps of Engineers.

L-Area will contain two surface fuel-oil storage tanks with capacities of approximately 30,000 and 11,000 liters. Each tank has a spill containment structure around it. L-Area will be included in the Spill Prevention Containment and Control plans for the Savannah River Plant.

7.6 FLOODPLAIN/WETLANDS

DOE issued a floodplain/wetlands notice regarding the proposed reactivation of L-Reactor on July 14, 1982 (47 FR 30563). A floodplain/wetlands determination regarding no practical alternative was published in the Federal Register on August 23, 1982 (47 FR 36691-2). The floodplain/wetlands assessment has been updated (see Appendix I) and the floodplain/wetlands determination will be updated and/or modified after completion of the Final Environmental Impact Statement.

The Fish and Wildlife Service's mitigation policy for wetlands is stated in 46 FR 7644-7663. This policy establishes four resource categories to establish
-6 mitigation levels consistent with the fish and wildlife resources involved. The wetlands that would be impacted by the restart of L-Reactor are categorized under Resource Category 2 as habitat of "high value for evaluation species" and

are "scarce or becoming scarce." The mitigation goal under this policy requires that there be "no net loss of inkind habitat value." FK-6

7.7 AIR QUALITY

The authority for the regulation of air emissions has been delegated by the EPA to the Bureau of Air Quality Control of the SCDHEC. The Bureau issues operating permits and performs Prevention of Significant Deterioration reviews. Because existing facilities will be used to supply steam and electric power to L-Reactor on a continuous basis, no new SCDHEC operating permits will be required for these facilities.

SCDHEC air pollution regulations require both construction and operating permits for emergency diesel generators that have greater than 150-kilowatt-rated capacity. L-Area will have three emergency diesel generators rated at more than 150 kilowatts; they have been on standby since L-Reactor operation was suspended in 1968. The permits necessary for their operation have been received from SCDHEC.

Modifications to the operating permits for increases in nitrous oxide emissions from the process facilities in F-, H-, and M-Area are currently under review by SCDHEC.

EPA has retained jurisdiction for the regulation of airborne radionuclides. The Savannah River Plant operates within the limits of the draft regulations currently proposed (48 FR 15076) and will remain in compliance after the restart of L-Reactor.

7.8 DEPARTMENT OF ENERGY HEALTH AND SAFETY ORDERS

DOE is responsible for assuring the health and safety of its own facilities and has established comprehensive health, safety, and environmental programs. These are contained in the following DOE Orders:

- DOE Order 5440.1B, "Implementation of National Environmental Policy Act," May 14, 1982.
- DOE Order 5480.1A, "Environmental Protection, Safety, and Health Protection Program for DOE Operations," August 13, 1981.
  - Chapter I - Environmental Protection, Safety, and Health Protection Standards
  - Chapter II - Reserved
  - Chapter III - Safety Requirements for the Packaging of Fissile and Other Radioactive Materials

- Chapter IV - Reserved
- Chapter V - Safety of Nuclear Facilities
- Chapter VI - Safety of Department of Energy Owned Reactors
- Chapter VII - Fire Protection
- Chapter VIII - Contractor Occupational Medical Program
- Chapter IX - Construction Safety and Health Program
- Chapter X - Industrial Hygiene Program
- Chapter XI - Requirements for Radiation Protection
- Chapter XII - Prevention, Control, and Abatement of Environmental Pollution
- Chapter XIII - Aviation Safety

- DOE Order 5484.2, "Unusual Occurrence Reporting System," August 13, 1981.
- DOE Order 5483.1, "Occupational Safety and Health Program for a Government Owned Contractor Operated Facility," April 13, 1979.
- DOE Order 5484.1, "Environmental Protection, Safety, and Health Protection Information Reporting Requirements," February 24, 1981.
- DOE Order 5480.2, "Hazardous and Radioactive Mixed Waste Management," December 13, 1982.
- DOE Order 5481.1A, "Safety Analysis and Review System," August 13, 1981.
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8 UNAVOIDABLE/IRREVERSIBLE IMPACTS

Impacts that cannot be avoided by reasonable mitigation measures are described in Section 8.1; these impacts are based on the reference case (direct discharge to Steel Creek). Impacts that differ from those caused by the preferred cooling alternative (described in Chapter 4 and Appendix L) are noted. Other individual mitigation alternatives would have smaller unavoidable and irreversible impacts. Section 8.2 describes commitments of resources and Section 8.3 outlines short-term versus long-term implications. AM-5, FR-27

8.1 UNAVOIDABLE ADVERSE IMPACTS

The unavoidable adverse impacts expected from the resumption of L-Reactor operation have all been experienced previously to either the same or a greater extent during the past operation of L-Reactor.

An additional 11 cubic meters per second of cooling water would be withdrawn from the Savannah River. This withdrawal would cause entrainment and impingement of aquatic biota (Section 5.2.4). The resumption of direct discharges of thermal effluents from reactor operation to Steel Creek (reference case) would impact between 730 and 1000 acres of wetlands and the wildlife supported by this habitat. Some habitat for the American alligator, waterfowl, and wood stork would be eliminated. The preferred cooling alternative would impact between 735 and 1015 acres of wetlands and 875 acres of uplands. Some habitat for the alligator, waterfowl, wood stork, and other wildlife would also be eliminated. AM-5, FR-27

For the reference case, the use of Steel Creek above its delta by fish would be significantly reduced. During the months of March, April, and May, thermal effluents from Steel Creek would block fish access to Boggy Gut Creek wetland areas (230 acres) and prevent spawning in this offsite creek. Thermal discharges would also increase the thermal plume in the Savannah River; however, a zone of passage for fish would be maintained. The impacts would be reduced with the preferred (1000-acre lake) cooling alternative, although the headwaters of Steel Creek would not always be available to fish. During winter, the temperature of Steel Creek below the embankment would be 7° to 9°C above ambient, leading to the possibility of cold shock. However, reactor shutdowns during the winter would result in gradual heat loss in this area, which would minimize any cold shock effects. Aquatic biota would be able to utilize the swamp and delta for spawning and feeding purposes. AM-5, FR-27

Unavoidable radiation exposure would include increased occupational exposures and exposures to the general public due to normal reactor operations, and the resuspension of radiocesium and cobalt-60 from Steel Creek. The occupational and public exposures (Section 4.1.2) would be minimal compared to those from natural and other manmade radiation sources.

