Energy & Environmental Research Center (EERC)

BAKKEN PRODUCTION OPTIMIZATION PROGRAM (BPOP) 2.0 UPDATE

Presented to: Oil & Gas Research Council
Bismarck, North Dakota
August 20, 2018

Charles Gorecki
Director of Subsurface R&D

Critical Challenges. Practical Solutions.

AGENDA

- Budget
- BPOP 2.0 Members Meeting
- Final Report Review Process
- Rich Gas EOR with Liberty Resource
- Refrac Study
- Inyan Kara Modeling
- Industry Support Activities
  - Vapor Pressure
  - Remediation
  - Statistical Analysis of Production Data

BPOP 2.0

Sponsors	Current Budget	Expenses as of 8/15/18	Balance
NDIC Share – Cash	$6,000,000	$2,748,573	$3,251,427
Industry Share – Cash	$800,000	$457,193	$342,807
Marathon Oil Company – In-Kind	$7,280,000	$4,749,086	$2,530,914
Liberty Resources LLC – In-Kind*	755,639	755,639	$0
U.S. DOE – Cash	2,000,000	582,577	$1,417,423
Total	**$16,835,639**	**$9,293,068**	**$7,542,571**

* 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 presented in the subsequent quarterly reports.

ANNUAL MEMBERS MEETING

Over 30 participants attended meeting at the EERC on August 7–8, 2018. Presentations on key topics:

- Transportation and infrastructure (Kringstad)
- Rich gas EOR
- Produced water disposal
- Vapor pressure strategies
- Aromatic/aliphatic fingerprinting
- Technology trends

Bakken Production Optimization Program 2.0

EERC UNIVERSITY OF NORTH DAKOTA

BAKKEN PRODUCTION OPTIMIZATION PROGRAM 2.0 ANNUAL MEMBERS MEETING

Dress Code is Business Casual

AGENDA

DAY 1 TUESDAY, AUGUST 7, 2018 EERC – GRAND FORKS, ND

TIME	ACTIVITY	DISCUSSION LEADER(S)
12:00 Noon	Lunch provided at the EERC	
1:00 p.m.	Welcome	John Harju
1:05 p.m.	EERC Bakken Research – Where We've Come from and Where We're Going	Charlie Gorecki
1:40 p.m.	Transportation and Processing Infrastructure – View from the North Dakota Pipeline Authority	Justin Kringstad
2:10 p.m.	Networking Break	
2:30 p.m.	Panel on Bakken Rich Gas EOR – Pilot Testing at Stomping Horse	
	• Introduction and Project Overview	Jim Sorensen
	• Objectives, Approach, and Status of the Pilot Test Field Activities	Tammy Kaier, Liberty Resources
	• Laboratory Studies to Support Rich Gas EOR	Steve Hawthorne
	• Modeling and Simulation Efforts	José Torres
	• Member Time (30 minutes for Q&A)	
4:30 p.m.	The Future of the Bakken – View from the North Dakota Department of Mineral Resources Director's Chair	Lynn Helms
5:00 p.m.	Wrap-Up	
6:00 p.m.	Dinner – BBQ/Social at the EERC	

