www.PedigreeTechnologies.com • 1854 NDSU Research Circle North • Fargo, North Dakota 58102 • Phone |701| 293-9949 • Fax |701| 364-0298 • info@pedigreetechnologies.com

Friday, May 29, 2009

North Dakota Industrial Commission
ATTN: Oil and Gas Research Program
State Capitol – Fourteenth Floor
600 East Boulevard
Bismarck, North Dakota 58505

Dear Oil and Gas Research Council Members,

Please find enclosed a proposal for a system for Remote Monitoring and Reporting of Conditions for Salt Water Injection Sites for your review and consideration. We believe this project can help develop relationships between the State of North Dakota and operators providing easy, reliable access data collection from remote salt water injection sites resulting in a greatly improved mechanism for protecting North Dakota's water and soil resources while simultaneously decreasing the costs involved in protecting the environment.

If the Commission makes the grant requested, Pedigree Technologies is committed to completion of the project as defined in the attached proposal.

Thank you for your consideration. We feel it offers a unique opportunity to provide a relationship of shared information between the State of North Dakota and businesses promoting efficient, economic, and environmentally sound use of North Dakota's oil and gas resources.

Sincerely,

Alex Warner
President, CEO
Pedigree Technologies
1854 NDSU Research Circle North
Fargo, ND 58102
Phone: (701) 293-9949 ext. 116
Fax: (701) 364-0298
E-mail: Alex.Warner@PedigreeTechnologies.com

Remote Monitoring and Reporting of Conditions for Salt Water Injection Sites

Pedigree Technologies

Proposal submitted to: The North Dakota Oil and Gas Research Council

Submitted by: Pedigree Technologies, LLC
Friday, May 28, 2009
Amount Requested: $25,350

Principle Investigator
Will Shulstad
1854 NDSU Research Park Circle
Fargo, ND 58102
Phone: (701) 293-9949 ext. 117
Fax: (701) 364-0298
Email: Will.Shulstad@PedigreeTechnologies.com

1 Table of Contents

2 Abstract

Pedigree Technologies, LLC, a North Dakota company based in Fargo, North Dakota, proposes the design, implementation, and test of a system for the automated remote monitoring, alerting, and reporting of conditions at salt water injection sites in North Dakota. The purpose of this project is to initiate or foster a relationship between the State of North Dakota and oil and gas businesses providing easy access and data collection from remote oil production areas and to gather reporting data for Federal, State, and local government requirements for salt water injection sites. The development of this system is meant to provide a user-friendly, affordable process to measure, report, and distribute crucial information from these remote sites, further strengthening the commitment or efforts around salt spill or contamination prevention. The proposed process allows for the monitoring of flow rate as well as alarming on changes within the casing and annulus pressures defining the potential presence of leaks and contamination at a site. The system and process will reduce the financial impact of intensive and time consuming data collection that the producers and State of North Dakota engage in every day for compliance requirements.

The proposal defines the design, implementation, and testing of the proposed system for a total project cost of $50,862 with funding of $23,350 requested from the OGRC. The proposed system is expected to be developed and installed at a North Dakota site within three months of the start date, followed by a three month preliminary field test of the system. The system will be continued to be tested for long-term performance for three years.

Design and implementation of the proposed system will be completed by Pedigree Technologies, a North Dakota company. The system will be tested at a North Dakota salt water injection site operated by Berenergy Corp.

3 Project Description

3.1 Introduction

At hundreds of sites throughout North Dakota and approximately 110,000 nation-wide, over 2 billion gallons of brine, a concentrated form of salt water, is injected into Class II injection wells. In a typical oil and gas extraction, a significant amount of brine is brought to the surface as part of the normal process. This brine is most often significantly saltier than seawater, can also contain toxic metals and radioactive substances, and can be extremely damaging to the environment and public health if discharged. To avoid soil and water contamination, this brine is injected deep underground. This re-injection has the additional benefit of being useful for enhanced production of oil and gas. In some cases, the brine is used to decrease the viscosity of the hydrocarbons to be extracted, enhancing production of neighboring production wells. In other cases, the brine is injected as a means for disposing of the material. There are about 590 injection sites and over 300 disposal sites in North Dakota.

