



April 15, 2019

Ms. Karlene Fine
Executive Director
North Dakota Industrial Commission
600 East Boulevard Avenue, Department 405
State Capitol, 14th Floor
Bismarck, ND 58505-0840

Dear Ms. Fine:

Subject: Quarterly Progress Report for the Period of January 1 – March 31, 2019, “Bakken Production Optimization Program 2.0”; Contract No. G-040-080; EERC Fund 22010

Attached please find the Energy & Environmental Research Center (EERC) Quarterly Progress Report for the subject project. If you have any questions, please contact me by phone at (701) 777-5355 or by e-mail at cgorecki@undeerc.org.

Sincerely,

A handwritten signature in blue ink, appearing to read "Charles D. Gorecki", is written over a faint, larger version of the same signature.

Charles D. Gorecki
Director of Subsurface R&D

CDG/kal

Attachment

BAKKEN PRODUCTION OPTIMIZATION PROGRAM

Quarterly Progress Report

(for the period January 1 – March 31, 2019)

Prepared for:

North Dakota Industrial Commission

Partners of the Bakken Production Optimization Program (BPOP) Consortium

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Equinor
Hess Corporation
Liberty Resources LLC
Marathon Oil Company
Oasis Petroleum
Petro-Hunt, LLC
WPX Energy
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April 2019

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TABLE OF CONTENTS

LIST OF TABLES	ii
EXECUTIVE SUMMARY	iii
INTRODUCTION	1
ACCOMPLISHMENTS DURING REPORTING PERIOD	1
Enhanced Oil Recovery Task	1
Refracturing Optimization Task	3
Produced Fluid Characterization Task	4
Reservoir Performance Modeling Task	5
Facility Process Optimization Task	6
Aromatic/Aliphatic Study Task	6
Environmental Support Task	6
EOR Pilot Test Data Management System	7
Program Management and Development	7
TRAVEL ACTIVITIES	7
PARTNERSHIP AND FINANCIAL INFORMATION	8
FUTURE ACTIVITIES	9
Enhanced Oil Recovery Task	9
Refracturing Optimization Task	9
Produced Fluid Characterization Task	9
Reservoir Performance Modeling Task	10
Facility Process Optimization Task	10
Aromatic/Aliphatic Study Task	11
Environmental Support Task	11
EOR Pilot Test Data Management System	11
Program Management and Development	11

LIST OF TABLES

1	BPOP – Original Budget.....	8
2	BPOP Partners.....	8
3	BPOP – Expected Budget and Expenses to Date.....	9

BAKKEN PRODUCTION OPTIMIZATION PROGRAM

EXECUTIVE SUMMARY

The Bakken Production Optimization Program (BPOP) was established to facilitate Bakken petroleum system oil recovery while simultaneously reducing the environmental footprint of oil and gas development. This program is administered by the Energy & Environmental Research Center (EERC) with funding from the North Dakota Industrial Commission (NDIC) Oil and Gas Research Program (OGRP) and the North Dakota petroleum industry. Through BPOP, the EERC is working closely with a consortium of industry partners and the State to address emerging opportunities and challenges related to Bakken development. As of March 31, 2019, nine partner companies support BPOP. This progress report presents an overview of BPOP activities from January 1 through March 31, 2019.

The major research focus areas of the program over the last quarter have included the following:

- Ongoing collaboration with Liberty Resources (Liberty) to evaluate rich gas enhanced oil recovery (EOR) in the Stomping Horse Oil Factory complex in Williams County.
- Various research efforts to address surface-related issues, including environmental support and produced fluids characterization to support ongoing BPOP activities and to gain a better understanding of geographic and temporal variations in produced oil, water, and gas.
- Compilation of recent well production, completion, and refracturing data to conduct an updated evaluation of Bakken well performance based on parent–child well relationships, completion type, well spacing, and field location.

BPOP activities in support of the rich gas EOR pilot were largely focused on field-based activities at the Leon–Gohrick drill spacing unit in the Stomping Horse complex in Williams County, North Dakota. Large-scale injection testing was initiated into the Gohrick 4-MBH well. A second gas tracer study was initiated. Isotherms were successfully measured on three shales using the high-pressure magnetic balance.

