Nuclear into environmental:

The transformation of Savannah River

From one of the country's biggest producers of nuclear weapons comes the startling new gift of affordable environmental remediation technology.

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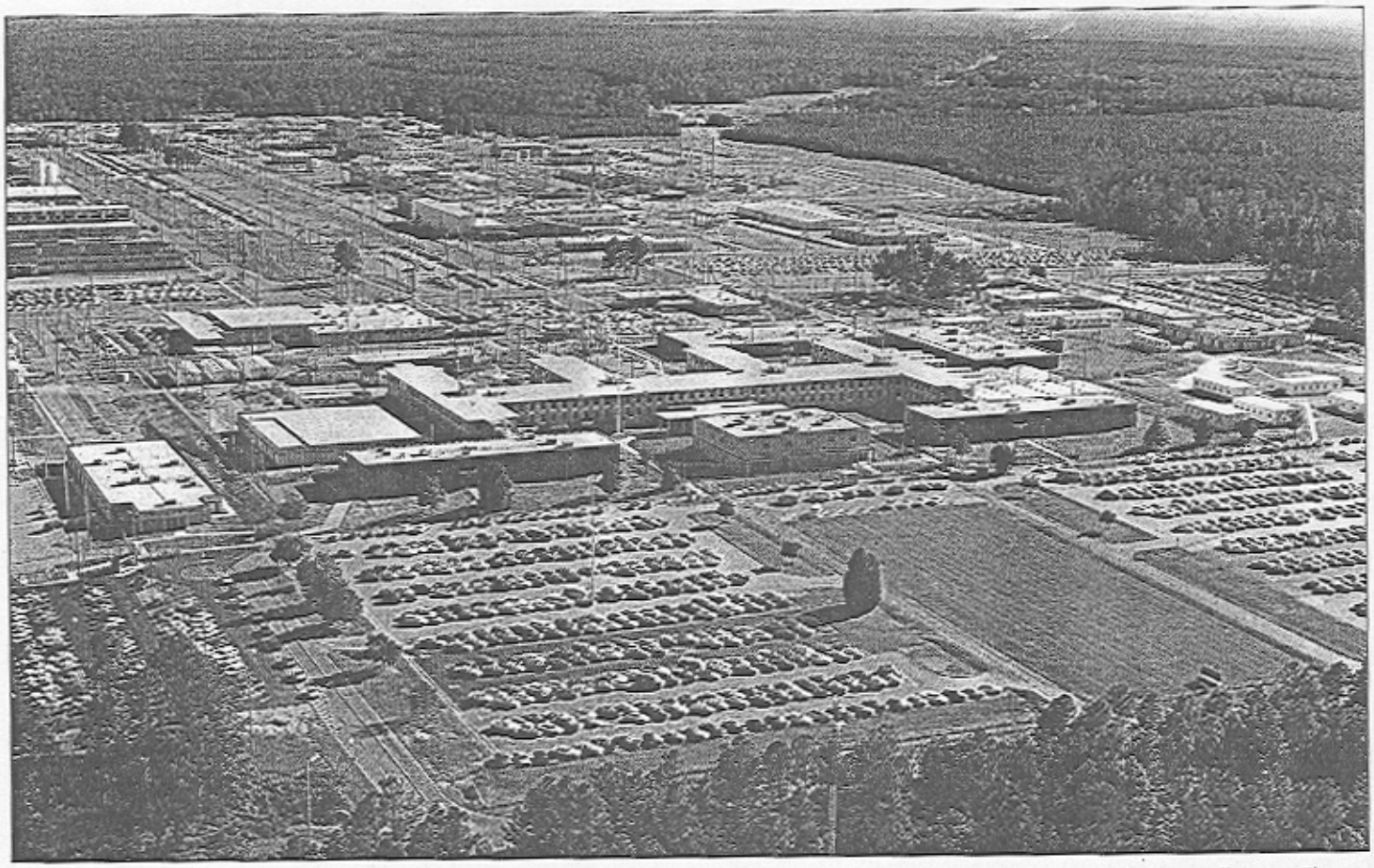
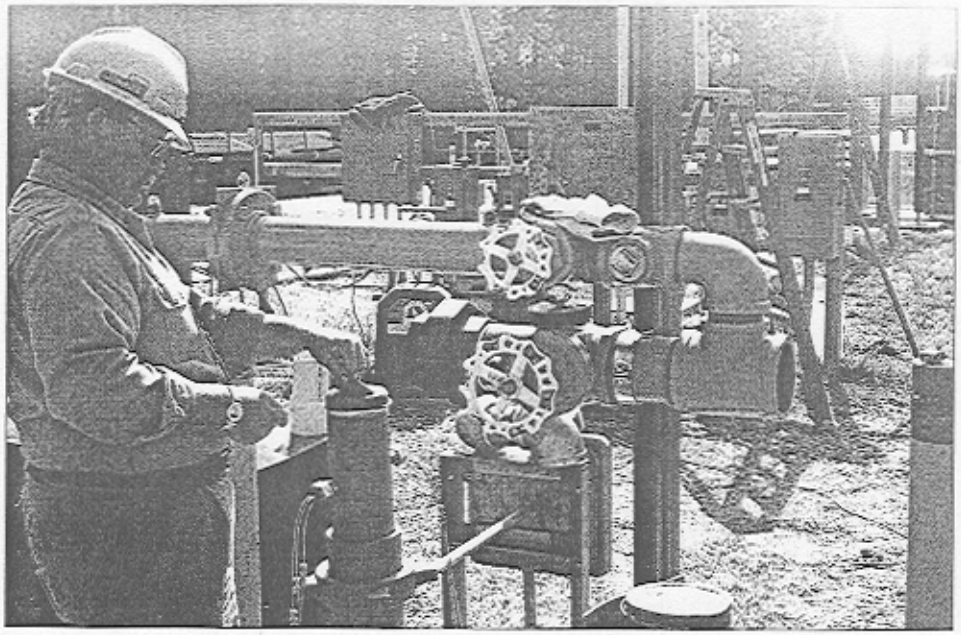
Since 1989, one of the country's earliest nuclear weapons production facilities, the 44-year old Savannah River Site, has added an important new function : that of testing and developing new environmental remediation technologies and making them available to industry under license from the government. In fact, very little nuclear material is produced at Savannah these days, with the exception of plutonium-238 for the space program and purification of tritium for defense. The facility's new role of environmental technology transfer has actually become more important than its original purpose of producing nuclear material.

