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Energy & Environmental Research Center (EERC)

BAKKEN PRODUCTION OPTIMIZATION PROGRAM 2.0 (BPOP 2.0) UPDATE

Presented to Oil & Gas Research Council
Bismarck, North Dakota
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AGENDA

- Rich Gas Enhanced Oil Recovery (EOR) with Liberty Resources
- Facilities Modeling
- Fluids Characterization
- Year 3 Activities
- Final Report Review Process
- Report Status

RICH GAS EOR – HIGHLIGHTS

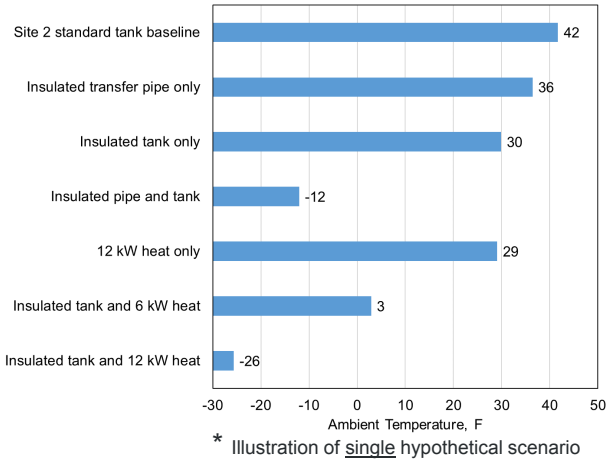
- **Lab studies of rich gas interactions with fluids and rocks**
  - The richer the gas, the lower the MMP.
- **Iterative modeling of surface and subsurface components**
  - Rich gas EOR predicted to not adversely affect surface facility operations.
  - Predicted incremental oil recovery >25%.
- **Pilot performance assessment**
  - Summer pilot tests (July–September) injected 24.6 MMscf into two wells over three injection periods.
  - Fall–winter pilot tests started November 20 and are ongoing. Injection into four wells planned at max. rate of ~2 MMscfd at wellhead pressure ~4000 psi.
  - Results are being analyzed and interpreted, models updated.

RICH GAS EOR – NEXT STEPS

- Rich gas injection anticipated to continue through the winter and spring.
- Fluid samples representing the reservoir and the surface processing facilities will continue to be collected to determine effects of rich gas injection on both.
- Laboratory experiments to determine the sorptive capacity of Bakken shale for rich gas components will be conducted.

FACILITIES MODELING

- **Impact**: Apply process-modeling tools to address Bakken-specific issues arising at production facilities.
  - Crude quality and shrinkage
  - Emissions
  - Safety
- **Products:** Whitepapers and presentations that address specific needs, including:
  - Tank battery emissions.
  - Wintertime crude vapor pressure limits.
- **Next Steps**
  - Continued participation in information exchange forums (TSG and others).
  - Develop new calculators as site configurations evolve.