An update of the refracturing study began. Wells that were refractured in 2018 were added into the existing data set and collection of fluid production data from those wells pre- and postrefracturing has begun. Updating the production performance of the current data set is ongoing.

An update to the North Dakota Remediation Resource Manual was completed, and it was added to the BPOP partners-only Web site.

Modifications and repairs to existing gas chromatographs were initiated to accommodate new whole-oil–crude fingerprinting analytical methods. These methods will be used to analyze existing crude and available core samples collected from within the Bakken to attempt to determine oil origination and/or subsurface migration during production activities.

To help supplement the Bakken well database compiled by the EERC using data from NDIC and FracFocus, alternative sources of well and production information were evaluated. A 1-year license for the Drilling Info (DI) database was purchased. Acquisition of the DI database helped to expand the well completion data that was contained in the EERC database. Efforts this past quarter focused on combining the DI database with the existing EERC database and performing a quality assurance/quality control check of the data.

Deliverables were added to the partners-only Web site including a task brief entitled “Vapor Pressure Modeling of Cold Weather Modifications for Bakken Surface Facilities” and a task wrap-up presentation entitled “Surface Facility Vapor Pressure Modeling.” The deliverables are currently available to the BPOP partnership and will be available to the public in April 2020.

The EERC is building a data management system (DMS) that can be used to support future rich gas injection pilot tests. When completed, the DMS will enable a pilot operator to integrate and analyze several data types. The EERC has completed the database design and is currently developing the user interface with TIBCO Spotfire®.

Significant progress was made on a BPOP Web site upgrade to update the design and program information and to serve as a program marketing tool. Several internal meetings were held to discuss the design and progress of the BPOP Web site.

Anticipated activities over the next quarter include ongoing collaboration with Liberty on the rich gas EOR pilot. The data generated from the injection tests in the summer of 2018 and the tests conducted during the winter of 2018–2019 will be evaluated. Laboratory experiments to examine the sorptive capacity of Bakken shale samples for rich gas components will continue to be conducted. The ongoing refracturing data set expansion and population will be continued as well as the refracturing production performance analysis. Data collection and sample acquisition within the produced fluid characterization task is expected to continue, with results supporting the ongoing compositional evaluations of each fluid and supporting the temporal evaluations and enhancing the size and usefulness of the database to the various BPOP research efforts. Modification of existing gas chromatographs and development of analytical methods to enable new whole-oil–crude fingerprinting and sulfur isotope characterization will continue. The upgrade of the BPOP Web site will be completed and released. A proposal will be submitted to NDIC OGRP to continue BPOP.

BAKKEN PRODUCTION OPTIMIZATION PROGRAM

INTRODUCTION

The Bakken Production Optimization Program (BPOP) was established to facilitate Bakken petroleum system oil recovery while simultaneously reducing the environmental footprint of oil and gas development. This program is administered by the Energy & Environmental Research Center (EERC) with funding from the North Dakota Industrial Commission (NDIC) Oil and Gas Research Program (OGRP) and the North Dakota petroleum industry. Through BPOP, the EERC is working closely with a consortium of industry partners and the State to address emerging opportunities and challenges related to the Bakken development.

The goals of BPOP are to:

- Develop knowledge that will enhance overall production efficiency, recognizing that improved coordination among various design factors (reservoir management, well design, surface processing, gas management, waste management) can lead to significant improvements in resource recovery efficiency while reducing potential health, safety, and environment impacts.
- Conduct applied research in topic areas that positively impact the efficiency of production and reduce the environmental footprint of operations.
- Advise industry and state entities on scientific aspects of exploration and production activities, especially as they pertain to economic and environmental impacts.
- Facilitate collaboration on issues that may not otherwise receive collaborative attention from industry and/or the state of North Dakota.

The anticipated ongoing outputs of BPOP are 1) increased well productivity and economic output of the Bakken petroleum system, 2) decreased environmental impacts of wellsite operations, and 3) reduced demand for infrastructure construction and maintenance. Specific results will include improved resource recovery efficiency, reduced land use impacts, increased royalties and tax revenue from harnessed associated gas and natural gas liquid streams, and increased revenue from added product streams captured earlier in the well life cycle.