Some of Savannah's new technologies include horizontal well air stripping, methane bioremediation nutrient injection, microbe density control, and accelerated microbe counting. The site itself was selected by DOE for the project because its 300 square miles of outdoor contamination by VOCs—chlorinated hydrocarbons and tetrachloroethylene mostly, as well as by petroleum and other substances—make it the largest groundwater cleanup project in the country. It has become a gigantic outdoor laboratory for environmental development work.

Funded by DOE and operated by Westinghouse Savannah River Company, objective of the environmental technology program is to provide contractors and other environmental businesses with cleanup technology tools that can increase their efficiency. Arranged by Westinghouse for DOE, licenses are available at fees that are designed to encourage use of the technology. For example, horizontal



The Savannah River nuclear site contains over 300 square miles of land, much of it contaminated by VOCs and other pollutants. The DOE is transforming it into a gigantic outdoor testing ground for development of new remediation techniques.



Savannah River site engineer takes samples from the methane injection project designed to speed growth of bioremediation microorganisms.

well technology can be licensed for $3000 plus one percent of the installation cost.

Horizontal well stripping

A fundamental, and so far the most widely adopted, technology developed at the nuclear site is the horizontal well system for in-situ air stripping. Two sets of wells remove pollutants from groundwater. One is used to inject air into the saturated zone on one side of the contaminant plume, the other to collect the air and volatilized contaminants from the plume on the other side. This system can provide acres of access to the plume, while a standard vertical well may only give a relatively few feet.

When initially operated, the system was used for simple vapor extraction. Comparison with a previous vertical well showed a fivefold increase in contaminant removal rate simply because the well geometry can be adapted to suit conditions exactly.

During demonstrations, typical extraction flow rates were 600 standard cubic feet per minute from the extraction well, operated at sub-atmospheric pressure of 10.3 in. of mercury. The maximum removal rate for total VOCs was 130 pounds per day when the horizontal wells were operating at 600 scfm extraction and 270 scfm injection (the lower injection rate ensures a net positive gas flow toward the extraction well).