8.2 IRREVERSIBLE AND/OR IRRETRIEVABLE COMMITMENTS OF RESOURCES

Energy, raw material, and other resources would be consumed in the operation of L-Reactor. Resources that could be irreversibly or irretrievably committed during operation of facilities include (1) materials that cannot be recovered or recycled, and (2) materials consumed or reduced to unrecoverable forms.

Resumption of L-Reactor operation would involve only land previously committed. However, final disposal of low-level radioactive waste associated with L-Reactor operation would probably involve additional land use (ERDA, 1977).

Irretrievable energy use would amount to 40-50 megawatt-years of electricity per year, 5.8×10^3 metric tons of coal per year, and 1.5×10^6 liters of diesel fuel per year. Additionally, process chemicals would be consumed and/or converted to unrecoverable forms. Other irretrievable resources would include contaminated materials and/or equipment that could not be reused.

8.3 SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

The short-term effects of L-Reactor operation include the unavailability of site areas for their natural productivity and wildlife habitat. However, this area has been committed for energy and defense activities since 1951. Following decommissioning and decontamination (Section 4.6), this area can revert back to its natural state with minimal long-term effects.

In the short term, L-Reactor operation would impact wetlands, wetlands habitat, and aquatic biota due to cooling-water withdrawal and thermal effluent discharge. There would be loss of a portion of local habitat for endangered species (e.g., the American alligator, and the wood stork). In the long term, after termination of L-Reactor operation, wetlands below the cooling lake embankment could become established through the process of natural succession. Emergent, nonwoody hydrophytes could become reestablished within months, depending upon the season when flow is terminated, and other habitat factors. Vegetation characteristic of bottomland and swamp wetlands would take longer. In 1981, 13 years after the shutdown of L-Reactor, the Savannah River swamp had only begun to return to its former composition and structure (Repaske, 1981). The 1000-acre lake would provide habitat for aquatic and semiaquatic biota.

AM-5, FR-27

AM-5, FR-27

Solid nonradioactive waste generated from L-Reactor would use additional land at a landfill site that will be unavailable for alternative uses. Additional space would be required at an already designated burial ground site for radiological solid waste generated by L-Reactor.

High-level radioactive waste from L-Area would require additional waste processing (DOE, 1982) and disposal in a geologic repository with the commitment of associated land and other resources.

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Office of the Chief
Department of Agriculture

Department of Commerce
Office of Environmental Affairs

Department of Health and Human Services
ATTN: Director
Office of Environmental Affairs

Occupational Safety and Health Administration

Department of Housing and Urban Development
ATTN: Director
Office of Environmental Quality

Mr. Bruce Blanchard, Director
Environmental Project Review
Department of the Interior

Dr. Sidney R. Galler
Deputy Assistant Secretary for Environmental Affairs
Department of Commerce

Department of Justice
Land and Natural Resources Division
Washington, DC 20530

Department of Labor
ATTN: Chief
Office of Environmental and Economic Impact

Lt. Colonel George F. Boone
U.S. Army Corps of Engineers

Water Resources Council

Federal Emergency Management Agency

Department of State
ATTN: Director
Office of Environmental Affairs

Advisory Council on Historic Preservation

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Department of Defense Headquarters

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Office of Management and Budget

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Director
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Department of the Interior

Office of Radiation Programs
Environmental Protection Agency

Director
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Department of Transportation

Director
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Director
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U.S. Arms Control and Disarmament Agency

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Nuclear Regulatory Commission

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Office of Policy and Analysis
Interstate Commerce Commission

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Office of Federal Activities
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Division of Engineering
Nuclear Regulatory Commission

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Environmental Project Review

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Office of Nuclear Reactor Regulation
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and Radiological Health
Department of Health and
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Region IV

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Department of the Interior

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Fish and Wildlife Service
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Nuclear Materials Production Division
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Office of Assistant Inspector General
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Energy Systems Department
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Laboratories

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South Carolina Department of Health
and Environmental Control

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Environmental Quality Control
South Carolina Department of Health
and Environmental Control

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and Environmental Control

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and Environmental Control

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Enforcement Division
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and Environmental Control

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District Director
Lower Savannah District Office
South Carolina Department of Health
and Environmental Control

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Water Quality Assessment and
Enforcement Division
Bureau of Water Pollution Control
South Carolina Department of Health
and Environmental Control

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South Carolina Department of Health
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Bamberg County Schools

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Department of Natural Resources

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Environmental Radiation Programs
Environmental Protection Division
Department of Natural Resources

Manager
Environmental Radiation Programs
Environmental Protection Division
Department of Natural Resources

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Water Supply
Department of Natural Resources

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Divisions of Physical Health and Social Services
Georgia Department of Human Resources

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Georgia State Department of Defense
Civil Defense Division

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Department of Transportation

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Port Planning and Harbor Development
Georgia Port Authority

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Augusta City Council

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Augusta City Council

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Augusta-Richmond County Planning Commission

Mr. Tim Maund, Director
Central Savannah River Area Planning and Development Commission

Mr. Dayton L. Sherrouse
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Richmond County

Mr. Emory Sayer
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Columbia County

Mr. Robert Cato, Director
Columbia County Planning and
Zoning Commission

Mr. Moye Walker
County Extension Agent
Richmond County Extension Service

Mr. Billy Hopper, County
Administrator
Burke County

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Friends of the Earth

President
National Audubon Society

President
National Wildlife Federation

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The Nature Conservancy

Director of Conservation
The Wilderness Society

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Environmental Defense Fund

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Environmental Policy Center

Natural Resources Defense Council,
Inc.

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Natural Resources Defense Council,
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Natural Resources Defense Council,
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Nuclear Weapons and Power Project
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Environmentalists, Inc.

