

Case Study

WaterWolf™ Dynamic Oil Recovery System eliminates toxic air emissions while reducing costs to treat produced water to less than \$US 0.01 per barrel for large Rocky Mountain operator



Handling the large volumes of water produced from an oil well throughout its life has long been a tall challenge for oil producers as they seek to operate safely and profitably—and extend the life of their producing assets. The success of new drilling and fracturing technologies amid ever-robust environmental standards has only heightened these challenges. The stakes are higher than ever as producers seek new and better ways to operate efficiently and harmoniously in the states and regions where they produce oil.

Background and Challenge

Marathon Oil Corp. sought help in optimizing water treatment and handling for its oilfield in Spring Creek, Wyoming. At 2,500 to 2,800 barrels of oil per day, the field has been a valuable contributor to America's oil production since it began producing in the 1930s. But like many aging oilfields, water production has steadily increased year over year, and today the field produces more than 90 barrels of water for every barrel of oil produced, or a water cut of close to 99 percent.

Like many producers, Marathon Oil skims as much oil as possible by conventional means, and then returns the water back underground to its origin in a well with good injectivity, thereby presenting no inherent environmental or operational challenges. However, because

of the well's close proximity to neighboring Yellowstone National Park and the region's shallow geothermal activity, produced waters contain large amounts of carbon dioxide (CO₂) and hydrogen sulfide (H₂S).

When the pressure of the water is reduced down to atmospheric in the oil skimming tanks, the CO₂ and H₂S gases come out of solution in much the same way that CO₂ is released from a can of soda when it is opened. Although the same phenomena happens naturally at the famous Yellowstone geysers a short distance away, engineers at Marathon Oil decided to search for a better way to handle the produced water. If they could find a way to skim the oil from the water while keeping it under pressure, the greenhouse and acid gases could be trapped in the water and sent back deep into the ground, reducing air emissions by thousands of tons each year.

"Environmental concerns were by far the driving force of the application at Spring Creek," says Mark Wolf, NOV's product line manager and the inventor of WaterWolf. "Reducing or eliminating the need to flare gases into the atmosphere was strong incentive to adopt a more modern approach, but the potential economic benefits of a better way of accomplishing a necessary task are also compelling for Marathon."

Challenges

Rocky Mountain operator sought a more efficient water treatment solution for its mature 2,800-BOPD production field.

H₂S and CO₂ emissions were high as a result of the naturally occurring gases in the region.

Chemical treatment costs were high; plant sought to reduce exposure associated with storage and transport.

Solution and Results

NOV deployed the WaterWolf Dynamic Oil Recovery System, the first installation of its kind in North America.

Eliminated H₂S and CO₂ emissions and associated flaring requirements.

Returned an additional 25 to 100 BOPD into the production stream while eliminating costly treatment chemicals.

Total operating costs for water treatment reduced to less than \$US 0.01 per barrel of water produced.

Dramatically reduced footprint of water treatment and handling process; ideal for compact spaces.

Current water treatment methods include moving large volumes of produced water to skim tanks for expensive chemical treatment, with resulting sludge and solids being stored and transported off site by third-party vendors.

The NOV Solution

The WaterWolf Dynamic Oil Recovery (DOR) system is an ideal fit for the Marathon Oil site. The WaterWolf is a complete water treatment system that recovers oil and removes suspended solids from produced water in a single stage of treatment without the use of chemicals. Discharged solids are oil free and nonhazardous—with superior effluent water quality over traditional treatment methods. And because the WaterWolf operates in a dynamic, pressurized, closed-loop system, no hazardous emissions or greenhouse gases are released, promising Marathon Oil a creative, turnkey solution to dealing with the naturally occurring gases inherent in the Spring Creek geology. Simple and quick to install and start up, the technology's compact size and weight—and relatively small footprint—are also attractive features for the mountainous terrain of the Bighorn Basin.

Results at Spring Creek

NOV's system was delivered and installed in May 2014, and the system operated for 18 weeks from May to September. WaterWolf has delivered impressive results in every major category of the pilot project:

- **Reduced air pollution.** The dynamic, closed-loop process eliminates the need to flare emissions of hydrogen sulfide and carbon dioxide.
- **Recovered more valuable oil.** The WaterWolf system recovered an additional 1 to 4 barrels of oil from every 10,000 barrels of water produced. For Spring Creek this equates to an additional 25 to 100 BOPD.

- **Reduced costs and risks of dealing with associated waste.** With the WaterWolf's single-stage technology, solids are removed separately from the oil, eliminating oily sludge to be stored and transported off site—and eliminating costly and hazardous tank cleanouts to remove accumulated tank-bottoms solids.

Based on these successful results Marathon Oil plans to move forward with two full-scale tests of the WaterWolf: a second 50,000-BWPD test at the Spring Creek field and an 8,000-BWPD test at the South Sugarloaf field south of San Antonio, Texas, a large play for Marathon Oil within the Eagle Ford Shale.



Marathon's oilfield sits in northwest Wyoming's Bighorn Basin, fewer than 60 miles from Yellowstone National Park and situated amid some of the country's most splendid natural beauty. With a century-long history of exploration and production in Wyoming and as the state's largest oil producer, Marathon Oil takes its stewardship responsibilities seriously and sought a progressive means of dealing with the naturally occurring gases lying beneath the Rocky Mountains.

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