The State of North Dakota regulates salt water injection used in oil and gas production. Among other requirements, North Dakota requires the consistent monitoring and reporting of injection sites through From 17 and 17A. These records are to insure operating requirements set forth by the State for injection wells are met for environmental and safety purposes.

Injection wells are required to have cased and cemented to prevent ground water contamination. Inside the casing, tubing is inserted through which salt water is injected into the underground site. Injection is not allowed in the annular region between this tubing and the casing. The State of North Dakota requires that the pressures in both the tubing and the annular region be monitored as well as the volume of salt water injected into the underground site. The pressures are monitored in order to detect fractures which could result in ground water contamination.

3.2 Technical Objectives

Pedigree Technologies proposes the creation and demonstration of a system for remote, automated monitoring and reporting of conditions at salt water injection sites with the following technical objectives. (1) This system will regularly monitor and record pressure readings from gauges in the (a) tubing and (b) annular regions of injection wells as well as the (c) volume of material injected. (2) This data will be stored at and made accessible from a remote location at Pedigree Technologies' data center. (3) From this data, reports will be automatically generated meeting State of North Dakota reporting requirements. (4) The system will be field-tested at ten injection sites operated by Berenergy Corp., an oil and gas company with operations in North Dakota.

3.3 Methodology

The following three tasks will be used to complete the defined technical objectives.

3.3.1 Task 1 - Data System Design and Implementation

Of primary importance to the design of the automated remote monitoring and reporting system is the design and implementation of an architecture which can support such a system. Pedigree Technologies' OneView system will be utilized to support the data in this system. A diagram of the system architecture is shown in Figure 1. In the OneView architecture, multiple data sources from multiple sites are connected over the Internet through Gateway devices to Pedigree Technologies' OneView Data Center where the data is logged and made accessible to users. Users can access the data from anywhere over the Internet using a standard web interface. Task 1 involves the configuration of the OneView system to support sensor hardware, and customization of reporting and analytical capabilities as appropriate for this application.

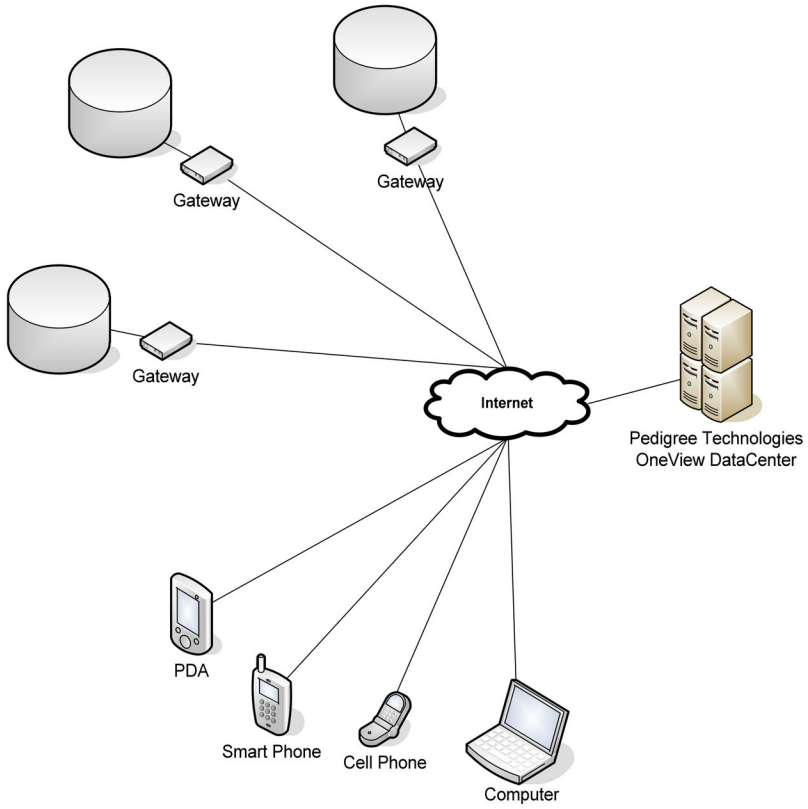

Figure 1. OneView Architecture

For this application, as part of Task 1, drivers will be created allowing pressure and volume sensors to communicate with the OneView system. These drivers will allow data to be collected from the sensors and pass this data into the system in an appropriate format.