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Research Consultant
Radiation Awareness

Piedmont Organic Movement

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South Carolina Nuclear Weapons
Freeze Campaign

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The Audubon Society

Georgia

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Coastal Director
The Georgia Conservancy

Mr. G. Robert Kerr
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League of Women Voters of Georgia

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Ms. Rebecca R. Shortland
Coastal Citizens for Clean Energy

Mr. Dan Siler, III
Georgians Against Nuclear Energy

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Nuclear Coordinator
South Carolina Chapter
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Citizens For Clean Air

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Athens Progressive Resource Center

Mr. Peter L. Patrick
Athens Progressive Resource Center

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Athenians for Clean Energy

Ms. J. Y Shorthouse
Georgians Against Nuclear Energy

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Academy of Natural Sciences of
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Nuclear Information and Resource
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Physicians For Social Responsibility

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Snake River Alliance

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National Wildlife Federation

The Sierra Club
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Public Reading Room
Chicago Operations Office
Argonne, IL

Public Reading Room
Idaho Operations Office
Idaho Falls, ID

Public Reading Room
Nevada Operations Office
Las Vegas, NV

Public Reading Room
Oak Ridge Operations Office
Oak Ridge, TN

Freedom of Information Reading Room
U.S. Department of Energy
Forrestal Building
Washington, DC

Public Reading Room
Albuquerque Operations Office
National Atomic Museum
Albuquerque, NM

Public Reading Room
Richland Operations Office
Richland, WA

Public Reading Room
Energy Resources Center
San Francisco Operations Office
Oakland, CA

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Aiken County Public Library

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Aiken-Bamberg-Barnwell-Edgefield Regional Library
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South Carolina State Library

Spartanburg County Library

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Burke County Library

Chatham County Public Library

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Charleston County Library

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(Channel 2 NBC)

WCSC-TV (Channel 5)

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WLTX-TV

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WJCL-TV (Channel 22)

Mr. Douglas Weathers
News Director
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WABV Radio

News Director
WAKN Radio

News Director
WKTX Radio

News Director
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WOKE Radio

News Director
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WCOS Radio

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News Director
WDOG Radio

News Director
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WANS Radio

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News Director
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WVGB Radio

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WOIC Radio

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WYNR Radio

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GLOSSARY

abatement

Method for reducing the degree or intensity of an environmental impact; also the use of such a method.

absorbed dose

Energy transferred to matter when ionizing radiation passes through it. Absorbed dose is measured in rads.

absorber

Material, such as concrete and steel shielding, that absorbs and diminishes the intensity of ionizing radiation.

absorption

The process by which the number and energy of particles or photons entering a body of matter are reduced by interaction with the matter.

acclimation

The physiological and behavioral adjustments of an organism to changes in its immediate environment.

acclimatization

The acclimation or adaptation of a particular species over several generations to a marked change in the environment.

activation

The process of making a material radioactive by bombardment with neutrons, protons, or other nuclear particles.

activation products

Nuclei formed by the bombardment of material with neutrons, protons, or other nuclear particles.

activity

A measure of the rate at which a material is emitting nuclear radiation, usually given as the number of nuclear disintegrations per unit of time. A unit of radioactivity is the curie (Ci), which equals 3.7×10^{10} disintegrations per second.

adaptation

A change in structure or habit of an organism that produces better adjustment to the environment.

adsorption

The adhesion of a substance to the surface of a solid or solid particles.

AEC

Atomic Energy Commission. A five-member commission established by the Atomic Energy Act of 1954 to supervise the use of nuclear energy. The AEC was dissolved in 1975 and its functions transferred to the Nuclear Regulatory Commission (NRC) and the Energy Research and Development Administration (ERDA), which became the Department of Energy (DOE).

aerobic

Processes that can occur only in the presence of oxygen.

air quality

A measure of the levels of pollutants in the air.

air quality standards

The prescribed level of pollutants in the outside air that cannot be exceeded legally during a specified time in a specified area.

air sampling

The collection and analysis of air samples for detection or measurement of radioactive substances.

alluvial

Deposited by a stream or running water.

alpha (^{t}) particle

A positively charged particle, consisting of two protons and two neutrons, that is emitted during certain radioactive decay, from the nucleus of certain nuclides. It is the least penetrating of the three common types of radiation (alpha, beta, and gamma).

ambient air

The surrounding atmosphere, usually the outside air, as it exists around people, plants, and structures. (It is not the air in immediate proximity to emission sources.)

anaerobic

Processes that occur in the absence of oxygen.

anion

A negatively charged ion.

aquatic biota

The sum total of living organisms of any designated aquatic area.

aquifer

An underground bed or stratum of earth, gravel, or porous stone that contains water. The water can be pumped to the surface through a well or it might emerge naturally as a spring.

archeological sites (resources)

Areas or objects modified or made by man and the data associated with these features and artifacts.

arcuate

A curved or bent axial trace in a fold. (The fold would be called arcuate.)

arenaceous limestone

Limestone with a texture or appearance of sand.

arkosic

Having wholly or in part the character of arkose, which is a sandstone containing 25 percent or more of feldspars, usually derived from silicic igneous rocks (e.g., granite).

artifact

An object produced or shaped by human workmanship of archeological or historical interest.

ash

Inorganic residue remaining after ignition of combustible substances.

atmosphere

The layer of air surrounding the earth.

backfill

Material used to refill an excavation.

background exposure

See exposure to radiation.

background radiation

Normal radiation present in the lower atmosphere from cosmic rays and earth sources. Background radiation varies considerably with location.

bedrock

Any solid rock exposed at the earth's surface or overlain by unconsolidated surface material such as soil, gravel, or sand.

bedroom community

An area, adjacent to a city, where a large number of individuals who work in the city reside.

benthic region

The bottom of a body of water. This region supports the benthos, a type of life that not only lives upon but contributes to the character of the bottom.

benthos

The plant and animal life whose habitat is the bottom of a sea, lake, or river.

beta particle

An elementary particle emitted from a nucleus during radioactive decay. It is negatively charged, is identical to an electron, and is easily stopped, such as by a thin sheet of metal.

biological dose

The radiation dose, measured in rems, absorbed in biological material.

biological oxygen demand (BOD)

A measure of the amount of oxygen consumed in the biological processes that break down organic matter in water. The greater the amount of organic waste in water, the greater the BOD.

biological shield

A mass of absorbing material placed around a radioactive source to reduce the radiation to a level safe for humans.

biosphere

The portion of the earth and its atmosphere capable of supporting life.

biostratigraphy

The study of stratigraphy via fossilized remains.

biota

The plant and animal life of a region.

BOD

See: Biological oxygen demand.

borosilicate glass

A strong chemically resistant glass made primarily of sand and borax. As a waste form, high-level waste is incorporated into the glass to form a leach-resistant, nondispersible (immobilized) material.

Btu

British Thermal Unit, a unit of heat. The quantity of heat required to raise the temperature of one pound of water by one degree Fahrenheit. One Btu equals 1055 joules (or 252 calories).

building codes

Legislative regulations which prescribe the materials, minimum requirements, and methods used in the construction, rehabilitation, maintenance, and repair of buildings and other structures.

burial ground

A place for burying unwanted radioactive materials in which the earth acts as a shield to prevent escape of radiation. In this EIS, materials are incorporated into concrete to prevent leaching of materials or movement in the underground environment.