ACCOMPLISHMENTS DURING REPORTING PERIOD

Enhanced Oil Recovery Task

The goal of the BPOP enhanced oil recovery (EOR) task is to develop knowledge that will support broad commercial implementation of EOR in the Bakken play. To achieve that goal,

the EERC is conducting laboratory-, modeling-, and field-based investigative activities to examine the effectiveness of using rich gas for EOR. The centerpiece of this task is the rich gas EOR pilot being conducted by Liberty Resources (Liberty) at its Stomping Horse complex in Williams County, North Dakota. The NDIC is providing \$1,527,234 and the U.S. Department of Energy (DOE) has committed \$2,000,000 to support EERC activities related to the Stomping Horse pilot. This past quarter, DOE also committed an additional \$1,000,000 toward laboratory-based investigations of the role that the organic-rich shales will play in rich gas-based Bakken EOR, especially with respect to gas utilization rates. The goals of the work to be conducted under this task include the following:

- Determine the effectiveness of cyclic multiwell huff ‘n’ puff as an injection/production scheme that can maintain conformance of the working fluid within the reservoir.
- Determine the ability of various rich gas mixtures (methane, ethane, and propane) to mobilize oil in Bakken petroleum system reservoir rocks and shales.
- Determine changes in gas and fluid compositions over time in both the reservoir and surface infrastructure environments, and assess how those changes affect reservoir and process facility performance.
- Optimize future commercial-scale tight oil EOR design and operations via iterative modeling of surface infrastructure and reservoir performance using data generated by the field- and laboratory-based activities.
- Establish the effectiveness of selected monitoring techniques as a means of reservoir surveillance and injection conformance monitoring in the Bakken petroleum system.
- Determine the sorptive capacity of Bakken shales for rich gas components and the effects of sorption in the shales on gas utilization rates in samples representing areas of low, medium, and high thermal maturity.

Specific activities conducted under this task during the past quarter include the following:

- Large-scale injection testing was initiated into the Gohrick 4-MBH well on January 17, 2019. Multiple severe weather events in February 2019 caused interruptions in the injection activities. Consistent injection was reestablished in early March 2019. A second gas tracer study was also begun shortly after the start of injection in the Gohrick 4-MBH well. Gas samples were collected and analyzed periodically from several offset wells in the drill spacing unit (DSU) to determine the timing and location of gas, oil, and water breakthrough. Data from the gas tracer study performed in late 2018 were analyzed, as were initial data from the second tracer study.
- Modeling and dynamic simulation activities continued. The EERC continued to provide technical support and guidance to the operation of the pilot injection/production scheme. History-matching exercises, using the previously developed static geomodel, detailed historical operational data, and data from the summer injection testing provided

by the project partner were conducted. Data analytical techniques were applied to the reservoir surveillance and operational data gathered over the course of the pilot. A material balance equation calculation was determined.

- Efforts to conduct laboratory-based experiments to determine the permeability and sorption behavior of rich gas components in Bakken shale continued. The high-pressure magnetic balance was installed and training was provided. Samples of three target shales were prepared for isotherm determination by extracting producible hydrocarbons with ethane. Isotherms from ambient to 5000 psi (345 bar) were successfully measured on all three shales, and ethane isotherms were initiated.
- On January 9, 2019, a WebEx was presented to participants from DOE summarizing rich gas–oil fluid behavior and Bakken rock extraction studies performed at the EERC.
- Biweekly conference calls with DOE were held to provide updates on the status and progress of the various aspects of the project.
- Biweekly conference calls were held with staff from Liberty to discuss progress on the various aspects of the project.