Data collected from the system must be adequately logged and processed. The system will allow for collection and recording of data on a regular interval, perhaps every few hours or even minutes. All data will be stored at the OneView Data Center.

For this particular system, in Task 1, a reporting layer will be created to generate automated reports of salt water injection observations. As data is collected by the system, a North Dakota Industrial Commission Form 17, “Enhanced Recovery Report” will be automatically generated for each site.

Additionally in Task 1, a user interface (UI) will be configured to allow users access to the observations of site conditions. This UI will allow a user to see readings from the sensors at any of the 10 sites where they are installed. The UI will also allow for customizations to view historical and trending information such as graphs of data over time. A user will be able to customize alerts which will, for example, notify users with a text message or email if a leak should occur or a maximum pressure exceeded at a site.

3.3.2 Task 2 – Hardware Installation and Configuration

Hardware must be installed at each site to monitor conditions. This sensor hardware will consist of two pressure sensors, one for the tubing and one for the annular region at each site. The current pressure sensors used at the site do not have a machine readable format, and so they will be replaced with new sensors. Additionally, a machine readable flow meter is already in place at the sites, so this meter will be used to measure the volume of injected salt water. The sensors will be connected to Pedigree's cellular Gateway through data acquisition units (DAQs). The Gateway will use a cell phone connection to connect to the Internet and pass data to the OneView Data Center. The Gateway has a solar power source, so no other electrical power source is required.

Task 2 involves the procurement and installation of the hardware at each injection site. A diagram of the hardware system to be installed at each site is shown in Figure 2.

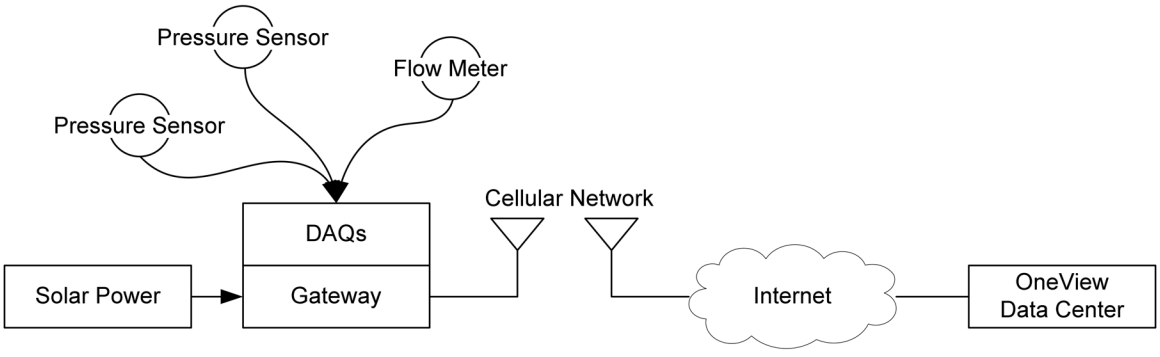

Figure 2. Site Hardware

3.3.3 Task 3 – Field Test

Hardware will be installed at ten Berenergy salt water injection sites near Glenburn, North Dakota. The system will be tested and monitored for a period of three years. During this time, reports will be automatically generated. Alerts and trending information will be configured and tested. A preliminary review will be performed three months into the test to report results from the system. The initial three month period will be sufficient to test system functionality. A final review will be performed after three years to report long-term results of the tests such as system durability and functionality in detecting rare transients such as fractures if they should occur.