°C

Degree Celsius. The Celsius temperature scale is related to the Fahrenheit scale as follows:

$$°F = °C \times \frac{9}{5} + 32.$$

calcareous cement

Calcium carbonate based cement.

calcine

The process in which the water portion of the slurried waste is driven off by evaporation at high temperature in a spray chamber leaving a residue of dry solid unmelted particles, also referred to as the calcine.

cancer

The name given to a group of diseases that are characterized by uncontrolled cellular growth.

canister

A metal (steel) container into which immobilized radioactive waste is sealed.

canyon building

A heavily shielded building used in the chemical processing of radioactive materials. Operation and maintenance are by remote control.

carbon monoxide

A colorless, odorless gas that is toxic if breathed in high concentration over a certain period of time. It is a normal component of most automotive exhaust systems.

carcinogen

An agent capable of producing or inducing cancer.

carcinogenic

Capable of producing or inducing cancer.

carolina bay

Wetland area found on the Southeastern Atlantic coastal plain. A shallow depression.

cask

A heavily shielded massive container for holding a canister of HLW during shipment of the immobilized radioactive material.

cc

Cubic centimeters, cm^3 or cc (1 cc = 1 milliliter).

CCDF

Complementary cumulative distribution function.

cfm

Cubic feet per minute.

cfs

Cubic feet per second.

Ci

See: Curie.

clarifier

A tank or other vessel to accomplish removal of settleable solids (e.g., in this EIS, the liquid waste transfer operations include transfer to a clarifier in which the sludge solids settle and the liquid is clarified).

clastic dike

A sedimentary dike formed by broken rocks from overlying or underlying material.

commercial HLW

High-level radioactivity waste materials produced by commercial operations. Most of such waste is produced by commercial nuclear power plants; it is the spent nuclear fuel from such plants or the product of reprocessing such fuels. Such wastes are distinguished from wastes produced in processing defense materials.

common carriers

The vehicles, such as trucks, trains, barges, and planes that are licensed to transport the wide assortment of goods and materials distributed regularly across the country.

concentration

The quantity of a substance contained in a unit quantity of a sample.

condensate

Liquid water obtained by cooling the steam (overheads) produced in an evaporator system. Also, any liquid obtained by cooling saturated vapor.

CO_2

Carbon dioxide, a colorless, odorless, nonpoisonous gas that is a normal component of the ambient air.

coolant

A substance, usually water, circulated through a processing plant to remove heat.

cooling tower

A structure designed to cool water by evaporation. In this EIS, the water being cooled was heated by absorbing heat in order to condense the steam in the evaporator system.

correlatable

Able to establish a connection between geological formations or events.

cretaceous

End of mesozoic era, between 136 and 65 million years ago.

crystalline metamorphic rock

Rock consisting wholly of crystals.

cuesta

A ridge formed from sedimentary rock, steep on one side, but with a gentle slope on the other.

cumulative effects

Additive environmental, health, and socioeconomic effects that result from a number of similar activities in an area.

curie (Ci)

A unit of radioactivity equal to 3.7×10^{10} (37 billion) disintegrations per second. A curie is also a quantity of any nuclide or mixture of nuclides having one curie of radioactivity.

daughter

A nuclide formed by the radioactive decay of another nuclide, which is called the parent.

decay heat

The heat produced by the decay of radioactive nuclides.

decay, radioactive

The spontaneous transformation of one nuclide into a different nuclide or into a different energy state of the same nuclide. The process results in the emission of nuclear radiation (alpha, beta, or gamma radiation).

decommissioning

Removing facilities such as processing plants, waste tanks, and burial grounds from service and reducing or stabilizing radioactive contamination. Decommissioning concepts include:

- The decontamination, dismantling, and return of an area to its original condition without restrictions.
- Partial decontamination, isolation of remaining residues, and continued surveillance and restrictions.

decomposition

The breakdown of a substance into its constituent parts.

decontamination

The removal of radioactive contaminants. This removal can be from surfaces of equipment, as by cleaning or washing with chemicals, or by wet abrasive blasting using glass frit and water (to decontaminate the filled canisters). Also, the removal of high-level radioactivity nuclides from within a material (e.g., from high-level radioactivity liquid defense wastes).

defense waste

Nuclear waste generated from government defense programs as distinguished from waste generated by commercial and medical facilities.

demography

The statistical study of human populations including population size, density, distribution, and vital statistics such as age, sex, and ethnicity.

depositional regimes

A systematic laying or throwing down of material over a substantial area.

detector

Material or device (i.e., instrument) that is sensitive to radiation and can produce a response signal suitable for measurement or analysis.

detritus

Dead organic tissues and organisms in an ecosystem.

diesel generator

A machine powered by diesel fuel that converts mechanical energy into electricity.

diesel oil

An oil fraction produced in processing crude oil, which is used to fuel diesel engines.

dip

The angle that a structural surface (e.g., a bedding or fault plane) makes with the horizontal, measured perpendicular to the strike of the substance.

disposal

Placement of HLW in a repository in such a manner that the materials remain isolated from the environment permanently or until radioactive nuclides have decayed to harmless levels.

distillation

Separation process achieved by creating two or more coexisting zones which differ in temperature, pressure, or composition.

DOE

United States Department of Energy.

dose

The energy imparted to matter by ionizing radiation. The unit of absorbed dose is the rad, equal to 0.01 joules per kilogram of irradiated material in any medium.

dose commitment

The dose which an organ or tissue would receive during a specified period of time (e.g., 50 or 100 years) as a result of intake (as by ingestion or inhalation) of one or more radionuclides from 1-year's release.

dose equivalent

A term used to express the amount of effective radiation when modifying factors have been considered. It is the product of absorbed dose (rads) multiplied by a quality factor and any other modifying factors. It is measured in rems (Roentgen equivalent man).

dose rate

The radiation dose delivered per unit time (e.g., rems per year).

dosimeter

A small device (instrument) that measures radiation dose (e.g., film badge or ionization chamber) and is carried by a radiation worker.

drawdown

The height difference between the water level in a formation and the water level in a well caused by the withdrawal of ground water.

drift

Mist or spray carried out into the atmosphere with the effluent air from cooling towers.

DWPF

Defense Waste Processing Facility, under construction at SRP; it is designed to process defense waste into a suitable form for terminal storage or disposal.

D_2O

Heavy water or deuterium oxide.

ecology

The science dealing with the relationship of all living things with each other and with the environment.

ecosystem

A complex of the community of living things and the environment forming a functioning whole in nature.