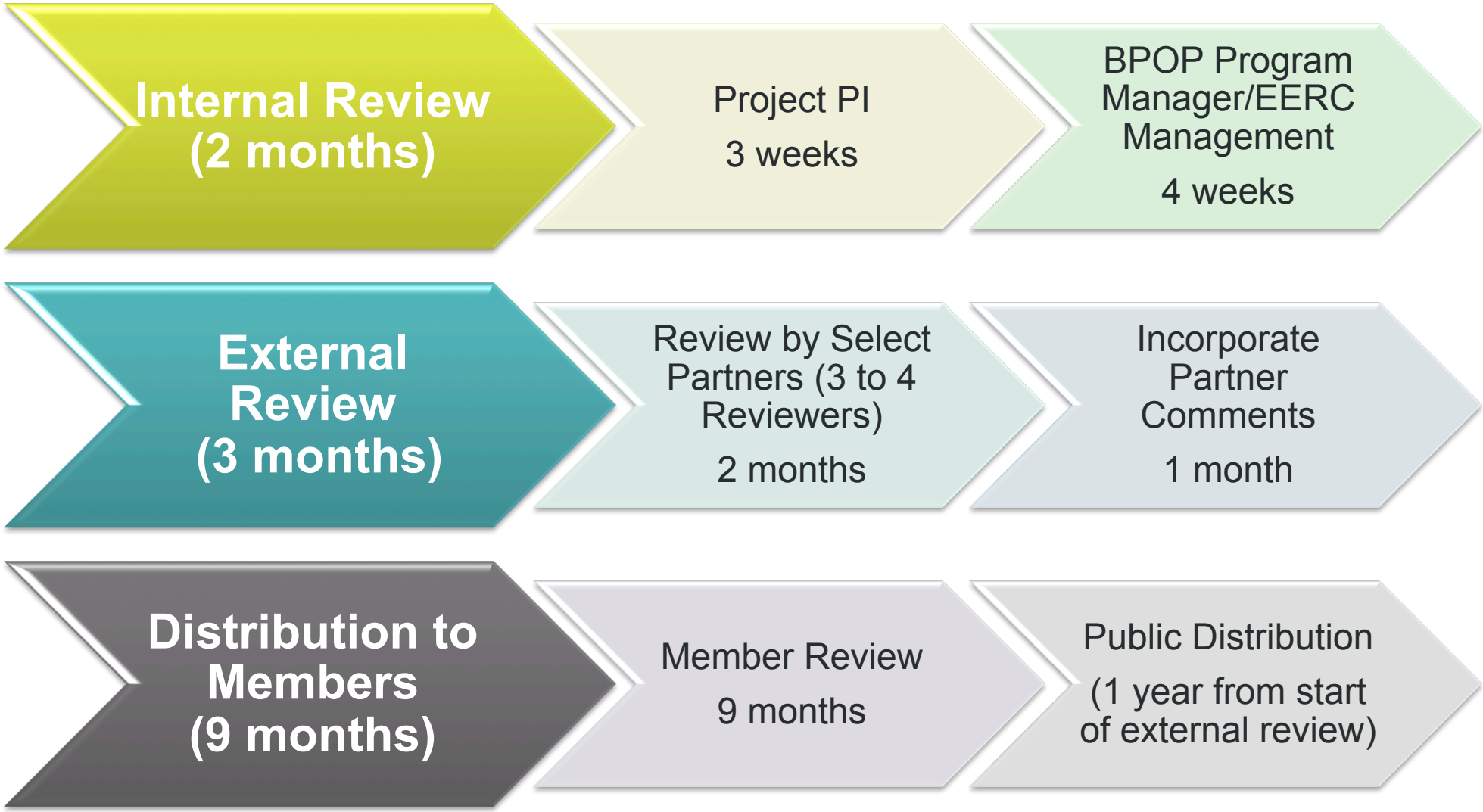
www.undeerc.org/Bakken/Bakken-Production-Optimization-Program.aspx

BAKKEN PRODUCTION OPTIMIZATION PROGRAM 2.0 ANNUAL MEMBERS MEETING

DAY 2 WEDNESDAY, AUGUST 8, 2018 EERC – GRAND FORKS, ND

ACTIVITY	DISCUSSION LEADER(S)
oduced Water	Beth Kurz
odeling	Chris Martin
ing and Potential Utility	Steve Hawthorne
d Technology Trends	
echnology Trends	Beth Kurz
roduction Data	Chantsa Dalkhaa
	Chantsa Dalkhaa
ne	
d at the EERC	

BPOP FINAL REPORT REVIEW PROCESS (DRAFT)



