

July 5, 2017

Ms. Karlene Fine
Executive Director
North Dakota Industrial Commission
State Capitol – 14th Floor
600 East Boulevard Ave. Dept. 405
Bismarck, ND 58505

Re: Final Report for Contract No. G-034-066, titled “Reduction of Flares and Capture or Natural Gas Liquids with Vortex Tools”

Dear Ms. Fine,

We are pleased to present to you the final report on the status of our project that is being funded by the North Dakota Industrial Commission, Oil and Gas Research Program, and our Company, Bakken Frontier.

The report includes a summary, objectives, project accomplishments and results, potential applications and a summary of the NDIC. In accordance with Contract No. G-034-066, we respectfully request the final payment of \$70,000.

Regards and Best Wishes,

Yours Very Truly,

Jay Simmons

Jay Simmons
Vice President
Bakken Frontier, LLC

Attachments

Final Report

1.0 Summary.

Bakken Frontier, LLC under contract with Whiting, worked together to have the Company's Natural Gas Liquid Recovery Plant Skid placed in operation to recover the Natural Gas Liquids (NGLs) and reduce their flare. The startup date was determined by Whiting and the site was staffed by Bakken Frontier to operate 24 hours per day and seven days per week during the initial test period. A purchase contract with a major buyer of Natural Gas Liquids (NGLs), Targa Resources, included the transportation and sales of the NGLs produced.

The NGL Recovery Skid (the Skid) was transported to and mobilized at the Whiting well site. In addition to the NGL Recovery Skid, the installation included flare gas piping, storage tanks, a power generator, NGL piping, electrical controls, NGL receiving tank, water and other vessels and berms. Upon completion of programming the initial startup and testing began. Shortly after the start-up phase, Whiting chose to end the Agreement, and the NGL Skid and associated equipment were demobilized to a storage site.

After months of discussions with other oil companies, Bakken Frontier entered into an Agreement with SHD Oil & Gas, LLC to place the Skid at their oil well site to process and recover NGLs. After the NGL unit was installed, the initial start-up phase tests conducted included, among other items, a comparison of variable flare gas inlet and outlet pressures, and temperatures.

Bakken Frontier provided management and staffing for the 24 hours per day testing and operating period. Each 12-hour shift consisted of several personal conducting predetermined tests and monitoring system controls, making adjustments, and providing for maintenance as required. The Skid and its associated equipment were designed to process a volume of 800- 1200 MCF/day of flare gas. The well was unable to provide the required 800-1200 mcf/day. However, while providing only 250-320 mcf/day, the Skid produced NGLs immediately.

The tests were successful and demonstrated the Skid's ability capability to extract NGLs from the flare gas without the high expense of a generator, compressor, and high energy consuming refrigeration equipment. Despite the very limited feed rate flare gas to the NGL Skid, the desired information was recorded, and 10,000 gallons of NGLs was produced.

Bakken Frontier's Skid design and small footprint allows it be setup and operated in remote areas and locations where flaring is permitted due to the unavailability of a natural gas lines, inadequate gas line size or topography and/or right-of-way issues.

Due to the small footprint of the Skid, it is easily moved in and out of locations by trailer, and if higher volumes of gas are produced, additional Skids can be delivered to the site.

2.0 Objectives.

The Project's task was to use a simple yet sophisticated system designed to capture rich Bakken flare gas and extract the valuable NGLs, while reducing the amount of flaring. Objectives were established to evaluate the impact of Bakken Frontier's technology on increasing productivity and efficiency on current oil and gas wells with minimal intervention, while increase revenues through the capture of high value byproducts within the flare gas, and ensure candidate wells will be in compliance with current and future environmental standards.

3.0 Project Accomplishments and Results.

The development of the North Dakota's Bakken shale oil field lent itself to many unique challenges for regulators and operators, including the flaring of natural gas. These challenges included an increase in gas volume, not having the additional infrastructure to gather, process, and transport the gas, as well as gas lines that may have been sized before the addition of multi-well sites, many remote well sites that are unable to connect to a gathering gas line due to topography or right-of-way issues or in some cases where the gas lines have not yet reached the well site.