EDC

See: Environmental dose commitment.

effluent

A liquid waste, discharged into the environment, usually into surface streams. In this EIS, effluent refers to discharged wastes that in their natural state or as a result of treatment are nonpolluting.

effluent standards

Defined limits of waste discharge in terms of volume, content of contaminants, temperature, etc.

EIS

Environmental impact statement, a document prepared pursuant to Section 102(2)(c) of the National Environmental Policy Act of 1969 (NEPA) for a major Federal action significantly affecting the quality of the human environment.

electron

An elementary particle with a unit negative charge and a mass 1/1837 of the proton. Electrons surround the positively charged nucleus and determine the chemical properties of the atom.

element

One of the 105 known chemical substances that cannot be divided into simpler substances by chemical means. All nuclides of an element have the same atomic number.

eluate

The liquid resulting from removing the trapped material from an ion-exchange resin.

emission standards

Legally enforceable limits on the quantities and/or kinds of air contaminants that may be emitted into the atmosphere.

endangered species

Plants and animals in an area that are threatened with either extinction or serious depletion of a species.

energy

The capacity to produce heat or do work. Electrical energy is measured in units of kilowatt-hours.

environment

The sum of all external conditions and influences affecting the life, development, and ultimately, the survival of an organism.

environmental dose commitment (EDC)

A dose representing exposure to and ingestion of environmentally available radionuclides for 100 years following a one-year release of radioactivity.

environmental fate

The result of the physical, biological, and chemical interactions of a substance released to the environment.

environmental transport

The movement through the environment of a substance; it includes the physical, chemical, and biological interactions undergone by the substance.

eocene

Lower tertiary period, after paleocene but before oligocene.

epidemiology

The study of diseases as they affect populations.

epoch

Length of time (geology).

erosion

The process in which uncovered soil and clay are carried away by the action of wind or water.

estuarine

Pertaining to an area where salt and fresh water come together, and are affected by tides.

exchange resin

Polymeric spheres containing bounded groups that carry an ionic charge, either positive or negative, in conjunction with free ions of opposite charge that can be displaced.

exposure to radiation

The incidence of radiation on living or inanimate material by accident or intent. Background exposure is the exposure to natural background ionizing radiation. Occupational exposure is that exposure to ionizing radiation which takes place during a person's working hours. Population exposure is the exposure to a number of persons who inhabit an area.

°F

Degree Fahrenheit. The Fahrenheit temperature scale is related to the Celsius scale as follows:

$$°C = \frac{(°F - 32)}{1.8}.$$

facies

A group of rocks that differ from surrounding rocks.

fall line

Imaginary line marking the point that most rivers drop steeply from the uplands to the lowlands.

fallout

The descent to earth and deposition on the ground of particulate matter (which may be radioactive) from the atmosphere.

fanglomerates

Sedimentary rock of water-worn heterogeneous fragments of every size, settling in an alluvial fan and cementing into rock.

fault

A fracture or a zone of fractures within a rock formation along which vertical, horizontal, or transverse slippage has occurred in the past.

faunal

Animal and plant fossils of a certain rock unit.

feldspar

Most common group of aluminum silicate minerals (containing other metals, such as potassium, sodium, and iron) that form rock.

ferruginous

Containing iron oxide.

fission

The splitting of a heavy atomic nucleus into two approximately equal parts, which are nuclei of lighter elements, accompanied by the release of energy and generally one or more neutrons. Fission can occur spontaneously or can be induced by neutron bombardment.

fission products

Nuclei formed by the fission of heavy elements (primary fission products). Also the nuclei formed by the decay of the primary fission products, many of which are radioactive.

fluvial

Relating to or living in, or near a river.

flux

Rate of flow through a unit area.

food chain

The pathways by which any material entering the environment passes from the first absorbing organism through plants and animals to humans.

fracture porosity

Breaking in a rock resulting in porosity.

fuel

A substance used to produce heat (e.g., from chemical energy by combustion, or from nuclear energy by nuclear fission).

fuller's earth

Fine grained natural earth substance. Has high absorbency. Consists mostly of hydrated aluminum silicates.

gal

Gallons.

gamma rays (γ)

High-energy, short-wavelength electromagnetic radiation accompanying fission and emitted from the nucleus of an atom. Gamma rays are very penetrating and require dense (e.g., lead) or a thick layer of materials for shielding.

gamma spectrometry

Identification and quantification of radioisotopes by measurement of the characteristic gamma rays emitted by elements undergoing radioactive decay.

generator

A machine that converts mechanical energy into electrical energy; a diesel generator is one that utilizes diesel fuel.

genetic effects

Radiation effects that can be transferred from parent to offspring; radiation-induced changes in the genetic material of sex cells.

geologic repository (mined geologic repository)

A facility for the disposal of nuclear waste. The waste is isolated by placing it within a continuous, stable geologic formation at depths greater than 1000 feet.

geology

The science that deals with the earth: the materials, processes, environments and history of the planet especially the lithosphere, including the rocks, their formation and structure.

g/L

Grams per liter.

glass frit

Ground or powdered glass.

glauconitic

Mineral aggregate containing glauconite, giving it a green color.

gneiss

Rock formed from bands of granular minerals alternating with bands of minerals that are flakey, or have elongate prismatic habits.

gpm

Gallons per minute.

gradient

Slope, particularly of a stream or land surface.

ground water

The supply of water under the earth's surface in an aquifer.

gypsum

Mineral containing hydrous calcium sulfate.

half-life (biological)

The time required for a living organism to eliminate, by natural processes, half the amount of a substance that has entered it.

half-life (effective)

The time required for a radionuclide contained in an organism to reduce its activity by one half as a combined result of radioactive decay and biological elimination.

half-life (radiological)

The time in which half the atoms of a radioactive substance disintegrate to another nuclear form. Half-lives vary from millionths of a second to billions of years.

half-thickness

The thickness of any absorber that will reduce the intensity of a beam of radiation to one half its initial intensity.

halogens

The group of five chemically related nonmetallic elements that include fluorine, chlorine, bromine, iodine, and astatine.

hardwoods

Trees which are an angiosperm and yield wood which has a hard consistency.

health physics

The science concerned with recognition, evaluation, and control of health hazards from ionizing radiation.

heat exchanger

A device that transfers heat from one fluid (liquid or gas) to another or to the environment.

heating value

The heat released by combustion of a unit quantity of a fuel, measured in joules or Btu's.

heavy metals

Metallic elements of high molecular weight, such as mercury, chromium, cadmium, lead, and arsenic, that are toxic to plants and animals at known concentrations.

heavy water

Water in which the molecules contain deuterium, an isotopic form of hydrogen which is heavier than ordinary hydrogen, and oxygen.

hectare

A metric unit of area equal to 2.471 acres.

