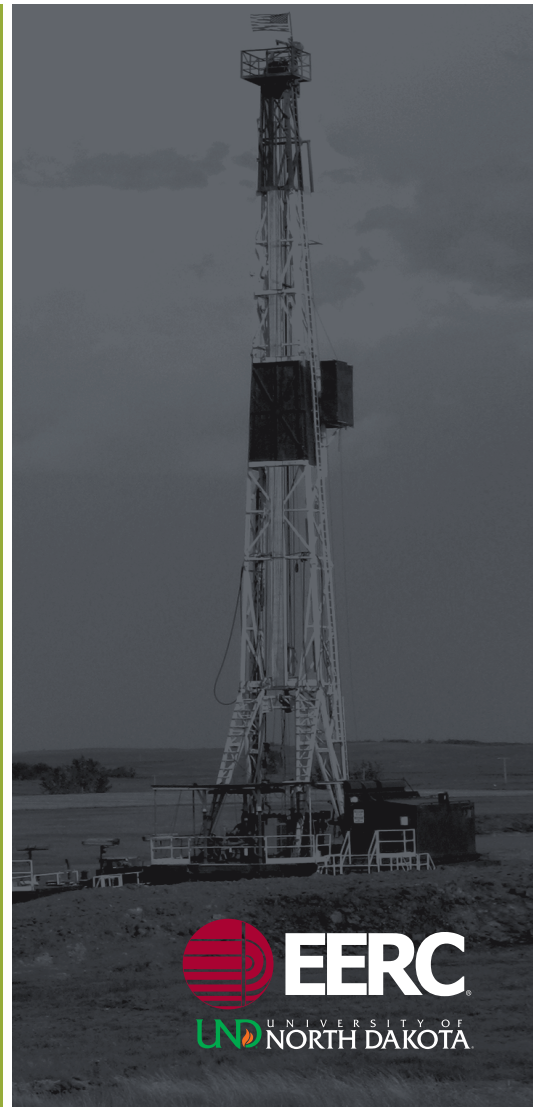




Bakken Production Optimization Program

BAKKEN PRODUCTION OPTIMIZATION PROGRAM 3.0 PROSPECTUS



PROGRAM INTRODUCTION

Led by the Energy & Environmental Research Center (EERC), the highly successful Bakken Production Optimization Program (BPOP), funded by its partners and the North Dakota Industrial Commission through its Oil and Gas Research Program, is continuing for the time frame of 2019–2023. The goals of this research program, BPOP 3.0, are to provide the state and industry with science-based insight to maintain the economic and environmental sustainability of the Bakken play in North Dakota and to provide stakeholders with the knowledge needed to plan and implement innovative development strategies that will take the Bakken into the next decade and help achieve the Governor’s goal of 2 million barrels per day of North Dakota oil production.

BPOP 2.0 PARTNERS

This premier partnership program has been cited as an exemplary model by others nationwide. It has demonstrated that state lawmakers, state regulators, and industry can work together for positive results for shareholders and taxpayers alike. Project partners focus research on industry-driven challenges and opportunities:

ConocoPhillips
Equinor
Hess Corporation
Liberty Resources LLC
Marathon Oil Company
North Dakota Oil and Gas Research Program
Oasis Petroleum
Petro-Hunt, LLC
WPX Energy
XTO Energy



BPOP ACHIEVEMENTS (2013–2019)

Liberty’s Stomping Horse Enhanced Oil Recovery (EOR) Pilot Project

In support of the rich gas EOR pilot conducted by Liberty Resources at its Stomping Horse complex, BPOP conducted laboratory, modeling, and field-based investigative activities.

Water Injection Reservoir Assessment

Because of industry’s current reliance on the Inyan Kara Formation as a saltwater disposal (SWD) target, an effort was conducted through BPOP to estimate local and regional pressure effects that have occurred as a result of historic SWD and to evaluate areas that may be suitable or problematic for disposal through reservoir simulation of hypothetical future injection scenarios.

Facility Process Optimization

Surface facilities are a key link in the overall Bakken production chain, and models have been created with partner input to examine in detail parameters that affect fugitive emissions and crude oil properties. Modeling results were then reduced to actionable suggestions for partner producers to consider when evaluating their operations.

Technical Forums for Industry

BPOP provided a regular forum for peer-to-peer technical discussions on issues affecting all partners. Partners commented that this function is available nowhere else.

Study of Bakken Refracturing

A review of a BPOP data set of 400 wells provides insight to help understand the impacts of different completion-related factors and geology-related factors on short- and long-term oil production from the Bakken petroleum system.

DSU Setback Rules

To better describe the impact of proposed changes to setback rules on drill spacing units (DSUs), BPOP refereed several teams performing representative simulation cases. The EERC then coordinated an informative presentation to the state of North Dakota.

