



ITT

PUMPLINES

Innovation ... Technology ... Leadership

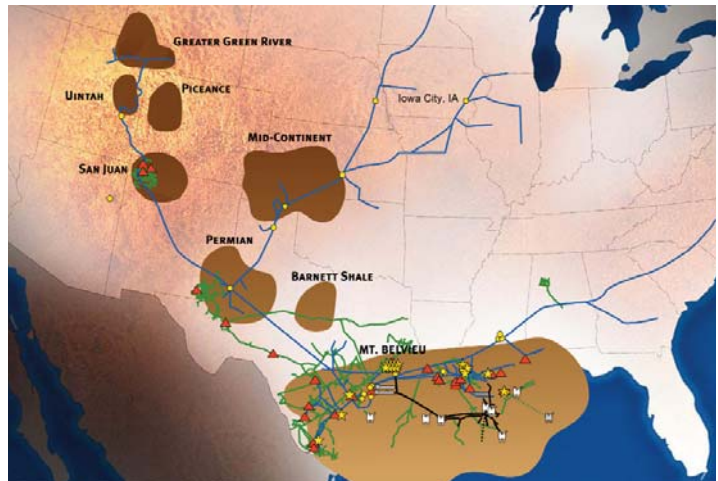
A newsletter for users of pumps, controls, monitoring and maintenance services
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Innovative Pumping System for Propane Cavern Service

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Enterprise Products Partners L.P. is a leading North American provider of midstream energy. Located in Houston, Texas, Enterprise provides transportation services to producers and consumers of various hydrocarbon products, natural gas liquids, and crude oil. A major segment of Enterprise's business services is pipeline transportation. These pipelines are both on and offshore and have a combined length of 32,670 miles.

The onshore pipelines transport product from production locations to fractionation facilities and then on to the end user. Enterprise's operating margin for its pipeline business is generally dependent upon the volume of product transported and the fee schedule for



their customers.

Liquefied Propane (LP) is transported along two of Enterprise's longest pipelines: Enterprise Dixie Pipeline and Mid-America Pipeline Systems. The Mid-America Pipeline runs from New Mexico to Wisconsin. One of the Mid-America propane storage caverns is located in a rural farm community outside of Iowa City, Iowa. Here, propane liquid from the pipeline is stored in a large underground salt cavern approximately 550 feet underground. The cavern stores the propane at vapor pressure (100 psig) in order to ensure that the product remains in the liquid phase. To meet the high volume demand, the propane is pumped in liquid phase from the caverns into the pipeline for transportation.

Traditionally, vertical line shaft turbine pumps have been used to pump liquid propane from the caverns. These vertical pumps are up to 550 feet in length. Just imagine a vertical pump that is almost two football fields in length! With a vertical pump that long, removing the pump for overhaul is a laborious process, not to mention the high cost of repair.

Enterprise decided to replace one of the three turbine pumps at the Iowa City cavern. Enterprise Houston Engineering called on ITT Goulds Pumps to consult on the idea of installing a vertical submersible pump, in lieu of the

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Feature

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vertical line shaft design. Motives for the change were to eliminate the need for mechanical seals, eliminate seal emissions, increase MTBR, and reduce the “in and out” costs incurred during repair. In our early discussions with Enterprise, a few challenges surfaced in regard to using a “submersible design” on this service.

The Challenge

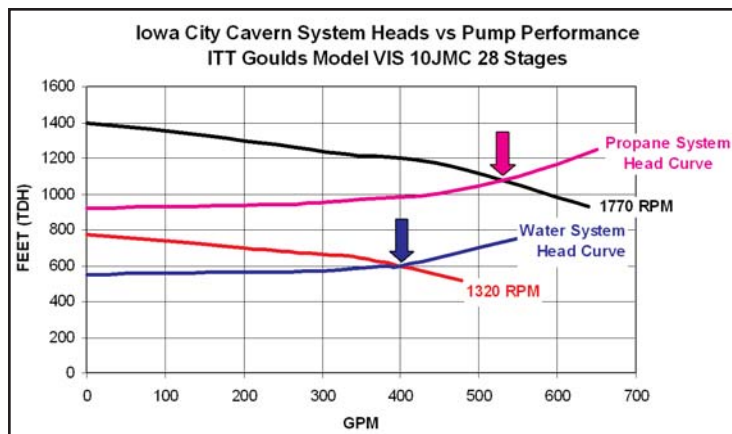
When maintenance is performed on a cavern pump, the cavern needs to be sealed in order to contain the propane in the cavern. The cavern is sealed by filling the pump caisson with a column of water 231 feet high. The water column prevents the propane from escaping up the caisson to atmospheric pressure. Once the water column is in place, the discharge elbow flange/head at the surface can be removed, allowing the pump to then be removed for overhaul without the risk of propane leaks or phase change of the LP. Once pump maintenance is complete, the repaired pump is installed back into the caisson and the water must be pumped out of the caisson to a surface tank.