HEPA

High efficiency particulate air filter. A type of filter designed to remove 99.9% of the particles down to 0.3 mm in diameter from a flowing air stream.

high-level waste

High-level liquid waste or the products from the solidification of high-level liquid waste or irradiated fuel elements if discarded without reprocessing. Also see: Commercial HLW; Defense waste.

historic resources

The sites, districts, structures, and objects considered limited and nonrenewable because of their association with historic events, persons, or social or historic movements.

HLW

High-level radioactive waste. (Also see: Commercial HLW; Defense waste).

holocene

Epoch of quaternary period from end of pleistocene to present time.

horneblende

Most common mineral of the amphibole group.

HSU

Hydrostratigraphic unit.

hydraulic conductivity

Water flow rate in gallons per day through a one square foot cross section under a unit hydraulic gradient.

hydraulic (water) head

Height of water with a free surface above a subsurface point.

hydrocarbons (HC)

Organic compounds consisting primarily of hydrogen and carbon. Hydrocarbons are emitted in automotive exhaust and from the incomplete combustion of fossil fuels such as coal.

hydrograph

Graph showing water characteristics such as velocity, or flow, in relation to time.

hydrologic regimen

Total quantity and characteristic behavior of water in a drainage basin.

hydrology

The science dealing with the properties, distribution, and circulation of natural water systems.

hydrosphere

The water portion of the surface of the earth as distinguished from the solid portion, the lithosphere.

hydrostratigraphic unit

Rock or soil body extending laterally for a considerable distance. (Sometimes abbreviated HSU.)

immobilization

Conversion of HLW into a form that will be resistant to environmental dispersion.

incorporated places

Political units incorporated or combined as cities, boroughs, towns, and villages.

indigenous labor pool

An area's native labor pool composed of workers normally residing in the area, who do not leave the area upon termination of a construction project.

induced radioactivity

Radioactivity that is created when substances are bombarded with neutrons as in a reactor.

indurated

Soil or rock compacted and hardened by heat, pressure, and cementation.

inert gas

A gas that is totally unreactive.

in-movers

Workers who move into an area during construction and leave when the project is finished. As used in this document, in-movers also include some weekly travelers.

intensity

The energy or the number of photons or particles of radiation incident upon a unit area per unit of time. Intensity of radioactivity is the number of atoms disintegrating per unit of time.

interfluvial

Falling in the area between two streams.

intergranular porosity

Porosity between grains of rock.

interim storage

Temporary storage of sealed canisters containing immobilized HLW in a shielded storage vault until transfer to a Federal repository.

ion

An atom or molecule that has gained or lost one or more electrons and thus has become electrically charged.

ion exchange

Process in which a solution, containing soluble ions to be removed, is passed over a solid ion exchange column, which removes the soluble ions by exchanging them with labile ions from the surface of the column. The process is reversible, so the trapped ions can be eluted from the column and the column regenerated.

ionization

The process whereby ions are created. Nuclear radiation can cause ionization as can high temperatures and electric discharges.

ionizing radiation

Radiation capable of displacing electrons from atoms or molecules thereby producing ions.

irradiation

Exposure to radiation.

isotope

An atom of a chemical element with a specific atomic number and atomic weight. Isotopes of the same element have the same number of protons but different numbers of neutrons.

joule

A unit of energy or work which is equivalent to one watt per second or 0.737 foot-pounds or 4.18 calories.

kaolin

Clay mineral group characterized by a silicon oxygen sheet, and an aluminum-hydroxyl sheet alternately linked to form a two-layer crystal lattice.

kilometer

A metric unit of length equal to 0.62137 mile.

leachate

Liquid that has percolated through solid waste or other media and has extracted from the solids dissolved or suspended materials into the liquids.

leaching

The process whereby a soluble component of a solid or mixture of solids is extracted as a result of percolation of water around and through the solid.

leukemia

A form of cancer characterized by extensive proliferation of nonfunctional immature white blood cells (leukocytes).

lignite

A brownish-black coal between stages of peat and subbituminous coal.

limonite

Hydrous ferric oxides occurring naturally, but having unknown origins.

liquid HLW

The aqueous high-level radioactive waste resulting from the production of nuclear materials at SRP.

liters per second

A metric unit of flow rate equal to 15.85 gallons per minute.

lithology

Rock descriptions by color, structure, grain size, etc.

lithosphere

The solid part of the earth composed predominantly of rock.

long-lived nuclides

Radioactive isotopes with half-lives greater than about 30 years.

low-level waste

Radioactive waste not classified as high-level waste. The wastes (mostly salts) remaining after removal of the highly radioactive nuclides from the liquid high-level wastes for immobilization.

man-rem

The radiation dose commitment to a given population; the sum of the individual doses received by a population segment.

marine terrace

Narrow coastal strip altered by marine deposit and erosion.

maximum permissible dose

That dose of ionizing radiation established by competent authorities as an amount below which there is no appreciable risk to human health and which at the same time is below the lowest level at which a definite hazard is believed to exist.

megawatt (MW)

A unit of power equal to 1,000 kilowatts (kW) or one million (10^6) watts.

mg

Milligram (one-thousandth of a gram).

mica

Variously colored, or colorless mineral silicates, crystallizing in monoclinic forms that separate into thin leaves.

micro (μ)

Prefix indicating one millionth. One microgram = 1/1,000,000 of a gram or 10^{-6} gram.

micrometer (μm)

A unit of length equal to one one-millionth (10^{-6}) of a meter.

micron

A micrometer (10^{-6} meters).

migration

The natural travel of a material through the air, soil, or ground water.

ml

Milliliter (one-thousandth of a liter).

mm

Millimeter (one-thousandth of a meter).

mobility

The ability of a chemical element or a pollutant to move into and through the environment.

moderator

A material used to slow down neutrons from fission to thermal energies.

molecule

A group of atoms held together by chemical forces. A molecule is the smallest unit of a compound that can exist by itself and retain all its chemical properties.

monitoring

Process whereby the level and quality of factors that can affect the environment and/or human health are measured periodically in order to regulate and control potential impacts.

monoclinal

Strata varying from the horizontal in one direction only.

mrem

Millirem (1/1,000 of a rem).

mutagen

An agent, physical, chemical, or radiative, capable of inducing mutation (above the spontaneous background level).

mutagenesis

The occurrence or induction of mutation, a genetic change that is passed on from parent to offspring.

mutation

An inheritable change in the genetic material (in a chromosome).

nano

Prefix indicating one thousandth of a micro unit; one trillionth; 1 nanocurie = 10^{-9} curie.

