P.K. Services International Inc.

Applying Innovative Technologies

Electro Kinetic Soil Cleaning

An Innovative Approach to Onsite Produced Water Spill Remediation

PTAC supported Project Proposal

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1.0 INTRODUCTION

P.K. Services is please to present this proposal and new technology for the remediation of a salt contaminated soil. The purpose of this project is to test the scalability of this new technology by extracting salt from a contaminated soil volume of not less than 100 m^3.

Project funding is anticipated from a combination of Industry, provincial and federal sources. Access to the project funding will be coordinated though the Petroleum Technical Alliance of Canada (PTAC. PTAC will leverage industry support though various levels of government to secure the remainder of the project budget requirements. This proposal represents phase one of a possible two phased project. It is estimated that $300,000 will be required to complete phase one of the proposed project. Phase two will require approximately $500,000 to complete. This proposal only addresses the financial requirements and project outline of the proposed first phase of the project.

2.0 BACKGROUND

Salt contamination of soil from oil and gas production operations is an on-going concern. Clean up of salt contaminated soil is currently conducted primarily by excavation and transport to a landfill; colloquially referred to as “dig and dump”. This practice has been deemed acceptable by regulators due mainly to a lack of better alternatives.

One alternative for remediation of salt contaminated soils is the electro kinetic process. Electro kinetics applies a low voltage DC electric current to the soil. The current creates an electronic field upon which the ionic species move towards the respective opposite electrode poles. The process has been traditionally conducted in-situ. Unfortunately, this approach has often met with limited success. The reason for this is primarily due to an inability of the operator to control the in-situ soil characteristics making it difficult to optimize the process. The inability to fully optimize the process creates significant challenges to achieve consistent regulatory compliance with stated guidelines.

Based on lessons learned from previous industry work it was concluded that the soil must be excavated. Once excavated, the operator can control the contaminated media so that electrokinetic removal of the contaminants can be optimized. The soil can also be amended to meet remediation guidelines or enhance soil fertility if desired.

Initial bench scale testing began in 2007. Numerous trials were conducted over a period of more than a year with small soil samples (2-3kg) of soil from contaminated sites in Alberta, Saskatchewan and Manitoba. These trials altered variables such as, moisture content, electrolyte composition, pH, and current in order to optimize the process.

Remediation to regulatory guidelines was achieved in 2008. Subsequent trials were conducted on increasingly larger sample volumes. The remediation cell size was increased from 0.1 m^3 and then to 1.0 m^3 all achieving similar and consistent results.

The next step in the process development is to scale up to commercial volumes. Projections to date indicate that remediation of larger volumes of soil can be completed at a cost equal to or lower than the current cost of transporting material to a landfill.

3.0 PROPOSED SCOPE OF WORK

The proposed scope of work is to move the electro kinetic soil cleaning technology to commercialization. This will involve moving from the laboratory environment to the field. An increase in treated volumes will represent a two order of magnitude increase in volume treated (1 m^3 to 100 m^3) and continued work on process optimization.

3.1 Project Objectives

The project objectives are:

- Work with industry and industry partners to identify potential markets and economic viability of this technology on a commercial scale
- Conduct a field trial on a volume of 100 to 200 m^3 of salt contaminated soil
- Conduct suitability testing on a range of soil types representative of broad geographic area
- Optimize control system design
- Continue process optimization

3.2 Benefits to industry

The goal of this project is to commercialize the electro kinetic soil cleaning technology for remediation of salt contaminated soils and provide industry with a cost effective alternative to digging and dumping. Additional benefits include:

- Reduced environmental footprint which is good for industry image
- Reduced volumes of soil to landfill
- Reduced trucking associated with landfilling of excavated soils
- Potential to eliminate back fill required for clean up and reclamation of sites
- Lower cost of site reclamation
- Elimination of long term liability associated with soils transported to landfill
- Suitable for northern locations.

4.0 PROJECT PLAN

The project plan will follow a Task Based approach.

Task I – Complete ex-situ remediation of 100 m^3 of salt contaminated soil

- Construct a cell capable of treating a minimum of 100 m^3
- The cell will be filled with salt contaminated soil from an industry partners site.
- Treat to regulatory guidelines
- The data collected will be used to optimize electrode configuration and power requirements and other costs to calculate economic feasibility.

Task II – Conduct suitability testing on soils from different regions in Western Canada

- Samples of salt contaminated soil will be collected from at least 5 different geographical regions of Western Canada, including at least one sample from a region with northern permafrost.
- (X) kg of soil will be placed into the test cell and an electro kinetic soil cleaning trial run will be conducted to test the rate of salt removal. Testing will determine of what types of soil are amenable to electro kinetic soil cleaning remediation and set out a list of benchmark parameters.

- Testing will also be conducted to see if soils that are not "naturally" amenable to the electro kinetic soil cleaning process can be amended to make the process effective.

Task III – Process optimization

- Process optimization will include changing process variables and measuring the effects to achieve optimal remediation rates at minimizes input requirements.
- Working with industry partners to improve the process and meet specific regional requirements.