* Illustration of single hypothetical scenario

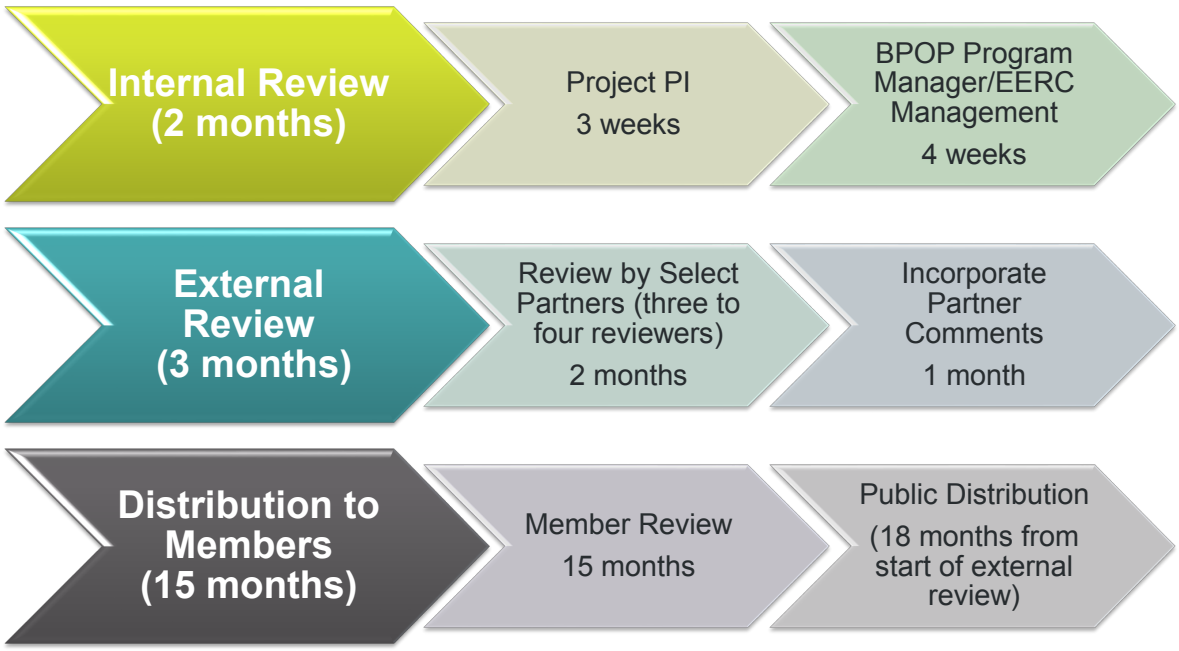
FLUIDS CHARACTERIZATION

- Coordinated with program leads to identify key information and data needed for ongoing and planned research efforts.
- Developed partnerships with key industry entities to obtain access to fluids data and information and site access for additional sample collection efforts.
- Supported a BPOP industry member conducting a rich gas injection EOR demonstration through periodic sampling and analysis of fluids potentially impacted through the EOR activity.
- Coordinated with a BPOP industry member, and initiated sampling and analysis activities on a stimulated and nonstimulated well for evaluating compositional differences that may indicate possible fluid migration pathways and possible sources of produced water in typical stimulated Bakken wells.

BPOP YEAR 3 ACTIVITIES – SUMMARY

- Improved oil recovery (IOR) encompasses any subsurface action that supplements the initial recovery profile of an oil well, including fluids injection for pressure maintenance, EOR, new stimulations, etc.
  - Reinjection of rich gas into parent wells – effects on offset wells
  - Refracs/IOR Workshop
- Subsurface activities
  - Data analytics and trend analysis
  - Reservoir characteristics and fluids database
  - Produced water management tools and general topics
- Surface activities
  - Facilities optimization
  - Fluids characterization
- Management
  - Program oversight, document control, Web site, etc.
- Reserve for possible U.S. Department of Energy match

BPOP 2.0 PRODUCT REVIEW PROCESS



BPOP 2.0 PRODUCTS

Title	Status
Process Modeling of Wellsite Production Operations	Public
Modeling and Simulation of the Inyan Kara Formation to Estimate Saltwater Disposal Potential	Partners only through April 2020
Bakken Refracturing Data Analysis	Under partner review; partners only through July 2020
Bakken Production Evaluation Using Multivariate Statistical Analysis	Under partner review; partners only through July 2020
Vapor Pressure Modeling of Cold Weather Modifications for Bakken Surface Facilities	Partners only through April 2020
BakkenSMART Fugitive Emissions Fact Sheet	Public
BakkenSMART Hydraulic Fracturing Fact Sheet	Public

QUESTIONS?

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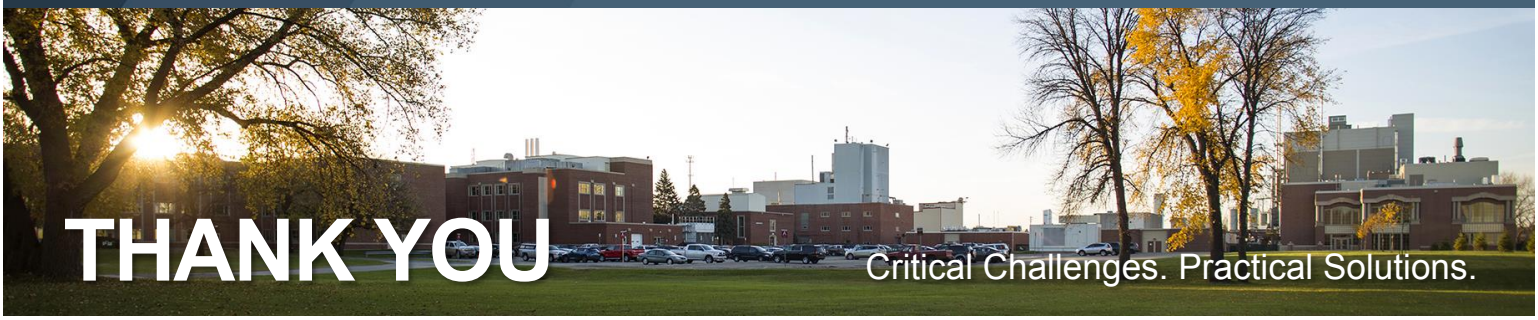


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