Case Study: Pioneer Energy

Colorado-based engineering firm solves challenges of extracting profitable gases and elminating environmentally harmful natural gas flaring

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CASE STUDY: PIONEER ENERGY

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THE CHALLENGE

At many newly developed oil wells you'll find a tall pipe rising into the air with a long flame blazing brightly at the end. Fueling this flame is a high-energy natural gas mixture that emerges along with the crude oil.

The natural gas contains methane gas, ethane, and natural gas liquids (NGLs) like propane and butane. Capturing the mixed natural gas and processing it can yield usable methane gas plus marketable alkane products like liquid propane and butane, but practical considerations quickly intervene when trying to accomplish this.

Associated petroleum gas, as the raw natural gas is called, contains a wide variety of hydrocarbons which aren't useful until separated. The raw gas can't be transported by truck from the well site due to its high vapor pressure, and it can't be burned for power due to its inconsistent fuel quality. If transported by pipeline, wet gas must go immediately to a local processing plant.

Developed oil fields often have pipeline and gas processing equipment in place for separating the gas. But installing this infrastructure for a new oil well—particularly one in a remote location—is expensive and rarely cost effective. A solution in wide practice today is to simply flare (burn) the raw natural gas on site.

This is a common practice at oil wells, and in North America alone thousands of sites flare gas 24 hours a day.

Flaring natural gas is problematic. Today, public concerns about flaring are increasing, and regulatory intervention mandates its reduction. Eliminating the need to flare raw natural gas is increasingly important.

Flaring wet gas also gives up additional revenue from the well site. Extracted methane gas could fuel onsite power generators, or be processed and sold as compressed natural gas (CNG) or liquid natural gas (LNG). Flaring gas also eliminates potential income from extracted propane, butane, and other saleable NGL products.

From space, gas flares in the Bakken formation in North Dakota (left) are almost as bright as Chicago.

Colorado-based engineering firm Pioneer Energy planned to address the challenges and possibilities of liquids-rich natural gas with their Mobile Alkane Gas Separator (MAGS), a portable system that can be taken to oil wells and process the raw natural gas on site.

The MAGS system would be brought in before building any gas transportation or refining infrastructure. If a well was found to be productive, more permanent pipeline and gas processing infrastructure could then be constructed.

Pioneer Energy intended for MAGS to surpass existing onsite gas processing capabilities by delivering both

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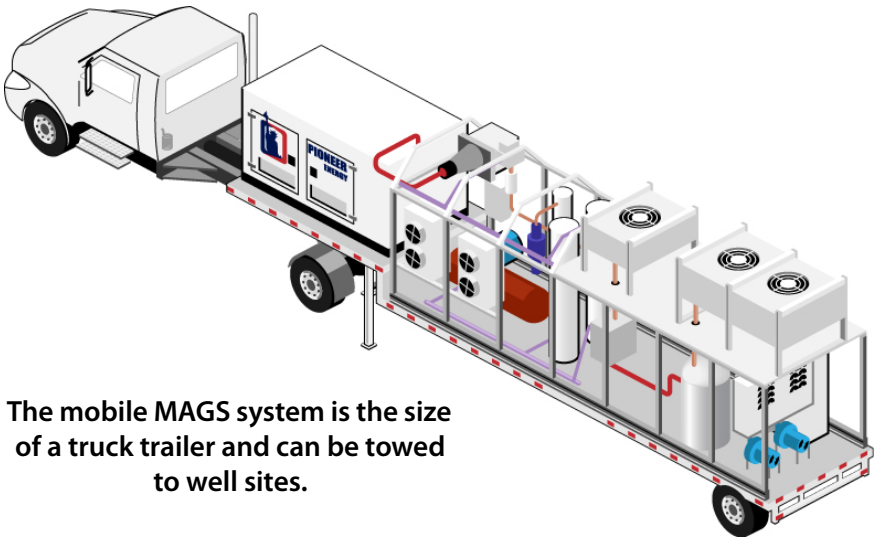
high-quality "lean" methane and "Y-grade" NGLs from the wet gas stream.

Lean methane consists of 80-90% methane and can be used directly in generators and other natural gas-powered engines. Y-grade NGLs have a low vapor pressure of no more than 250 psia at 100 °F (38 °C) and can be transported in regular propane trucks.

