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BATTELLE/TERRA VAC FIRM TO EMPLOY SIX-PHASE HEATING FOR SOIL CLEANUP

Current Environmental Solutions, LLC, has been formed by Terra Vac, San Juan, P.R., and Battelle to commercially apply the Six-Phase Soil Heating (SPSH™) technology developed at the Battelle-operated Pacific Northwest National Laboratory for DOE (HTN, Aug. 3, 1995, p. 114). The firm also has the rights to an in-situ corona process from PNNL (HTN, Sept. 24, 1992, p. 146).

The six-phase approach to in-situ soil heating extends the applicability of Terra Vac's soil vacuum extraction process by vaporizing low-volatility contaminants and moving vapors through low permeability soils, explains Bretton Trowbridge, president of CES and vice president of Terra Vac. This occurs because heating increases the contaminants' vapor pressures, facilitating their removal by SVE. Also, water in the soil turns to steam, which strips contaminants from the soil and carries them to the vacuum vent; and removal of soil moisture increases the air permeability of the soil.

SPSH is based on the ability to split conventional three-phase electricity into six separate electric phases. Each phase is delivered to one of six electrodes placed in a hexagonal pattern around the contaminated area. Since each electrode is at a separate phase, each one conducts to all the others, plus an electrically-neutral electrode in the center. This causes all the soil within the array to be heated, not just the area around the electrodes, notes PNNL's Theresa Bergsman, who is vice president of CES. The electrodes are made of standard metal well casing and can double as vapor extraction vents. Currently, the electrode arrays can be as large as 40 feet in diameter and effectively heat soil within a 55-foot diameter. For larger areas, several arrays are operated simultaneously. The heated region can extend to 200 feet below the ground surface (bgs). Current power supplies can treat up to 7,000 cubic yards of soil at one time.

The first commercial SPSH system was installed last September at an Illinois site where the clay/silty soil has a permeability of 10^{-6} to 10^{-8}. More than 8,000 lbs of VOCs -- primarily perchloroethylene, trichloroethylene, 1,2-dichloroethylene -- were removed during the first four months of operation, Trowbridge reports. Five SPSH arrays, extending to as far as 35 feet deep, are being used to treat 10,000 yd^3 of soil. The neutral electrode in the center of each array is oper-

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SIX PHASE SOIL HEATING (Cont.)

ated as dual vacuum extraction (DVE™) well to recover the vapors and ground water. Compliance with cleanup standards is expected to occur shortly.

An evaluation of the technology for removing DNAPL in the saturated zone was conducted at Dover Air Force Base in an uncontaminated aquifer using tracer compounds to mimic the DNAPLs. A single array was operated to heat a region extending from 20 to 35 feet bgs. The water table was located about 25 feet bgs and extended to a dense clay layer 34 feet bgs. The electrodes were used as the vapor extraction wells. The total heating operation lasted 30 days, with 50,000 gallons of condensate collected, Bergsman says. Tracer removal rates are estimated at about 35% and 100% for two tracers, with most of the compounds recovered over 21 days.