The flared gas also has an exceptional value as it is rich in Natural Gas Liquids (NGLs). The gas contains, approximately, 8 to 12 gallons of NGLs per thousand cubic feet of gas which include ethane, propane, butane, pentane, and natural gasoline.

Bakken Frontier used a new and novel approach to extract NGLs from gas being flared by wells located in the Bakken field. The Company designed, engineered, and constructed a Skid and its associated equipment with the capability to process between 800-1200 MCF/day of flare gas.

During the test period, the available flare gas at the well site was limited to 250-320 MCF/day. Although the Skid was designed for significantly higher volumes, the Skid produced NGLs immediately. The positive test results received on a low producing gas well has led to further discussions with operators regarding a design of a smaller unit that would increase its efficiency, while allowing the operator to comply with flare regulation compliance.

Over the course of the test period, a wide range of tests were conducted, including the use of different flare gas inlet and outlet pressures, flow rates and temperatures. Liquid gas analysis showed that the NGLs captured contained less than 1% methane while recovering the valuable NGL components: propane, butane, pentane, and hexane.

The tests successfully demonstrated the Skid's ability to extract NGL's from the flare gas without the high expense of a generator, compressor, and high energy consuming refrigeration equipment, despite the very limited flare gas feed rate to the NGL Skid.

During the period of operation, the Skid produced, approximately 10,000 gallons of NGLs, and the Company's goal of testing and validating its technology was accomplished.

4.0 Potential Applications.

Due to its small footprint and minimum electrical power requirements for the instrumentation, valves, and the control system, the Skid's operating costs are low. This allows it to be an ideal application for capturing flare gas at remote and/or stranded wells while reducing the flare, and generating additional revenue for the operator, state, county, and royalty holders. The Skid's simplicity in design and function also allow it to be easily scalable in multiple processing units for multi-pad well sites.

Energy producers and operators are looking to alternative means to become more efficient, reduce costs, and optimize revenue that includes generating power from the flare gas produced. Additional applications for the Skid, and its technology include providing a cleaner flare gas for electric power generation after NGLs have been recovered by the Skid. Bakken Frontier has been working with electric power generator manufacturers on a plan whereby a generator would be installed adjacent to the NGL Skid and receive the off gas as a fuel, which would be converted to on-site electrical power or for sales into the electric power grid.

5.0 Budget.

Due to the unexpected multiple site mobilizations and demobilizations, unforeseen oil well shutdowns and restarts, the Project costs came in higher than the original budget. These additional costs were paid by Bakken Frontier, which allowed the Project to be completed as a successful test program. Below is a summary of the participant contributions, and project expenditures.

Bakken Frontier, LLC

923 E Interstate Ave.
Bismarck, ND 58503
(701) 258-4869

Budget Expenditures

<u>Participant</u>	<u>Total Project</u>	<u>Participation</u>
NDIC	\$350,000	46.67%
Bakken Frontier	<u>\$400,000</u>	<u>53.33%</u>
Total	\$750,000	100.00%

Actual Expenditures

<u>Participant</u>	<u>Total Project</u>	<u>Participation</u>
NDIC	\$350,000	32.61%
Bakken Frontier	<u>\$723,271</u>	<u>67.39%</u>
Total	\$1,073,271	100.00%

Summary of Expenditures

<u>Item</u>	<u>Costs Incurred</u>
Compressor	\$67,131
Compressor Scrubber	\$5,520
Construction Labor	\$77,147
Construction Space	\$6,456
Cooler rent	\$15,244
Drug Testing	\$1,449
Electric Motor	\$9,331
Electrical Components	\$69,754
Engineering and Design	\$16,246
Fuel	\$60
Gas Sample Testing	\$807
Generator	\$20,172
NGL Tank Rent	\$28,417
Office On Site Rent	\$3,331
Office Supplies	\$22
On-Site Setup	\$89,516
Operational Components	\$47,053
Parts	\$77,254
Permitting	\$1,000
Piping Insulation & Heat Trace	\$1,203
Sales Tax Paid on Parts	\$268
Separator - Three Phase, Parts	\$21,522
Siding/Insulation	\$4,463
Labor & Management	\$127,575
Steel	\$6,913
Transportation Labor	\$5,505
Travel	\$5,572
Travel Meals	\$1,601
<u>Welding & Materials</u>	<u>\$12,739</u>
Total	\$723,271