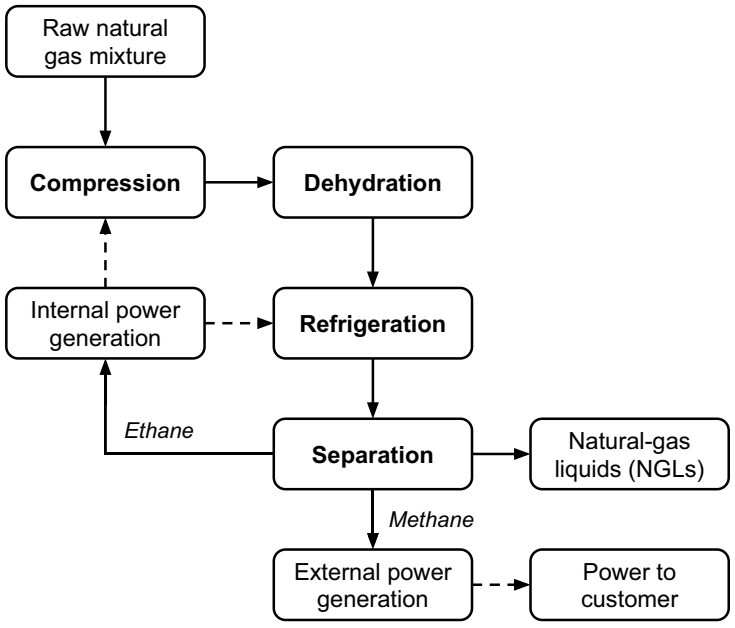
First, however, Pioneer Energy faced a significant engineering challenge: how do you reproduce—and exceed—the processing capabilities of an entire gas processing plant in a single, mobile system that can fit on a truck trailer?



The mobile MAGS system is the size of a truck trailer and can be towed to well sites.

THE SOLUTION

A wet gas processing plant uses compression, dehydration, refrigeration, and separation to split the original stream from the well into individual streams of methane gas, ethane gas, and NGLs like propane and butane.



Compression, dehydration, refrigeration, and separation are the key steps in processing liquids-rich, raw natural gas.

- The raw natural gas is first compressed and then dehydrated.
- The dry compressed gas is refrigerated down to very cold temperatures, causing the high molecular weight natural gas components to liquefy.
- A miniature distillation column system then separates the natural gas mixture into three streams.

Pioneer Energy improves this process by focusing on refrigeration. By lowering the temperature of incoming gas to an optimal temperature range—as low as -80 °C depending on the gas composition—methane and NGL products that emerge from separation already meet commercial standards for use and transport.

The pipeline-quality methane produced can power an onsite power generator, replacing diesel-powered generators and the costly fuel required to run them.

NGLs like propane, butane, pentane, and hexane that MAGS produces can be immediately placed in containers and transported to market for sale.

The ethane stream that emerges, typically considered a waste product, is used to power the MAGS unit itself. Using all components of the wet gas stream generates additional revenue for the well operator, and nearly eliminates gas flaring.

Opto 22 PAC controllers and SNAP I/O modules are used to monitor and control all processes.

THE CONTROL SYSTEM

MAGS is a complex system, and Lead Controls Engineer Andrew Young needed a control system to make components work together.

Young wanted compact and reliable hardware with low power requirements and support for a wide range of I/O signals and communication protocols. He found that Opto 22 hardware and software hit this target, and did so affordably.

"To interface with all the equipment on MAGS," says Young, "we use nearly all of Opto 22's I/O modules plus the SNAP PAC System's built-in Modbus protocol support."