Refracturing Optimization Task

The Year 3 activities will focus on updating and expanding the work done on the Year 2 refracturing study by 1) expanding the existing refracturing database by incorporating the recent (2017 and 2018) refractured wells and 2) integrating the comments and feedback on the technical report of Year 2 received from our BPOP partners' review process (the report was marked as interim and added to the partners-only Web site for BPOP partners and will be available to the public in September 2020). Some of the review comments were beyond the previous scope of work; therefore, these comments will be addressed in this year's activities and beyond. Thus, the main objectives of the Year 3 refracturing study are to 1) update the analysis of production performance of wells that have been refractured in the Bakken petroleum system; 2) reevaluate the economics of well refracturing; 3) quantify the overall potential for Bakken-wide refracturing operations; 4) investigate the impact of different parameters, such as well spacing, refracturing treatment size and completion type (barefoot or nonbarefoot), on refractured well production performance; and 5) evaluate the impact of refracturing a single well on the production performance of the entire DSU.

Updating of the refracturing study has begun. Wells that were refractured in 2018 were added into the existing data set, and collection of fluid production data from those wells pre- and postrefracturing has begun. Updating the production performance of the current data set is ongoing using decline curve analysis (DCA) to calculate the estimated ultimate oil recovery (EUR oil) for each individual refracturing well, pre- and postrefracturing peak oil rates, and changes in daily oil production rate and gas–oil ratio (GOR) following the refracturing operation.

Produced Fluid Characterization Task

The produced fluids characterization task was established for the purpose of compiling physical and chemical property data pertaining to Bakken Formation fluids, including crude, produced water, and associated gas. The goal of this task was to develop and maintain a robust database of Bakken-related fluids data, and facilitate data and sample acquisition and analyses to support the many ongoing BPOP activities conducting basin-specific research of interest to industry and the state of North Dakota. The objectives of this task include thorough review and compilation of relevant publicly available data, establishing industry partnerships to enable acquisition of nonpublic information and potential access for sample acquisition, conducting sampling and analysis efforts to support project needs, and performing a review of relevant information to identify specific data needs.

Key accomplishments for this quarter include continued collaboration with key industry partners to obtain access to fluids sample collection and acquisition of existing compositional data to support the ongoing research efforts of individual BPOP program tasks. Review of existing data and development of newly updated geographic information system (GIS)-based maps derived from these data was initiated. Sampling and analysis activities have also continued, supporting an increased geographical distribution of data and providing a temporal evaluation of compositional changes throughout a well's production life. Specific activities conducted this quarter include the following:

- Continued crude, water, and gas sampling and analysis activities at two locations in the northern and southern portions of the Bakken play in North Dakota.
- Continued sampling and analysis activities on fluid samples from two adjacent producing Bakken wells (one stimulated and one nonstimulated) for the purpose of evaluating compositional differences that may indicate possible fluid migration pathways.
- Conducted a site visit on March 27, 2019, to collect samples from a total of four wells.
- Continued conducting additional sample collection and analysis on four separate wells for the purpose of a temporal evaluation of compositional changes throughout the production life of newly established wells. Site visits to collect samples were conducted on January 15 and March 28, 2019.
- Initiated efforts to arrange sample collection and related fluids analysis training/education for multiple EERC field personnel. The training/education is intended to provide sample collection personnel with better insight to analytical methods and sampling procedures and their benefits to oil and gas production-related research activities.
- Continued to support an industry partner through the collection and analysis of fluid samples to evaluate the performance and effects of an ongoing EOR project. A site visit

was conducted on March 28, 2019, to collect samples of water, crude, and gas phases for analysis at the EERC.

- Reviewed and refined collected data/information for inclusion in the previously developed database and to identify specific data gaps/needs.
- Created updated GIS maps using the refined database information to evaluate basinwide characteristics specific to Bakken and Three Forks data/information.
- Initiated modifications and repairs to existing gas chromatographs to accommodate new whole-oil–crude fingerprinting analytical methods. These methods will be used to analyze existing crude and available core samples collected from within the Bakken to attempt to determine oil origination and/or subsurface migration during production activities.
- Supported data compilation and evaluation activities for a project to evaluate sour well locations within the Bakken.