Areas of potential optimization include, but are not limited to:

- Power control design, electrode composition and electrode spacing
- Process amendments including electrolyte composition
- Fluid minimization and filtration, pH control
- Cell construction materials and cell design refinements
- Soil amendments and enhancements
- Effects on other contaminants such as oil or heavy metals (limited scope in this initial project)

Task IV – Minimize process water requirements

Various methods of water handling are available as possibilities; Downhole injection, evaporation, membrane filtration are a few. These processes will be explored further to better understand the best method. Water re-use is considered the preferred option.

Task V – Assess economic viability and market potential

- Survey industry to assess potential market for the electro kinetic soil cleaning technology
- Determine current regional remediation costs using conventional remediation practices
- Compare conventionally remediate cost to electro kinetic soil cleaning costs as identified in this project.

4.1 Research Plan

The scope of work detailed in Section 4.0 constitutes Phase I. Phase I aims to complete the work necessary prior to commercialization of electrokinetic soil cleaning technology. The technology has been proven on a small scale. Phase I will work out field scalability issues.

Phase II, which is not include in the scope of this proposal, will consist of implementation and further commercialization of electrokinetic soil cleaning. By leveraging the knowledge gained in Phase 1, Phase two will continue work with industrial support to fully remediate one or more of the sites identified and evaluated in the phase 1, regional site assessments. Phase II will continue the phase 1 optimization processes with the expectation of proving the commercial viability of the electro kinetic soil cleaning technology and determining the economies of scale.

Phase II could also be an extension of the initial Phase 1, 100 m^3 treatment. The site of both the Phase 1 and Phase II treatments will be determined by the industry partners.

4.2 Industry Participation

Multiple industry participants are required to achieve all the tasks listed in Section 4.0. For example, a single industry partner may not be able to submit samples from all representative geographic areas, nor wish to pay for such work, but have a specific area of interest. It is expected that multiple industry partners will need to be involved to not only meet the projects objectives but also meet the joint funding requirements.

The Tasks listed above can be streamlined to include only those things that are required to complete remediation of 100 m^3 sample based on the guidance of the industry participants and showing progressive improvements in the process as the project proceeds. Optimal performance may not be an initial requirement of the industry participants as their evaluation may be based on a successful 100 m^3 trial. The scope of the project will be finalized though a discussion with the confirmed participants before project initiation.

5.0 DELIVERABLES

The primary deliverables will be to meet the project objectives as identified in section 3.1. In addition to the meeting the project objectives PK Services will provide interim reports over the course of the project. The purpose of the reports will be to keep all participants abreast of the on going development.

- Provide progress updates to all participants
- Provide status reports and data collected from the field trial on a volume of 100 to 200 m^3 of salt contaminated soil
- Provide status reports and data collected from regional process suitability testing.
- Provide a final Phase one project report out lining detailed results
- Conduct a PTAC Technical Information Session presenting the projects results to industry

6.0 PROJECT TIMELINE

The project will be initiated following industry consultation and budgetary approval. If approval is obtained in the fourth quarter of 2009 the project could be initiated early in the first quarter of 2010. It is anticipated that if the project is initiated in early Q1 of 2010 that the initial 100 m^3 field treatment would be initiated before the end of Q2, or early Q3 of 2010. This is an aggressive schedule but one that the Team at PK Services believes is achievable.

7.0 DEVELOPMENT TEAM

TEAM MEMBERS

The project will be directed and managed by Mike Holm and Kevin McLenehan. In addition a multi discipline team of experts have been utilized to date and will continue to be utilized as required to meet the project objectives. Experts in electrical engineering and control system design, mechanical engineering, process design and material handling will be utilized as required.

To date, Access Analytical Laboratories has been utilized for soil analysis and result validation, this is expected to continue into the future.

All available resources that will aid in the successful completion of this project will be utilized to meet the project objectives.

INDUSTRY PARTNERS

Yet to be determined

REGULATORY INPUT

The goal of this project is to commercialize the electro kinetic soil cleaning technology for remediation of salt contaminated soils and provide industry with a cost effective alternative to digging and dumping.

It is realized that in order to achieve the benefits that have been identified the technology must be able to remediate the contaminated soil to meet or exceed all regulatory guide lines. Therefore regulatory input will be a guide to evaluate the projects over all success.

Regulatory input will be solicited.

8.0 BUDGET

TASK I

- Cell design, manufacture and deploy **100,000**
- Labour - lab, field and project management **50,000**

TASK II

- 5 regional site evaluations (12K each**)** **60,000**

TASK III

- Process optimization and equipment testing **45,000**

TASK IV

- Detailed fluid management design **30,000**

TASK V

- Assess economic viability and report preparation **15,000**

Total **$300,000**

AUTHORIZATION AND PROJECT SCHEDULE

PK Services is prepared to initiate the project upon approval of the above scope of work and cost estimate; or a mutually agreeable alternative proposal. A services agreement defining detailed project scope and deliverables as well as payment terms will be in place before any work is initiated.