RICH GAS EOR – HIGHLIGHTS

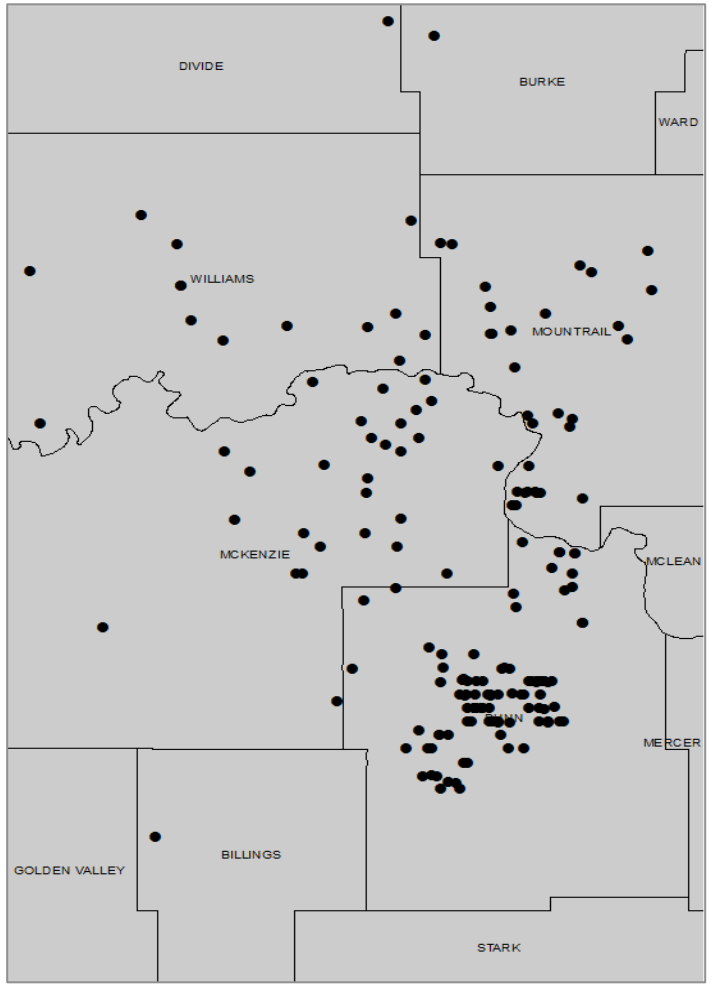
- **Lab studies of rich gas interactions with fluids and rocks**
  - The richer the gas, the lower the MMP.
- **Iterative modeling of surface and subsurface components.**
  - Surface infrastructure modeling predicts rich gas EOR will not adversely affect Stomping Horse surface facility operations.
  - Reservoir modeling predicts incremental oil recovery >25%.
- **Pilot performance assessment**
  - Initial “precharging” injection started July 17 using gas lift compressors capable of 1.4 MMscf/day and 1400 psi.
  - Operational and monitoring data being evaluated.

RICH GAS EOR – NEXT STEPS

- **Large-scale rich gas injection imminent**
  - Refurbished compressor expected delivery in late September 2018 (capable of 4200 psi and 3 MMscf/day).
  - Injection starting target for early October.
  - Pressures, rates, and injection/soak durations for the pilot will be determined based on learnings from the ongoing precharge injection activities.