Reservoir Performance Modeling Task

The goal of this task is to update and expand the previous work that focused on statistical analysis of the key factors that could affect Bakken well performance, summarized in the BPOP report entitled “Bakken Production Evaluation Using Multivariate Statistical Analysis.” In addition to the general well production statistics used in the previous effort, the 2019 study will greatly expand the number of wells included in the evaluation (from 400 to over 10,000) and focus on understanding the possible correlations between well performance and engineering factors such as well spacing, child versus parent relationships, field location, and completion design. More than 30 different factors (drilling -, completion- and geology-related) will be analyzed to assess their effects on short-term (6-month) and long-term (60-month) production using advanced analytical methods and statistical models such as multiple regression, principal components, and gradient boosting. This task also entails an updated evaluation of Bakken fluids production and completion practice trends to better understand the potential future impacts of fluids production on surface-related infrastructure, freshwater demand, and saltwater disposal (SWD) capacity. The overall trend analysis will also take into account the difference in oil, gas, and water generation between parent and child wells on a DSU.

To help supplement the Bakken well database compiled by the EERC using data from NDIC and FracFocus, alternative sources of well and production information were evaluated, including commercially-available databases offered by IHSMarkit, Drilling Info (DI), and others. A 1-year license for the DI database was purchased. Acquisition of the DI database helped to expand the well completion data that was contained in the EERC database. Efforts this past quarter focused on combining the DI database with the existing EERC database and performing a quality assurance/quality control (QA/QC) check of the data. Once the QA/QC check is complete, the database will be used to update the key trends discussed above.

The final report from the previous work entitled “Bakken Production Evaluation Using Multivariate Statistical Analysis” was added to the partners-only Web site for review by BPOP partners. No review comments were received by January 31, 2019, thus the report will be made available to the entire BPOP partnership for a 15-month period before the report is fully public.

Facility Process Optimization Task

The overall goal of this task is to apply process simulation to the operation of Bakken surface facilities to improve performance, reduce emissions, and ultimately streamline operating costs. These facilities are a key link in the overall Bakken production chain, and under this task, models have been created with partner input to examine in detail parameters that affect fugitive emissions and crude oil properties. Modeling results are then reduced to actionable suggestions for partner producers to consider when evaluating their operations.

During the previous quarter, partner feedback was incorporated into finalized deliverables that address the issue of weather-induced changes to crude oil vapor pressure. This quarter, the deliverables added to the partners-only Web site including a task brief entitled “Vapor Pressure Modeling of Cold Weather Modifications for Bakken Surface Facilities” and a task wrap-up presentation entitled “Surface Facility Vapor Pressure Modeling.” The deliverables are currently available to the BPOP partnership and will be available to the public in April 2020.

Aromatic/Aliphatic Study Task

The goal of the aromatic/aliphatic (A/A) task is to investigate and develop the use of the determination of the relative ratios of aromatic hydrocarbons to aliphatic hydrocarbons in rock cores and produced crude oil for two general applications: 1) to provide a well management tool that can determine the changes in produced crude oil contributed from the adjacent source shales to wells completed in the Middle Bakken (or Three Forks) and 2) to yield a better understanding of oil migration from the source shales to the target reservoir formations. Studies on rock core samples are continuing to increase the understanding of thermal maturity and oil migration across the Basin, and crude oil samples collected temporally during oil production from several wells are being analyzed to determine the efficacy of using A/A ratios to facilitate well management.

Analysis for A/A ratios of all produced crude oil samples collected from the beginning of the project through the end of 2018 were completed. Temporal crude oil samples continue to be collected.

Environmental Support Task

The environmental support task was largely focused on providing assistance to our partners on issues related to brine and hydrocarbon spills and the associated cleanup. In addition to spill remediation-related efforts, EERC staff participated continue to support partner activities and North Dakota Petroleum Council (NDPC) task force work related to flaring mitigation, well site emission control and management, and crude oil vapor pressure management.

During this reporting period, EERC incorporated review comments to the North Dakota Remediation Resource Manual. This final document is now complete and is available on the BPOP partners-only Web site. The manual will be available to the entire BPOP partnership for a 15-month period before the report is fully public in September 2020.