3.4 Needs and Anticipated Results

Current monitoring practices at injection sites are subject to errors and are labor intensive for both the business operating the site as well as the State of North Dakota. The current practice involves the business periodically sending a technician to the site to record data. Form 17 is completed by hand and returned to the State. Additionally, the State of North Dakota employs agents to verify that the sites are in compliance.

Initially, the proposed system would provide a redundant means for monitoring the sites. If the proposed system could be proved through this project as well as others if needed, it could be used to partially or wholly replace the current manual system or augment it.

Because the current system is manual, it is subject to errors. Human error is easily introduced by mistaken or “dog housing” errors. These errors could be eliminated through an automated system. This would result in more reliable information about individual injection sites which could be accessed by the operating business, the State, or both.

Since the proposed system is capable of taking readings more frequently than is feasible using the current manual process, problems at sites can be detected faster. A fracture could be detected quickly so action could be taken immediately to avoid human safety or environmental problems. The system would generate an alarm if a dangerous event would take place, and immediately notify appropriate individuals.

3.5 Facilities, Resources, and Capabilities

Pedigree Technologies, LLC, and its partner, Berenergy, will utilize their facilities and capabilities to complete the work proposed. Pedigree Technologies is based in Fargo, North Dakota, with operations in Raleigh, North Carolina and Denver, Colorado. Pedigree operates its Data Center in the new Center for Technology Enterprise building in Fargo. Berenergy has multiple oil and gas operations in North Dakota as well as throughout the nation. The site chose as the test site for this project is just outside of Glenburn, North Dakota, north of Minot, and has ten injection wells.

The Pedigree Technologies' OneView system will be utilized to provide remote access to the data. OneView connects physical assets – including machines, tanks, equipment, vehicles, and inventory. It sends valuable information via the Internet to a central, secure system so assets can be managed as quickly and easily as possible using a web browser.

3.6 Environmental Impacts

Accidentals spills or fractures at injection sites create significant harm to both soil and water. According to "A Guide for Remediation of Salt/Hydrocarbon Impacted Soil" distributed by the North Dakota Industrial Commission, there are three major impacts on soil and pants when salt water spills occur. (1) Soil particles are dispersed which destroys aggregation; (2) Osmotic potential reduces the plants ability to up take water; and (3) Ionic balance of the soil solution is impacted reducing nutrient

absorption. The results include loss of soil and pore structure, reduced air and water movement, reduced bioactivity, reduced nutrient transfer, and increased water runoff and erosion of soil.

Remediation is required if a contamination occurs. Trained technicians must be deployed to the site to gather samples and have them tested in a laboratory environment. This testing will indicate the immediate and long term impact of the soil structure and fertility. Current remediation procedures are based on three or more year duration for typical spill events, and some can be much longer.

The proposed system, with consistent monitoring, could determine, measure, and alert to probable leak events. This could result in reduced response time which could significantly reduce the amount of environmental damage, and therefore remediation required. This could results in the protection of North Dakota's land and water resources.

3.7 Technological and Economic Impacts

There are significant technological and economic impacts which could be attained by monitoring conditions at gas and oil sites in North Dakota. Currently the State performs 4000 inspections over the course of a year at over 560 locations. On average, this requires about 10 minutes each to record data and an injection site, but 20 minutes in travel time. This travel time could be significantly reduced or eliminated using the remote monitoring capabilities of the proposed system. Operators also spend a significant amount of manpower monitoring these sites, much of which could be reduced by the proposed system. Most significantly, costs currently expended on remediation would be reduced. Technologically, the project represents significant opportunity as remote sensing with access to the data by both the operator and the State has extensive additional applications in the oil and gas industry in North Dakota.

