Trichloroethylene Removal from an Active Cooling System at the Main Laboratory Building Located at Cold Regions Research Engineering Laboratory, Hanover, New Hampshire

Neil Schofield (nschofield@sovcon.com) (Sovereign Consulting Inc, Holyoke, MA, USA)
Mike Oliva (mikeoliva@m2enterprisesusa.com) (M2 Enterprises LLC, Mine Hill, NJ, USA)
Marc Cicalese (mcicalese@sovcon.com) (Sovereign Consulting Inc., Mine Hill, NJ, USA)

Background/Objectives. The Cold Regions Research Engineering Laboratory (CRREL), located in Hanover, New Hampshire, is one of five Engineering and Research Development Centers (ERDCs) operated by the United States Army Corps of Engineers (USACE). Established in 1961, the facility performs experiments on cold weather operations and the effects on equipment and materials. To support the research, CRREL used trichloroethylene (TCE) extensively as a refrigerant in the Main Laboratory Building from the early 1960s through the late 1980s. In 2010, a report titled *Vapor Intrusion Investigation Report, CRREL, Hanover, New Hampshire* was prepared outlining the results of investigations of historic TCE releases and focused on three Areas of Concern (AOCs) and the likelihood of vapor intrusion to buildings across the facility and in close approximation to those AOCs. The Main Laboratory Building is located adjacent to three of the AOCs and also utilized TCE exclusively as a refrigerant in the buildings cooling system until 1987. The combination of subsurface vapor migration and residual sources of TCE within the buildings active cooling system made remediation an on-going challenge. In order to eliminate fugitive sources of TCE and reduce exposure to workers maintaining the active cooling system, CRREL contracted with M2 Enterprises LLC (M2) in 2015 to treat the current cooling system's ethylene glycol and remove residual TCE which is the focus of this presentation.

Approach/Activities. To address the vapor intrusion in the Main Laboratory, three separate vapor mitigation systems were installed across the 40,000 square foot building in 2013 and 2014. However, residual sources of TCE within the buildings active cooling system were likely contributing to indoor air quality issues. The cooling system contained a mixture of approximately 50 percent ethylene glycol and 50 percent water and was contaminated with concentrations of up to 1,400 micrograms per Liter (µg/L) of TCE. During the transition from TCE to Ethylene Glycol, it's unlikely all piping was flushed completely, resulting in concentrations of TCE in the cooling system that required treatment or complete ethylene glycol replacement. M2 and their teaming partner Sovereign Consulting Inc, initiated a Pilot Treatment Study to determine the effectiveness of liquid carbon treatment to remove TCE from the ethylene glycol. The results of the pilot treatment confirmed that TCE removal from ethylene glycol was effective; however, the liquid carbon also removed ethylene, thereby removing the cooling properties of the ethylene glycol. As an alternative to liquid carbon treatment, Sovereign designed an innovative treatment system using CRREL's existing 4,000-gallon ethylene glycol above ground storage tank (AST) and piping by installing an air aeration nozzle and recirculation line to treat the glycol in 4,000 gallon batches within the existing AST. The technology was successful in reducing TCE in the cooling system from 1,400 µg/L to less than 80 µg/L during the 12 week treatment process. The project resulted in cost savings to CRREL and minimized the need for liquid carbon waste disposal.

Results/Lessons Learned. Following successful completion of the cooling system remediation in early 2016, portions of the cooling system were dismantled in early 2017. During the removal, portions of the inactive system not previously treated were found to have residual TCE concentrations confirming that TCE was still a source of vapor intrusion. Long-term remediation

designs are being pilot tested to address source control in deeper portions of the aquifer which have already further mitigated vapor intrusion through source reduction.