Bioremediation advances

The search for still greater efficiencies led to the addition of bioremediation techniques. With the horizontal well in place, 1 to 4 percent mixtures of air and methane are injected as a food source for soil microorganisms known to degrade trichlorethylene. The extraction rate is reduced to give the methane more time to work.

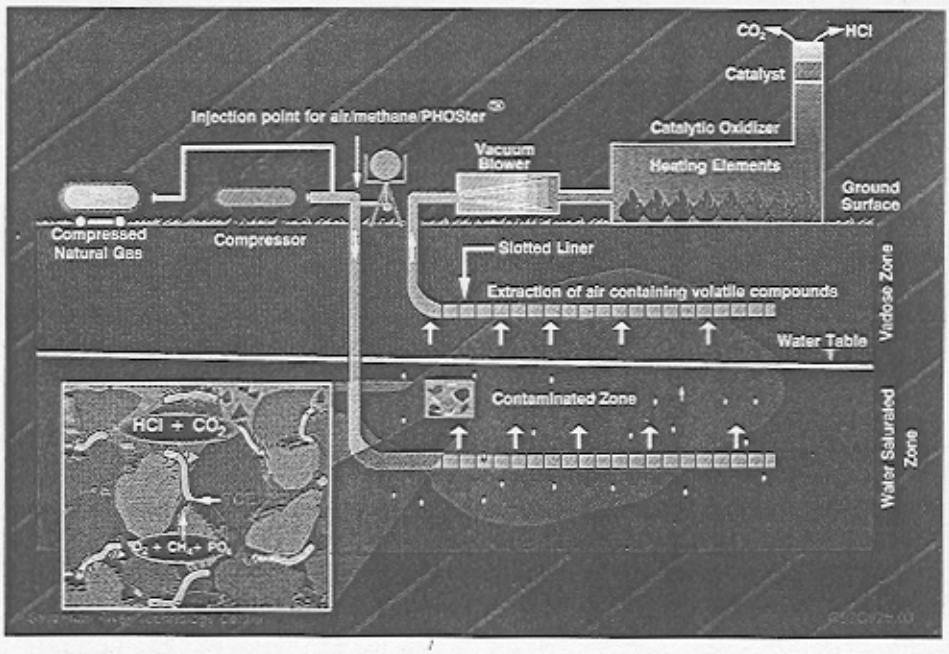
This technology has been found to be 41 percent more efficient than horizontal well air stripping alone. A major area being treated at the site will take about five years using bioremediation, whereas it would take double that time without. However, both are far better than the conventional vertical well approach. The program has also developed a way to add gaseous phosphate nutrients to soil bacteria, further energizing them and increasing the rate of bioremediation.

The large potential for biodegradation of volatile organics has led to numerous refinements to the technique. For example, since different industries deal with different groundwater problems, Savannah scientists developed a fast way to recruit the right microbes for cleanup chores. Two patents have been allowed in this area.

The first patent is based on the demonstrated fact that soil bacteria can be attracted or repelled by very low concentrations of specific chemicals. The project operator can then control local microbe densities by using their affinities for chemical compounds. Specific kinds of microbes can be "called in" to help degrade a contaminant, or, for example, fended off to avoid microbial corrosion of gas lines. The latter trick is accomplished by putting the appropriate compound in the gas pipe coating.

The other patent is a process that can greatly speed up a bioremediation task. A small amount of the targeted contaminant is put in a capillary tube, which is in turn inserted into a sample of the soil to be treated. Within an hour or two, the microbes can be counted by conventional methods, or much faster than with the usual soil dilution procedure. The latter involves diluting soil samples, cultivating bacteria that may be present, and then testing their ability to degrade the contaminant—a process that can take more than two weeks.

Since the Savannah River site now has technology transfer as an important mission priority, its developments in environmental cleanup are expected to benefit other U.S. environmental contractors. Many of the cleanup needs on the site are those faced by industrial organizations worldwide, and the solutions tried on the site are expected to be useful and economical elsewhere.



Graphic rendering of horizontal well system for in-situ air stripping developed by Savannah scientists shows its ability to adapt to terrain.

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