Flaring Reduction

As the Flaring Task Force formulated a multistage plan to decrease flaring rates, BPOP provided flaring statistic analysis that served as the foundation for these plans. The BPOP team presented the resulting plan to the governor in January 2014.

Bakken/Three Forks Production Analysis

Using a data set of approximately 13,000 wells, Bakken/Three Forks production trends were analyzed, and factors that could improve oil recovery were estimated.

BPOP 2.0

FOCUS ON RICH GAS EOR AT LIBERTY RESOURCES' STOMPING HORSE COMPLEX

BPOP 2.0 activities in support of the rich gas EOR pilot included field-based activities at the Leon–Gohrick DSU in the Stomping Horse complex, modeling and dynamic simulation activities to provide technical support and guidance to the design of the pilot injection/production scheme, and laboratory-based experiments to determine the permeability and sorption behavior of rich gas components in Bakken shale.

Laboratory Accomplishments

The “richer” the gas, the lower the MMP (minimum miscibility pressure) is.

Rich gas can effectively mobilize oil from Bakken rocks.

Field Test Accomplishments

As of May 2019, a total of ~160 MMscf gas was injected in five wells during six different injection periods.

Reservoir surveillance and monitoring demonstrate the injected gas can be controlled and contained within the DSU.

Injectivity into Bakken and Three Forks reservoirs has been readily established and has not been a constraint on operations.



Rich gas injection wells at Liberty Resources' Stomping Horse Complex.

ABBREVIATED LIST OF BPOP 3.0 ACTIVITIES*

- › **Rich Gas Enhanced Oil Recovery (EOR)** – Develop knowledge to support broad commercial implementation of EOR in the Bakken play.
- › **Process Optimization** – Analyze trends by assimilating data and information from multiple operators, assist in defining the challenges to improved process efficiency, and identify technological and operational solutions through process modeling and system design.
- › **Produced Fluid Characterization** – Collect and analyze data on crude oil, associated gas, and produced water to gain a better understanding of the resource and support facilities process modeling and reservoir modeling.
- › **Improved Reservoir Drainage and Production Efficiency** – Investigate the impact and interactions of phase behavior, well spacing, changing GOR (gas-to-oil ratio), allocation of produced oil to its source interval, and associated gas reinjection on resource recovery and system performance.
- › **Well Completions and Fluids Production Trends Analysis** – Evaluate overall trends in well completion practices and fluids production to better understand reservoir performance as a whole, and predict future gas and water production volumes.
- › **Well Completions Optimization** – Continue to assess the performance of different completion techniques on well performance, including evaluation of parameters such as well spacing, treatment size, and completion type on the production of oil, gas, and water from hydraulically fractured and refractured wells.
- › **Produced Water Management** – Assess options for produced water management, including the feasibility of recycling and reuse, SWD into other subsurface targets, or possible reinjection into the Bakken for pressure maintenance.
- › **Rich Gas–Oil Fluid Behavior and Rock Extraction Studies** – Conduct laboratory investigations to determine the effect of different potential injection gas mixtures on the MMP of oil from the new pilot reservoir.
- › **Machine Learning (ML) and Big Data Analysis (BDA) Applied to the Bakken** – Conduct activities that use ML and BDA to address questions related to improving EOR operations and developing long-term strategies for overall Bakken resource development.
- › **Partner-Driven Activities** – Evaluate other topics identified by our partners.

* Activities are partner-driven.

MEMBERSHIP MODEL AND TIERS

Several leading Bakken producers enlisted as founding consortium members. Continued membership is now being actively solicited with annual contributions:

MAJOR PARTNERS

LARGE PRODUCERS
(150 wells or more)

\$100,000/yr

- › Prerelease review of program products
- › Participation in program-facilitated technical/policy forums
- › Highlighted participation in public briefings
- › Access to all program products via Web page

MINOR PARTNERS

SMALL PRODUCERS
(fewer than 150 wells)

\$50,000/yr

- › Limited direction of program activities
- › Participation in program-facilitated technical/policy forums
- › Highlighted participation in public briefings
- › Access to all program products via Web page

ASSOCIATE MEMBERS

SERVICE COMPANIES AND
NONOPERATING PRODUCERS

\$25,000/yr

- › Participation in program-facilitated technical/policy forums
- › Access to all program products via Web page

BAKKEN PRODUCTION OPTIMIZATION PROGRAM WEBSITE

- › The BPOP website can be accessed at <http://undeerc.org/Bakken/Optimization/>.
- › A key feature of the site is access to all BPOP products through the Search Documents feature. All products are accompanied by a public abstract.
- › Free, publicly available products are available for download by all.
- › Premium products are available **EXCLUSIVELY TO PARTNERS** for 15 months prior to public release.

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