4 Standards of Success

The success of this project will be determined by the successful field demonstration of the proposed system to monitor injection sites, provide automated reports and access to the data, as well as alert users of potential problems. North Dakota will reap tremendous value from this project from the environmental, technical, and economic impacts. Ultimately, the proposed system could improve the efficiency of salt water injection monitoring, reducing costs while securing the environment. This will result in efficient, sound exploration, development and use of North Dakota's oil and gas resources with the ultimate outcome of preserving and creating jobs in the exploration, production, and utilization of the State's oil and gas resources helping to ensure economic stability, growth, and opportunity in the North Dakota oil and gas industry.

5 Background/Qualifications

Pedigree Technologies is uniquely positioned to complete the work in this proposal. Pedigree is recognized by leading industry trade magazines such as *Machine-to-Machine* as one of the top twenty companies in the field of sensor networks and is recognized as a 2008 Global M2M Company in the field of sensor networks and software. Pedigree's experts have more than 25 years of combined experience in developing cost-effective platforms and systems that connect and automate wired and wireless assets.

Pedigree has performed many projects in the area of remote monitoring. Pedigree has systems deployed that monitor tanks and other assets at convenience stores throughout the upper Midwest. They have solutions currently in use capturing and integrating information from hundreds of tank controllers across customer and company sites. Pedigree has deployed fleet and mobile-asset tracking systems monitoring locations of vehicles in real time as well as tracking mileage, engine/idle time, stops,

and speed. Additionally, pedigree was rewarded a contract from the Naval Air Systems Command (NAVAIR) in June 2007 to build a system for remote battle field monitoring.

6 Management

Will Shulstad, Project Manager, will be the technical manager for the proposed project. Will has been with Pedigree wince 2004 and has been responsible for the delivery of a majority of Pedigree's projects. He will be responsible for ensuring that the project's technical objectives are met as well as coordinating partners and project staff. Additionally, Shannon Dennis, Account Executive, will be responsible for interfacing with OGRC management with timely reports as requested or proposed.

7 Timetable

The initial portion of proposed project is anticipated to follow the timeline shown in Figure 3. The anticipated start date for the project is August 3, 2009. Hardware will be procured and installed while the data system is designed and implemented. Following installation, the three-month preliminary field test will be completed followed by a preliminary review tentatively scheduled for January 15, 2010.

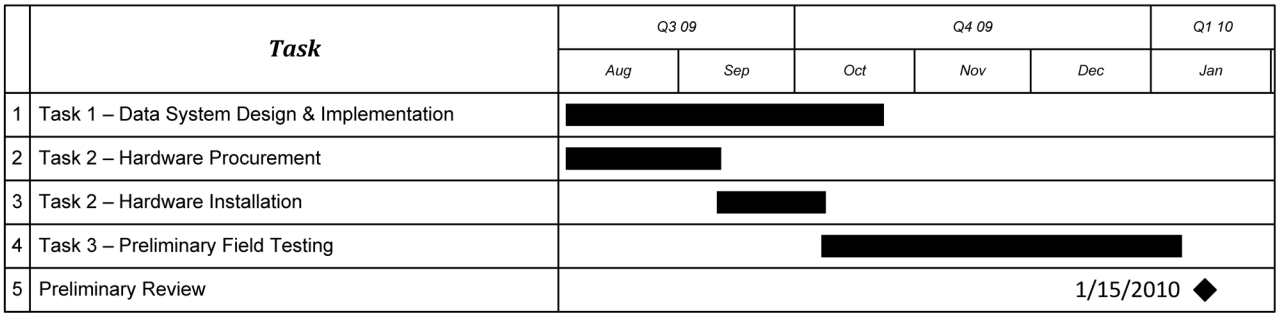

Figure 3. Preliminary Period Timeline

The field test will continue into a long-term test with duration of three years ending on or about October 15, 2012. This will be followed by a final review on or about November 1, 2012.