EOR Pilot Test Data Management System

The EERC is building a data management system (DMS) that can be used to support future rich gas injection pilot tests. When completed, the DMS will enable a pilot operator to integrate and analyze several data types, including 1) daily production (oil, gas, and water) and injection data, 2) daily casing and tubing wellhead pressure measurements, 3) continuous downhole pressure and temperature measurements, and 4) gas chromatography and tracer measurements conducted periodically on produced gas and fluid samples. A customized user interface will allow the user to visualize the available data and conduct real-time data analytics. The EERC has completed the database design and is currently developing the user interface with TIBCO Spotfire®. The DMS will provide a valuable tool for monitoring future pilot test performance and will provide real-time decision-making support for evaluating injection operations.

Program Management and Development

Work continued on a BPOP Web site upgrade to update the design and program information and to serve as a program marketing tool. Several internal meetings were held to discuss the design and progress of the update. All BPOP product titles will be visible on the public BPOP Web site and will be accompanied by a public abstract and key words for searchability. Publicly available products will be downloadable instantly, while BPOP partners-only products will be available to BPOP partners or will provide information for nonpartners on how to join BPOP. Products will be accessible to BPOP partners for 15 months prior to public distribution.

TRAVEL ACTIVITIES

Representatives from BPOP incurred travel costs for their participation in the following meetings and sampling trips:

- January 14–18, 2019: traveled to the Liberty wellsites near Tioga, North Dakota, to conduct sample collection.
- February 11–15, 2019: traveled to Galveston, Texas, to attend and present at the Society of Professional Engineers (SPE) Workshop: Complex Reservoir Fluids – Focus on New Developments.
- February 19–20, 2019: traveled to Dickinson, North Dakota, to attend a NDPC Technical Solutions Group meeting.
- February 26, 2019: traveled to Dickinson, North Dakota, to attend the North Dakota Reclamation Conference.
- March 12–15, 2019: traveled to Houston, Texas, to attend the NORM and Natural Radiation Management North America Conference.

- March 17–19, 2019: traveled to San Diego, California, to attend the EUCI Shareholder Symposium on Mitigating Methane Emissions – Technology, Regulations, Measurement and Mitigation Best Practices.
- March 17–22, 2019: traveled to Houston, Texas, to attend and speak at the ADA-Upstream – Applied Data Analytics for Business Decision-Making Conference.

PARTNERSHIP AND FINANCIAL INFORMATION

The original budget as proposed to NDIC OGRP is \$13,280,000, as shown in Table 1.

The EERC continues to seek support for this program, and to date, additional cost share has been secured from the Bakken producers listed in Table 2.

Table 1. BPOP – Original Budget

	Y1	Y2	Y3	Total
	Nov 2016 to Oct 2017	Nov 2017 to Oct 2018	Nov 2018 to Oct 2019	
Sponsors				
NDIC Share – Cash	\$2,000,000	\$2,000,000	\$2,000,000	\$6,000,000
Industry Share (Marathon) – In-Kind	\$2,500,000	\$3,500,000	\$1,280,000	\$7,280,000
Total	\$4,500,000	\$5,500,000	\$3,280,000	\$13,280,000

Table 2. BPOP Partners

ConocoPhillips	Liberty Resources	Petro-Hunt
Equinor	Marathon Oil	WPX Energy
Hess Corporation	Oasis Petroleum	XTO Energy

In addition, the EERC has secured \$2,000,000 from DOE to complement the ongoing work to determine the feasibility of reinjecting captured rich gas into a Bakken reservoir to enhance oil recovery. Liberty is providing in-kind contributions that support this programmatic scope.

Table 3 presents a revised expected budget based on the additional cost share secured by the EERC. This revised budget is an increase of more than 85% over the original budget. Expenses to date are also listed in Table 3.

Table 3. BPOP – Expected Budget and Expenses to Date

Sponsors	Expected Budget	Actual Expenses as of 3/31/19	Balance
NDIC Share – Cash	\$6,000,000	\$3,815,759	\$2,184,241
Industry Share – Cash	\$1,350,000	\$683,114	\$666,886
Marathon – In-Kind	\$12,615,401	\$12,615,401	\$0
Liberty – In-Kind*	\$2,763,830	\$2,763,830	\$0
DOE – Cash	\$2,000,000	\$1,153,280	\$846,720
Total	\$24,729,231	\$21,031,384	\$3,697,847

* An estimate for the total expected in-kind cost share from Liberty is not available. Liberty will periodically report actual costs to the EERC, which will be subsequently presented in the quarterly report.

