ABSTRACT: At the Savannah River Site (SRS), dose and risk assessments indicate cesium-137 in deer, fish, soil, and vegetation has been, and continues to be, the critical radionuclide/pathways with the highest potential human exposure. In this assessment, statistical analyses of the long-term trends of cesium-137 activity concentrations are used to provide estimates of its effective half-life in these environmental media. The effective half-life includes the physical decay half-life (about 30 years for cesium-137) and the ecological (environmental dispersion/dilution) half-life.

Cesium-137 released during 1954-1974 from SRS nuclear production reactors contaminated a portion of the Savannah River floodplain known as Creek Plantation. Cesium-137 activity concentrations have been measured in Creek Plantation since 1974, making it possible to calculate its effective half-life in the soil and in the vegetation and to assess the spatial distribution of it and other contaminants on the floodplain. The analysis revealed that activity concentrations in vegetation are significantly related to concentrations in soil. The effective half-life for cesium-137 in shallow (0-7.6 cm) soil and in vegetation is 14.9 years and 11.6 years, respectively, and rates of cesium-137 removal from shallow soil and from vegetation do not differ significantly among sample sites.

Most of the cesium-137 measured in deer on the SRS is not from site operations but from nuclear weapons testing fallout from the 1950’s and early 1960’s. This legacy source term has been trended in SRS deer since 1965, since consumption of animal flesh is an important exposure pathway. Controlled hunts of deer and feral hogs are conducted at SRS for approximately six weeks each year. Before any harvested animal is released to a hunter, SRS personnel perform a field analysis for cesium-137 concentrations to ensure the hunter’s dose does not exceed the SRS administrative dose limit. Based on this long term dataset, the estimated effective half-life of cesium-137 in SRS deer is 15.9 years.

Fish in the Savannah River have been contaminated with cesium-137 from both SRS operations and nuclear weapons testing fallout. As such, consumption of fish caught in the Savannah River is another important exposure pathway at SRS. On an annual basis, three species of fish (panfish, catfish, and bass) are sampled from the Savannah River upriver, downriver, and near the mouths of the five SRS streams that reach the river. Three composites of up to five fish of each species are analyzed from each sampling location. Long-term trending of the cesium-137 concentrations in downriver fish indicates that its effective half-life is about 6.51 years. This is much shorter than for the other media due to greater dilution and dispersion in the riverine ecosystem.
Potential health risks have declined more rapidly than expected on the basis of radioactive decay alone because of the relatively short effective half-life of cesium-137 in the various environmental media at the Savannah River Site.