Lone Wolf Resources, LLC

In Situ Soil and Groundwater Remediation Via Electrical-Resistance Heating

Location: **Former Fuel Terminal**

Greensboro, North Carolina

Project Value: **$3.7 Million**

LWR was the remedial construction, system installation, operation, and maintenance contractor at the Greensboro, NC Electrical-Resistance Heating (ERH) project site from the time pilot testing work began in 2005. The project site is a former bulk fuel terminal which had an estimated release volume of gasoline and diesel fuel of over 450,000 gallons to soil and groundwater over its 25-year operating history. LWR worked with a team of consultants and technology vendors to develop a comprehensive and complex remedial strategy for the site. The technology selected for the project is electrical-resistance heating. ARCADIS was the primary design and oversight consultant for the project team, which also included GES (Richmond, VA), McMillian-McGee Corporation (Alberta, CA), and MK Environmental (Chicago, IL).

This project is the largest ERH remediation project ever constructed world wide, and includes a diverse set of design and construction elements. LWR provided turnkey construction, operation, and maintenance services at the site including: site grading, installation of stormwater controls, construction of concrete foundations, assembly of a sprung structure to house treatment equipment and installation of associated piping, and coordination of system installation work with electrical power and SCADA controls systems subcontractors and technology vendors.

ERH thermal treatment using McMillan-McGee's patented ET-DSPTM process involves the installation of electrodes, recovery wells, and sensor wells throughout treatment zones. Electrical power is applied to the subsurface electrodes in a three-phase configuration, heating the soil and groundwater to 100-degrees C (212-degrees F) over a five to six month period. Heated groundwater and liquid-phase petroleum hydrocarbons are recovered and treated on site using conventional water treatment equipment (e.g., oil/water separators, sand filters, and carbon filters) and recycled back through the electrodes to keep them cool. Heated soil gas, steam, and gaseous-phase petroleum hydrocarbons are extracted from the recovery wells, cooled using fin-fan heat exchangers, and treated using two separate air treatment devices (Thermal Oxidizer and Catalytic Oxidizer). Special engineering controls were required because the oxygen and hydrocarbon levels within the recovered gasses cause the mixture to pass through the LEL and UEL zones.

The final design included a building comprised of a large sprung structure (i.e., large tent constructed using flame-retardant materials). The tent was designed to be open at both ends and sides, allowing adequate ventilation. Two Class I/Div II classified areas separate processes that might contain flammable liquids and gasses from non-classified areas. Also, sophisticated control panel and control logic were designed and constructed to detect upset conditions, and immediately notify plant personnel in the event of potential hazards. Two LEL meters were incorporated into the control logic to shut down the plant in the event of hazardous vapor levels (>10%LEL) detected in ambient air within the plant. The recovered waste fuel is re-condensed using heat exchangers and oil-water separators, and then sold to local fuel recyclers.

Explosion mitigation equipment (i.e., Fike System) was also incorporated into the system. The Fike System utilizes approximately 13 infra-red detectors and pressure sensors throughout the process plant that will detect flames and/or a pressure front within the plant's piping and/or tanks. The program logic for the Fike system activates a series of fast-close valves and releases sodium bicarbonate into the processes tanks and piping systems to extinguish a flame front (deflagration) should it occur.

The site was subdivided into four treatment areas, each covering approximately 1.2 acres. Treatment Zone 1 was 100% complete as of October 12, 2007, where a total of 214,000 pounds of hydrocarbons were recovered and recycled or destroyed in the treatment process. Energy consumption, including electric power and natural gas, for Zone 1 was 15% less than original estimates.

All system components including electrodes and piping arrays have been reused as the zoned equipment was dismantled and re-installed in Treatment Area 2, Treatment Area 3, and is currently operating in Treatment Area 4.

The entire project team vigorously promoted health and safety during all phases of work, including the integration of LPS into its work processes. This project was recognized as the *2007 National Groundwater Association's Outstanding Ground water Remediation Project*.

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