8 Budget

8.1 Summary Budget

Description	Site Cost	Qty.	Total	OGRC Share	Berenergy Share	Pedigree Share
Installation	$ 560.00	10	$ 5,600.00	$ 5,600.00		
Software	$ 9,312.00	1	$ 9,312.00			$ 9,312.00
Design/Development						
Hardware Materials	$ 1,975.00	10	$ 19,750.00	$ 19,750.00		
3Yrs Data Hosting & SaaS	$ 1,620.00	10	$ 16,200.00		$ 16,200.00	
		Total	**$ 50,862.00**	**$ 25,350.00**	**$ 16,200.00**	**$ 9,312.00**

8.2 Budget Description & Justification

The proposed work is to be done on a fixed-cost basis as defined in the above budget with a total project budget of $50,862 of which $25,350 is requested from the OGRC. The funds requested from the ORGC cover materials and labor for equipment to be installed on the sites (Task 2). Pedigree Technologies will absorb the costs of data system software design, development and implementation (Task 1). Berenergy will provide funds for data hosting and Software as a Service (Saas) costs for the three-year test period and may continue to fund these services beyond this period if it is agreed to be of value.

9 Tax Liability Affidavit

I, Alex Warner, do hereby confirm that Pedigree Technologies, LLC, does not have an outstanding tax liability owed to the State of North Dakota or any of its political subdivisions.

_____

Alex Warner, President & Founder, Pedigree Technologies

STATE OF North Dakota)
)ss
COUNTY OF Cass)

On _____,_____, known to me to be the person described in and who executed the foregoing instrument, personally appeared before me and acknowledged that (s)he executed the same as a free act and deed.

_____

Notary Notary Public

Seal State of _____, County of _____

My Commission expires_____

10 Appendix

10.1 Detailed Budget

10.1.1 Software Design, Development, & Integration

Description	Personnel	Hours	Rate	Total
Project Management	Project Manager	24	$ 69.00	$ 1,656.00
Form Design & Integration	Software Developer	60	$ 57.00	$ 3,420.00
Sensor Integration	Software Developer	60	$ 57.00	$ 3,420.00
Quality Assurance	QA Engineer	24	$ 34.00	$ 816.00
			Total	**$ 9,312.00**

10.1.2 Materials (Per Site)

Description	Manufacturer & Part Number	Price	QTY	Total
Cellular Gateway	Calamp LMU4100-CDMA	$ 476.00	1	$ 476.00
Pressure Sensors	American Sensor Tech. AST4000	$ 237.00	2	$ 474.00
Data Acquisition Interface	Calamp IOPod	$ 79.00	1	$ 79.00
Data Acquisition Unit	Integrity Instruments 232M2A0LE	$ 182.00	1	$ 182.00
Sensor Connector	Integrity Instruments DB15TSM	$ 17.00	1	$ 17.00
Sensor Connector	Integrity Instruments DB25TSM	$ 22.00	1	$ 22.00
Battery	Onlinesolar 8A22NF	$ 173.00	1	$ 173.00
Solar Panel	Onlinesolar SX330J	$ 301.00	1	$ 301.00
Solar Panel Bracket	Onlinesolar HPM1830	$ 51.00	1	$ 51.00
Solar Charge Controller	Onlinesolar SS-6L	$ 61.00	1	$ 61.00
20' Solar Power Cable	Onlinesolar #10-2X20'OP	$ 36.00	1	$ 36.00
GW/DAQ Enclosure	Hoffman ASG 12x12x4	$ 24.00	1	$ 24.00
Battery Enclosure	Hoffman ASG 8x8x4	$ 17.00	1	$ 17.00
Cables/Misc Parts		$ 62.00	1	$ 62.00
			Total	**$ 1,975.00**

10.1.3 Installation (Per Site)

Description	Contractor	Hours	Rate	Total
Gateway/DAQ Installation	Electrical Contractor	1	$ 80.00	$ 80.00
Pressure Sensor Installation	Petroleum Contractor	1	$ 80.00	$ 80.00
Sensor Wiring	Electrical Contractor	1	$ 80.00	$ 80.00
Power Installation	Electrical Contractor	2	$ 80.00	$ 160.00
Travel	Electrical Contractor	1	$ 80.00	$ 80.00
Travel	Petroleum Contractor	1	$ 80.00	$ 80.00
			Total	**$ 560.00**