REFRAC PERFORMANCE EVALUATION

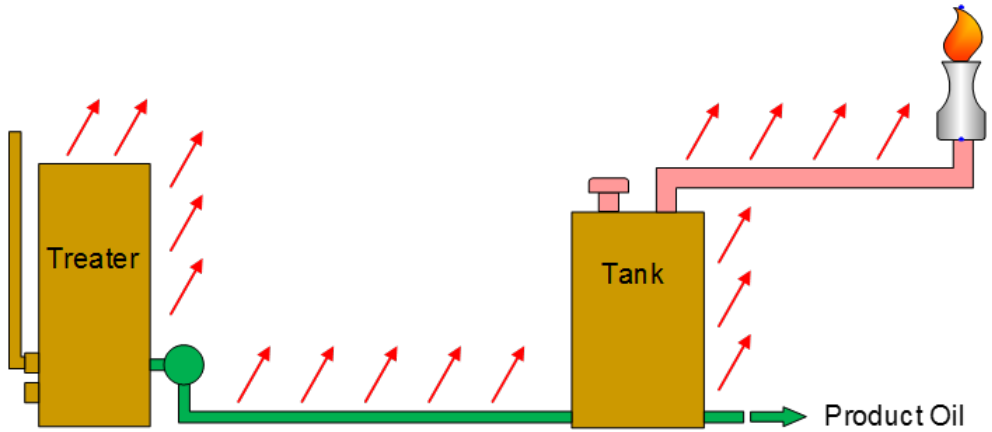
- **Evaluation of 168 refracs identified in ND (as of Sept 2017)**
- **Refrac production performance**
  - Average uplift in daily oil production of 350 stb/day during 30 days following refrac.
  - Incremental EUR ranging from 80 to 260 Mstb.
  - Avg GOR decrease of 20% during first 30 days after refrac.
- **Results show some positive potential in Bakken refracs, but…**
- **Current refrac data set substantially influenced by wells of specific initial completion type (openhole, single stage).**
  - Inventory of remaining openhole single-stage wells is limited.
  - Risk increases with increasingly complex completions.



Surface location of refrac wells.