National Register of Historic Places

A list maintained by the National Park Service of architectural, historical, archaeological, and cultural sites of local, state, or national significance.

natural radiation or natural radioactivity

Background radiation.

nCi

Nanocuries, 10^{-9} curies.

NEPA

National Environmental Policy Act of 1969.

neutron

An uncharged elementary particle with a mass slightly greater than that of the proton and found in the nucleus of every atom heavier than hydrogen-1. A free neutron is unstable and decays with a half life of about 13 minutes into an electron and a proton.

neutron flux

Number of neutrons flowing through a specified area per unit time.

NH_3

Ammonia, a pungent reactive colorless gas, which is irritating to the eyes and moist skin in high concentrations.

NO_x

Refers to the oxides of nitrogen, primarily NO and NO_2. These are often produced in the combustion of fossil fuels. In high concentration they constitute an air pollution problem.

nodes

The intersection of horizontal and vertical grids.

NRC

Nuclear Regulatory Commission.

nuclear energy

The energy liberated by a nuclear reactor (fission or fusion) or by radioactive decay.

nuclear power plant

A facility that converts nuclear energy into electrical power. Heat produced by a reactor is used to make steam to drive a turbine which drives an electric generator.

nuclear reaction

A reaction in which an atomic nucleus is transformed into another element, usually with the liberation of energy as radiation.

nuclear reactor

A device in which a fission chain reaction is maintained and which is used for irradiation of materials or the generation of electricity.

nucleus

The small positively charged core of an atom, which contains nearly all of the mass of the atom.

nuclide

An atomic nucleus specified by its atomic weight, atomic number and energy state. A radionuclide is a radioactive nuclide.

organic degreasers

Cleaning agents having organic chemical structures.

outcrop

Part of a geologic formation above the surface of the earth.

paleocene

Epoch of tertiary period between the gulfian of the cretaceous period and before the eocene.

particulates

Solid particles small enough to become airborne.

pascal

A metric unit of pressure. 101,000 pascals is equal to 14.7 psi (1 atmosphere).

pD

The negative log of the deuterium (heavy hydrogen) ion concentration in solution; analogous to the term pH, which refers to the normal hydrogen ion concentration.

peneplain

Almost featureless, plain land surface.

perched

A water-bearing area of small lateral dimensions lying above a more extensive aquifer.

permeability

Ability for water to flow through a porous rock, or soil.

pH

A measure of the hydrogen ion concentration in aqueous solution; specifically, the negative logarithm of the hydrogen ion concentration. Acidic solutions have a pH from 0 to 7, basic solutions have a pH greater than 7.

phosphatic marl

Soft, loose, earthy phosphates that crumble easily.

photon

Electromagnetic radiation; a quantum of electromagnetic energy having properties of both a wave and a particle but without mass or electric charge.

physiography

Description of earth surface features, including air and water as well as land.

piedmont province

Large area forming a plateau at the base of the Appalachian mountains, extending from New Jersey to Alabama.

piezometric maps

Lines of equal groundwater pressure drawn on a map.

piezometric surface

The surface to which water in an aquifer would rise by hydrostatic head.

pisolitic clay

Clay that exhibits an internal structure of pea-sized clay grains.

plant stream

Any natural stream on the SRP site. Surface drainage of the site is via these streams to the Savannah River.

pleistocene

Epoch of the quaternary period, between pliocene and holocene.

pliocene

Epoch of the tertiary period, between miocene and pleistocene.

plume

The visible emission from a flue or chimney.

pollution

The addition of any undesirable agent to an ecosystem in excess of the rate at which they can be degraded, assimilated, or dispersed by natural processes.

ppb

Parts per billion (10^{-9}), one thousandth of a part per million.

ppm

Parts per million. The unit is commonly used to represent the degree of pollutant concentration when the concentration is small. In air, ppm is usually volume pollutant/1,000,000 volumes of air; in water, a weight/1,000,000 weight units.

primary road

Interstate, state, and regional routes including rural arterial routes and their extensions into or through urban areas.

psi

Pounds per square inch, a measure of pressure. Atmospheric pressure is about 15 psi.

pyrite

Isometric mineral: FeS_2 (iron sulfide).

quality factor

The factor by which absorbed dose, in rads, is multiplied to obtain a quantity expressing the irradiation incurred by various biological tissues taking into account the biological effectiveness of the various types of radiation.

quartz

Crystalline silica: SiO_2.

quartzite

Very hard, metamorphosed sandstone.

quaternary age

The period from the end of the tertiary to present time.

rad

Acronym for radiation absorbed dose; is the basic unit of absorbed dose equal to the absorption of 0.01 joules per kilogram of absorbing material.

radiation

The emitted particles and/or photons from the nuclei of radioactive atoms. Some elements are naturally radioactive whereas others are induced to become radioactive by bombardment in a reactor. Naturally occurring radiation is indistinguishable from induced radiation.

radiation detection instrument

Devices that detect and record the characteristics of ionizing radiation.

radiation monitoring

Continuous or periodic determination of the amount of radiation present in a given area.

radiation protection

Legislation, regulations, and measures to protect the public or laboratory of industrial workers from harmful exposure to radiation.

radiation shielding

Reduction of radiation by interposing a shield of absorbing material between a radioactive source and a person, laboratory area, or radiation-sensitive device.

radiation standards

Permissible exposure levels of radiation and regulations governing same.

radioactivity

The spontaneous decay or disintegration of unstable atomic nuclei, accompanied by the emission of radiation.

radioisotopes

Nuclides of the same element (same number of protons in their nuclei) which differ in the number of neutrons, and which spontaneously emit particles or electromagnetic radiation.

receiving waters

Rivers, lakes, oceans, or other bodies of water into which treated or untreated waste waters are discharged.

rem

Acronym for roentgen equivalent man; is the unit of dose for biological absorption. It is equal to the product of the absorbed dose in rads and a quality factor and a distribution factor.

repository

A facility for the terminal storage or disposal of spent nuclear fuel or immobilized HLW.

residence time

The period of time during which a substance resides in a designated area.

resin

An organic polymer used as an ion-exchange material.

roentgen (R)

A unit of exposure to ionizing radiation equal to or producing one coulomb of charge per cubic meter of air.

runoff

The portion of rainfall, melted snow, or irrigation water that flows across ground surface and eventually is returned to streams. Runoff can carry pollutants into receiving waters.