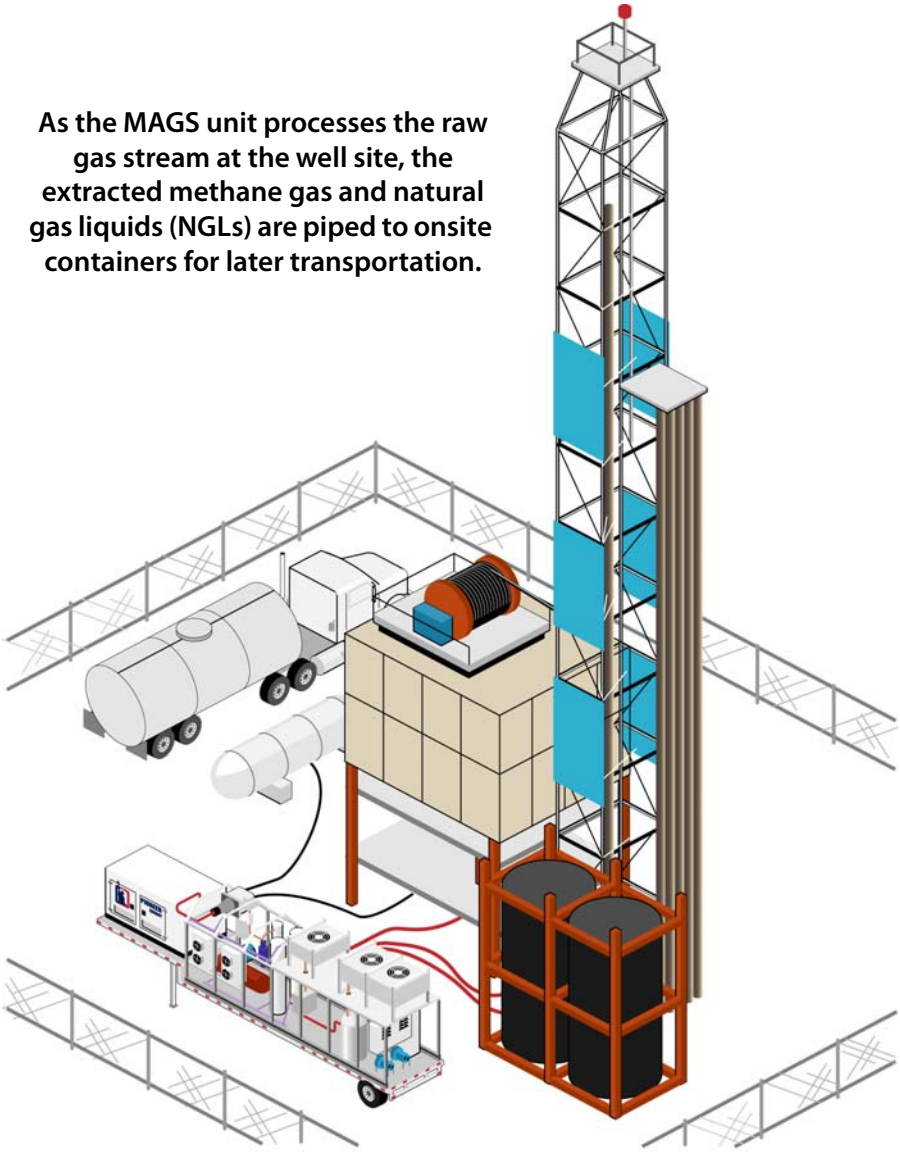
The Opto 22 system automates the entire system, monitoring and controlling temperature sensors, flowmeters, pressure transmitters, control valves, the generator, refrigeration compressors, a gas chromatograph, process heaters, and other devices.

The MAGS system is deployed at well sites that are often remote and usually unmanned, and unscheduled maintenance calls are costly. Stable and reliable unattended operation is a competitive advantage for Pioneer Energy, and Young says the Opto 22 system's reliable operation and built-in support for multiple communications protocols are key in allowing a MAGS system to operate autonomously.

To commission or troubleshoot a MAGS unit in the field, Pioneer Energy uses Opto 22's *groov* View mobile operator interface system. *groov* View lets an operator or technician securely connect to the MAGS unit's control system with a tablet or other mobile device and adjust settings in real time.

Opto 22's presence also extends to Pioneer Energy's Lakewood, Colorado operations center, where control

As the MAGS unit processes the raw gas stream at the well site, the extracted methane gas and natural gas liquids (NGLs) are piped to onsite containers for later transportation.



room operators use Opto 22 PAC Display HMI software to remotely monitor and manage MAGS units deployed throughout North America.

"Pioneer Energy," says Young, "has based a lot of its technology on adding value to waste streams. We see flare gas as another potential waste stream, and remote communications and a reliable controls platform let us convert that into a resource."

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- Andrew Young, Lead Controls Engineer

ABOUT OPTO 22

Opto 22 was started in 1974 by a co-inventor of the solid-state relay (SSR), who discovered a way to make SSRs more reliable.

Opto 22 has consistently built products on open standards rather than on proprietary technologies. The company developed the red-white-yellow-black color-coding system for input/output (I/O) modules and the open Optomux® protocol, and pioneered Ethernet-based I/O.

In early 2013 Opto 22 introduced *groov* View, an easy-to-use IoT tool for developing and viewing mobile operator interfaces—mobile apps to securely monitor and control virtually any automation system or equipment.

Famous worldwide for its reliable industrial I/O, the company in 2018 introduced *groov* EPIC® (edge programmable industrial controller). EPIC has an open-source Linux® OS and provides connectivity to PLCs, software, and online services, plus data handling and visualization, in addition to real-time control.

All Opto 22 products are manufactured and supported in the U.S.A. Most solid-state SSRs and I/O modules are guaranteed for life.

The company is especially trusted for its continuing policy of providing free product support, free training, and free pre-sales engineering assistance.

For more information, visit opto22.com or contact **Opto 22 Pre-Sales Engineering**:

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