# Implementing Field-Scale Remediation Technologies for Uranium and Tetrachloroethylene in Soil and Groundwater

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**Background/Objectives.** The NFS facility is located in Erwin, Tennessee, and has manufactured nuclear fuel for the Navy for more than 50 years. Beginning in the 2000s, NFS embarked on an effort to address historical impacts to soil and groundwater in coordination with the NRC, EPA, and TDEC. Soil remediation was the initial focus with excavation of source mass on the North Site. With accessible source mass removed, NFS then focused on addressing groundwater cleanup. While remediation of mixed groundwater plumes has not been successfully executed using in situ bioremediation technologies, NFS implemented an enhanced reductive dechlorinated technology using the Arcadis In situ Reactive Zones (IRZs) technology to address both chlorinated organics and radiological contaminants. The field scale remediation goal is removal of uranium and tetrachloroethylene mass and achieving the drinking water maximum contaminant levels.

**Approach/Activities.** The unique characteristics of each groundwater contaminant plume required specific design requirements. Some of these variables included the contaminant mixture, hydrogeologic conditions, and geochemical makeup of the aquifer. Armed with thorough site characterization, a variety of technologies/reagents have been implemented across the site, including:

- IRZ using phosphate reagent to remediate uranium
- EVO together with ferrous sulfate to remediate uranium source term
- IRZ using molasses and ferrous sulfate reagents for mixed CVOC/Uranium
- PRB using ZVI reagent for CVOCs
- IRZs using molasses or EVO to target CVOCs
- Soil source removal for uranium and CVOCs

**Results/Lessons Learned:** Field-scale remediation data will be presented for this site, including a description of the various technologies and reagents implemented. Emulsified vegetable oil, molasses, phosphate, and ferrous sulfate have reduced/precipitated the uranium concentrations in groundwater via a reduction process through mineral precipitation. Tetrachloroethylene concentrations in groundwater have been reduced biologically using emulsified vegetable oil and molasses, and abiotically through use of zero valent iron.

So successful was the initial effort that EPA selected it as one of their Region 4 Success Stories. The dynamic process of applying lessons learned from one plume to another has led to an integrated approach to remediating groundwater across the site. This holistic site-wide planning has not only integrated best practices, but has lowered overall remediation costs, while addressing the highest risks and priorities. The transfer of best practices and lessons learned has proven valuable in design of each subsequent project, with technology and reagent selection that is moving each contaminant plume toward closure.