saltcake

The crystallized salts (primarily nitrates and nitrites) resulting from the evaporation of liquid HLW.

saltcrete

A mixture of partially decontaminated salts and concrete.

sandstone

Clastic rock containing large individual particles visible to the unaided eye.

sanitary landfilling

An engineered method of solid waste disposal on land in a manner that protects the environment; waste is spread in thin layers, compacted to the smallest practical volume, and covered with soil at the end of each working day.

saprolite

A rock that is earthy, soft, clay-rich, extremely decomposed.

schist

Strongly foliated crystalline rock formed by dynamic metamorphism that can easily be split into thin slabs, or flakes.

screen

Tool used to allow particles of a certain size through while separating out larger particles.

scrubber

An air pollution control device that uses a liquid spray to remove pollutants from a gas stream by absorption or chemical reaction.

secondary road

A rural major collector route.

sedimentation

The settling of excess soil and mineral solids of small particle size contained in water.

seep lines

Small zone where water leachate percolates slowly to the surface; a series of ground water or leachate springs.

seepage basin

An excavation in the ground to receive aqueous streams containing chemical and radioactive wastes. Insoluble materials settle out on the floor of the basin and soluble materials seep with the water through the soil column where they are removed partially by ion exchange with the soil. Construction includes dikes to prevent overflow or surface runoff.

seismic

Pertaining to any earth vibration, especially an earthquake.

seismicity

The tendency for the occurrence of earthquakes.

settling tank

A tank in which settlable solids are removed by gravity.

sewage

The total of organic waste and wastewater generated by an industrial establishment or a community.

sewer

Any pipe or conduit used to collect and carry away sewage or stormwater runoff.

sewerage

The entire system of sewage collection, treatment, and disposal.

shield

An engineered body of absorbing material used to protect personnel from radiation.

short-lived nuclides

Radioactive isotopes with half lives no greater than about 30 years (e.g., cesium-137 and strontium-90).

siderite nodule

A small clump or knot of a rhombohedral mineral: $FeCO_3$.

siliceous cement

Cement with an abundance of silica.

siltstone

Silt having the texture and composition of shale, but lacking its fine lamination.

sink

An area from which water drains or is removed.

sludge

The precipitated solids (primarily oxides and hydroxides) that settle to the bottom of the storage tanks containing liquid HLW.

slug

Small, isolated body of water.

slurry

A suspension of solid particles (sludge) in water.

socioeconomic baseline characterization

A description and discussion of a study area's social and economic characteristics including a profile of local government, housing supply, land use, and public and private services.

softwoods

Trees, particularly evergreens and shrubs, that produce seeds in a cone.

SO_2

Sulfur dioxide; a heavy pungent colorless gas (formed in the combustion of coal). SO_2 in high concentration is considered a major air pollutant.

SO_x

The oxides of sulfur, primarily SO_2 and SO_3. SO_x is a common air pollutant.

sparger

A discharge nozzle which provides quick dispersion of one fluid (liquid or gas) into another.

spill

The accidental release of radioactive material.

spray irrigation

The practice of dispersing treated aqueous effluents by spraying land in controlled amounts. Treated effluent is rich in nutrients that may be utilized by plants.

SREL

Savannah River Ecological Laboratory, an ecology research institution operated by the University of Georgia under contract from DOE.

SRL

Savannah River Laboratory.

SRP

Savannah River Plant.

stable

Not radioactive.

stack

A vertical pipe or flue designed to exhaust gases and suspended particulate matter.

stack gases

Gases emitted from a stack.

stationary source

A source of emissions into the environment that is fixed rather than moving, as an automobile.

storage

Retention of radioactive waste in man-made containment such as a tank or vault in a manner permitting retrieval as distinguished from disposal which implies no retrieval.

storage coefficient

Volume of water released from storage in a vertical column of 1.0 sq. ft. when the water table declines 1.0 ft.

stratified

Formed or arranged in layers.

stratigraphy

Division of geology dealing with the definition and description of rocks and soil both major and minor natural divisions.

strike

The direction or trend that a structural surface (e.g., a bedding or fault plane) takes as it intersects the horizontal.

study area

A specific geographic area isolated from surrounding areas for the purpose of examining and analyzing specific phenomena and activities.

supernatant, supernate

The liquid portion of the liquid HLW that consists of water and materials in solution in the water.

surface water

All water on the surface, as distinguished from groundwater.

surficial deposit

Most recent geological deposit lying on bedrock or on or near the earth's surface.

surveillance

A monitoring system designed to assure safe and secure containment of HLW at all times and to identify potential sources of escape or release into the environment.

tank farm

An installation of interconnected underground tanks for the storage of high-level radioactive liquid wastes.

tertiary age

First period of cenozoic era, thought to be between 65 and 2 million years ago.

thermal pollution

Degradation of water quality by introduction of a heated effluent.

threshold dose

The minimum dose of a given substance to produce a measurable environmental factor.

tolerance

The relative capability of an organism to endure an unfavorable environmental factor.

topography

The configuration of a surface area including its relief or relative elevations and the position of its natural and man-made features.

toxicity

The quality or degree of being poisonous or harmful to plant or animal life.

tracer injection detection tests

Injection of dye in water to trace water flow.

transmissivity

The rate at which water of prevailing kinematic viscosity is transmitted through a unit width under a unit hydraulic gradient.

transuranic waste

Solid radioactive waste containing primarily alpha emitters.

transuranium elements

Elements above uranium in the periodic table. All 13 known transuranic elements are radioactive and are produced artificially.

triassic period

First period of the mesozoic era. Thought to be between 225 and 190 million years ago.

tritium (^{3}H)

A radioactive isotope of hydrogen, a weak beta emitter with a half-life of 12.5 years.

TSP

Total suspended particulates. Refers to the concentration of particulates in suspension in the air irrespective of the nature, source, or size of the particulates.

turbidity

Measure of sediment or suspended foreign particle concentration in solution.

unconsolidated

Loosely arranged or unstratified sediment.

unincorporated places

Closely settled population centers without corporate limits.

USGS

United States Geological Survey.

vacancy rate

The ratio between the number of vacant housing units and the total number of units in a specified area.

vault

A reinforced concrete structure for storing canisters of immobilized high-level radioactive waste.

venting

Release of gases or vapors under pressure to the atmosphere.

washout

The removal of a pollutant from the atmosphere by precipitation.

waste heat

Heat in materials at temperatures that are close to that of ambient and hence not valuable for production of power. Waste heat must be discharged to the environment.