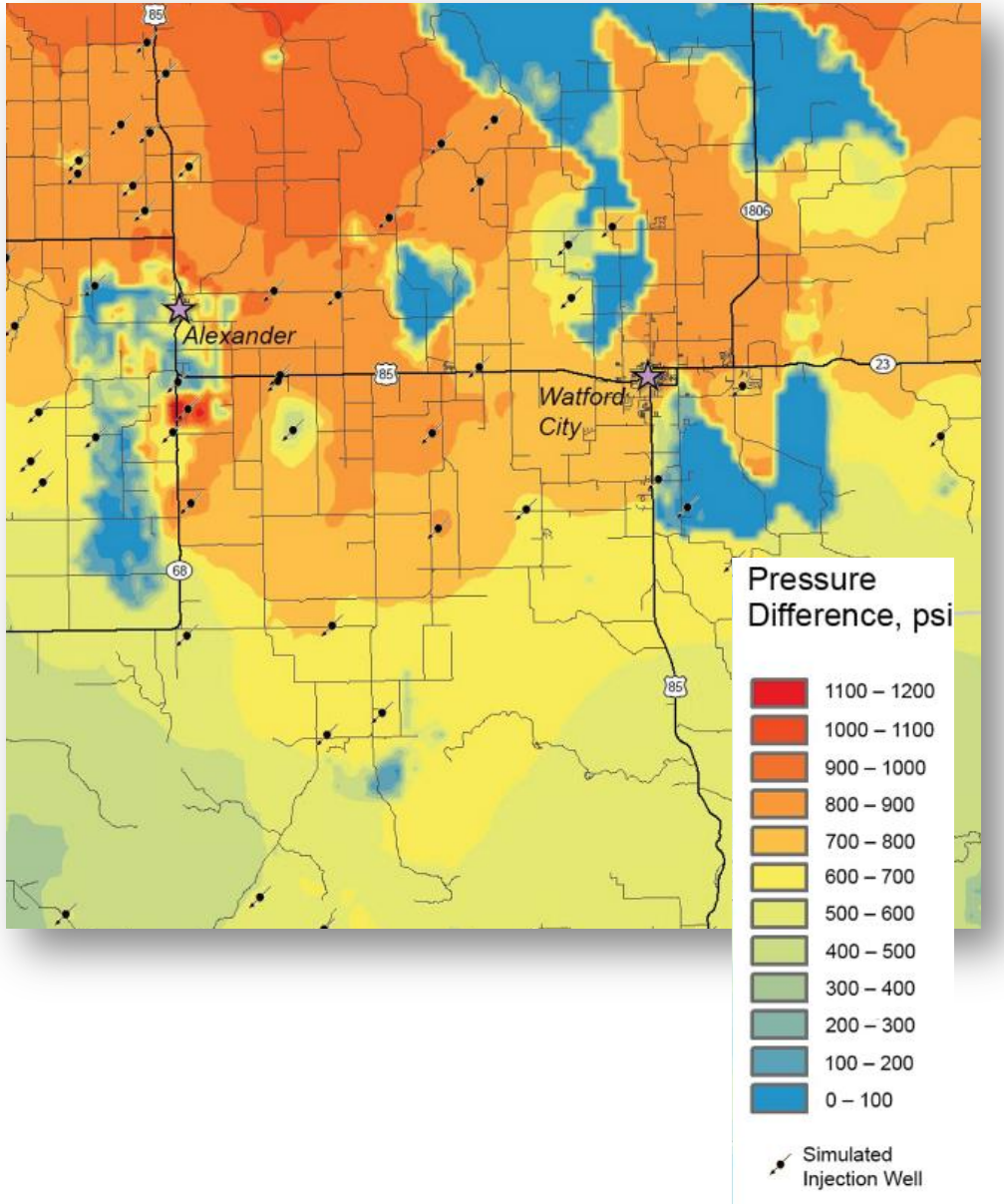
CRUDE OIL VAPOR PRESSURE MANAGEMENT

- **Impact**: determining optimal conditions for efficient operation will…
  - Help compliance with the state and midstream operators in cold weather.
  - Minimize hydrocarbon losses to gas stream in hot weather.
- **Activities**: worked with industry operators to gather data, develop computer models, and validate them with field data.
- **Next Steps**
  - Modeling activities are complete and being reviewed by participating BPOP members.
  - Final project summary being completed for distribution in upcoming weeks.



SALTWATER DISPOSAL (SWD) MODELING

- **Key Results:** modeling and simulation suggest a large overall storage potential in the formation; however, significant increases in pressure have been observed in certain areas of the formation.
  - Pressurization issues will likely increase as more SWD wells are installed and volumes of produce water requiring disposal continue to increase.
  - Pressurization of the Inyan Kara can be problematic when drilling new Bakken/Three Forks wells.
- **Next Steps: s**implistic models being developed to assist with estimating the zone of influence of SWD wells.
  - Could be used to assist in locating/siting SWD wells.



ANCILLARY ACTIVITIES

- **Statistical Analysis of Bakken Production Data**
  - 30 completion and geologic variables evaluated at 6- and 60-month cumulative oil production.
  - Quantified the relative effect of these variables on short- and long-term Bakken productivity.
  - Results summarized in presentation available on Members-Only Web site.
- **Remediation Support**
  - Providing information to the Hydrocarbon Remediation Task Force as subject matter experts.
  - Updated North Dakota Remediation Resource Manual to include brine and hydrocarbon impacts; being reviewed by BPOP members prior to distribution.

PROGRAM NEXT STEPS

- Input from member companies is being used to refine the focal points of our refrac efforts.
  - Refrac opportunities beyond barefoot completions?
  - Examine technical challenges relative to emerging technologies.
  - Compare and contrast refrac to infill drilling.

- A survey has been sent out to personnel at member companies to ensure BPOP is addressing the top priorities of the membership.


QUESTIONS?
Critical Challenges.
Practical Solutions.

CONTACT INFORMATION

Energy & Environmental Research Center
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

www.undeerc.org
701-777-5355 (Phone)

Charles Gorecki
Director of Subsurface R&D
cgorecki@undeerc.org


EERC
UNIVERSITY OF NORTH DAKOTA
Critical Challenges.
Practical Solutions.