FUTURE ACTIVITIES

The planned activities for the next quarter are detailed below.

Enhanced Oil Recovery Task

Anticipated activities over the next quarter will focus on continued collaboration with Liberty on the rich gas EOR pilot. The data generated from the injection tests in the summer of 2018 and the tests conducted during the winter of 2018–2019 will be evaluated. The lessons learned from those injection tests will be used to guide operation of the next injection test that is anticipated to be initiated in the next quarter. A draft white paper on the findings from the surface facility modeling of the Stomping Horse complex will be finalized during the next quarter.

Laboratory experiments to examine the sorptive capacity of Bakken shale samples for rich gas components will continue to be conducted. Ethane and methane isotherms will be completed and isotherms using 70/20/10 produced gas mixture will be initiated.

With respect to modeling, ongoing efforts will continue to calibrate gas and water production at longer times. Once calibrated, the DSU model will allow obtaining predictions that are more reliable. Later, dynamic simulations will allow forecasting, assessing, and optimizing short-term and long-term recovery efficiencies.

Refracturing Optimization Task

The ongoing refracturing data set expansion and population will be continued as well as the refracturing production performance analysis.

Produced Fluid Characterization Task

Key upcoming activities for this task include developing additional partnerships with industry to further understand their specific needs related to Bakken production issues and

practices and to expand the geographical extent of the sampling and analysis effort. Data collection and sample acquisition is expected to continue, with results supporting the ongoing compositional evaluations of each fluid and supporting the temporal evaluations and enhancing the size and usefulness of the database to the various BPOP research efforts. Specific activities to be conducted include the following:

- Continue monthly and quarterly sample collection and analysis events on established wells.
- Review and evaluate collected data as they pertain to overall production characteristics throughout the Bakken play. Work will continue to refine data analysis and develop GIS-based tools to understand trends and characteristics of produced fluids.
- Coordinate access and sample acquisition/analysis on additional wells throughout the basin.
- Continue to provide sample acquisition and analytical interpretation support to an ongoing EOR project within the Bakken play.
- Modify existing gas chromatographs and develop analytical methods to enable new whole-oil–crude fingerprinting and sulfur isotope characterization. These methods will be used to analyze existing crude and available core samples collected from within the Bakken to determine oil origination and/or subsurface migration during production activities.

Reservoir Performance Modeling Task

The final QA/QC check of the data in the combined EERC/Drilling Info database will be completed and a statistical analysis of the data will be initiated. The overall Bakken production trend analysis will be updated to include a summary of average annual oil, water, and gas production and completion data statistics (lateral length, number of stages, fracturing fluid volumes, proppant amount) based on the initial production date of each Bakken and Three Forks well. Exploratory data analysis, including the use of statistical models such as multiple regression, principal components, gradient boosting, and others, will be made to identify the key engineering and locational factors impacting well performance. A key priority will be to better understand the impact of the well spacing and parent/child relationships on well performance.

Facility Process Optimization Task

The EERC will continue to engage BPOP partners to assess facility optimization needs relative to flaring mitigation, emission control, vapor pressure management, and related process-related issues. The EERC plans to send a representative to the next NDPC Technical Solutions Group meeting in May 2019 for an opportunity to gather producer perspectives on these evolving issues.

Aromatic/Aliphatic Study Task

Temporal crude oil samples continue to be collected.

Environmental Support Task

The EERC plans to send a representative to the “Flaring Issues, Solutions and Technologies Workshop” in Denver, Colorado, on April 23, 2019.

EOR Pilot Test Data Management System

The DMS user interface with TIBCO Spotfire® will continue to be developed.

Program Management and Development

The upgrade of the BPOP Web site will be completed and released. A proposal will be submitted to NDIC OGRP to continue BPOP.