Exhibit A: Project Description
(Scope of Work, Special Requirements)

Project Title: Remediation Technology for Chlorinated Pollutants Based on a Natural Product from Soil Bacteria

PI (Lewis) has spent several years investigating the chemical and genetic basis of a bacterial carbon tetrachloride (CCl4, tetrachloromethane) breakdown process. The work has detailed how the process was due to the production of pyridine-2,6-bis (monothiocarboxylic acid) (PDTC). The process results in conversion to non-toxic endproducts (mostly CO2) and complete removal of the problematic carbon-chlorine bonds responsible for toxicity in animals. Essentially, the bacteria that produce the molecule are not required once the molecule is excreted into its surrounding environment. This has led the team to propose remediation technology which does not depend on introduction of bacteria to a site where they did not naturally occur and are subject to vagaries of survival and competition with indigenous microbes, but rather to simply add the active agent to achieve destruction of the pollutant in-situ. The currently recommended technology for this contaminant involves removal and subsequent treatment, called pump and treat for groundwater and soil vapor extraction above groundwater. Those technologies are being used to remove CT at two sites the PIs are aware of: the Department of Energy's Hanford site, involving 1000 metric tons of CT disposed of over decades of cold war plutonium production, and a former grain elevator in Hastings, Nebraska of a large extent but unknown source mass resulting from the use of CT as a grain fumigant and its improper handling/leakage. These examples are not isolated; a 1984 survey of groundwater used for drinking supplies showed detectable amounts of CT in up to 5% of sampled sites, likely due to improper disposal. The technologies currently employed (e.g. pump and treat) move the hazard from one medium to another and require handling of the toxic material to achieve final destruction. Furthermore, removal is slow due to equilibria involved and depending upon the presence of a non-aqueous phase which can act as a long-term source. Projections for the Hanford site call for 125 years of continued operation.

This proposed methodology could be used to augment these methods and achieve destruction in-place, which would significantly reduce costs of remediation efforts by reducing treatment times. With chemical modifications, it may be possible to produce derivatives of PDTC that attack the more prevalent chlorinated pollutants perchloroethene (PCE) and trichloroethene (TCE). The proposed work will involve synthetic chemistry to produce a set of PDTC derivatives and analytical chemistry to assess their performance in simulated groundwater conditions with CT and other chlorinated pollutants.

Specific Aims:

1. Synthesize PDTC derivatives for improved performance in field application
2. Conduct analytical work to assess the performance of the new derivatives