In the past, Enterprise had been pumping the water out of the caverns at a synchronous speed via the same vertical pumps used to pump the propane. In this situation, the pump motor horsepower rating needs to be sized to pump water. Because liquid propane has a 0.51 specific gravity (s.g.), the horsepower requirements to pump water at 1.0 s.g. is double that of propane. Since the motor on a vertical line shaft pump is mounted above ground, having a 250HP motor installed to accommodate the higher water power demand was not a problem. This motor sizing would cause a big challenge for a submersible motor mounted in an underground cavern with a limited entry hole diameter in the caisson

(inside diameter).

We started by first selecting the pump and motor based on the propane hydraulics of 525 GPM @1100 FT (differential head through the pump discharge bowl assembly). This rating was supplied by the customer and based on the old pump performance. The best selection was a Goulds Model VIS 10 JMC 28 Stage pump operating at 1770 RPM. Using this pump on a propane service of 0.51 specific gravity, would require a 125HP motor. However, if operating this pump in synchronous speed with water, a 250HP motor would be required on the submersible. We discovered quickly that a 250HP submersible motor was too large to fit in the caisson. The initial cost impact by using the 250HP motor would also make the project payback impractical.

Before Enterprise pulled the plug on the submersible pump idea, we investigated an alternative solution. We looked at the system head based on two different requirements; one for propane and one for water. We determined the system head curve for pumping water to atmospheric pressure. The pump’s water system-head-curve is very different than the propane system head curve. The reason for this is that propane is being pumped into a pressurized pipeline and water is pumped to atmosphere. By looking at the two system head curves together (water and propane), it was determined that extreme throttling would be required when pumping water at synchronous speed. In order to handle two different system head curves, we decided to determine the non-synchronous speed that would be required to pump water out of the caisson. We turned to the system head curve data. We determined that a speed of 1320 RPM would move water out of the cavern at an acceptable capacity and that we would not overload a 125HP motor. Since there would be no need for excessive throttling at the lower speed, a 125HP motor was applicable for both fluids when used in variable speed.



System Head Curves and Variable Speed Pump Performance for Water & Propane

Feature

Innovative Pumping System **Continued...**

The PumpSmart® Solution

The solution was to operate the pump at a synchronous speed of 1770 RPM when pumping propane and 1320 RPM when evacuating the water. To accomplish this, we introduced Enterprise to ITT's PumpSmart variable frequency drive technology. We explained that by using PumpSmart intelligence, we could operate at two different speed set points. Using a straight forward configuration, the standard dual set point functionality could be enabled, thus allowing a single 125HP VIS in the cavern to pump both liquids.

During this phase another challenge surfaced. The submersible motor required a start-up current inrush that is 4x the FLA (Full Load Amps) even when using a soft-start system. Since PumpSmart has soft start capabilities, we could optimize the motor speed ramp rate. We calculated that this application would need a 250HP drive configuration to handle the inrush current on the 125HP motor.

Enterprise placed the order with ITT for the 125HP VIS 10JMC with 28 Stages and the 250HP PumpSmart PS200. With a tight schedule, ITT Goulds Pumps Vertical Products Operation (VPO) was able to get the pump to Iowa in less than three months. The old pump was removed and the new VIS was installed. A VPO field service technician was on site to assist with installation.

In the controls arena, the PumpSmart was wired and configured for the dual speed service. The day prior to start up, we were on site in Iowa to help Enterprise configure the parameters that would allow two way communication between the drive and the pipeline SCADA communication system. This was accomplished by using the basic analog inputs and outputs



125HP proves to be a tight fit into the pump caisson.

that come standard with the PumpSmart PS200 firmware. With the pump installed and the PumpSmart PS200 configured, it was time to push the button.

Would our theory work? Would the PumpSmart be the solution to the dual duty dilemma?

Yes!

The pump evacuated the water at 1320 RPM. The water was evacuated from the cavern in less than four minutes. By watching the power input on the PumpSmart keypad, we were able to



Enterprise Engineer, Kevin Dostal, checks the power draw from the PS200 key pad.



Goulds Model VIS 10JMC 28 Stage pump is lifted into place for installation.

Feature

Innovative Pumping System **Continued...**

watch the transition from water to propane via the power draw (density change of liquid in the pump). Once the cavern water was evacuated and propane was being pumped, the Enterprise crew manually closed a bypass valve to divert flow into the pipeline. This was done without shutting down the pump. At this exact moment, the dual set point switch on the PumpSmart was toggled to full synchronous speed of 1770 RPM and we were now moving propane into the pipeline. The Wisconsin facility called to confirm a steady flow of propane upstream.

Over a year has past since startup and Enterprise is very happy with the new pump system. They are so satisfied with the system that Enterprise placed a second VIS order with ITT Goulds Pumps to replace the second pump system in Iowa City. The new pump arrived in time for the beginning of the home heating season when propane demand increases.

The ITT Goulds Vertical Pump product and ITT PumpSmart product proved to be the solution that Enterprise needed in Iowa City. By understanding the customer's system curves and combining this with our knowledge of how these system head curves work in relation to centrifugal pump curves, we were able to be a solutions provider for Enterprise.

This project was a win-win for both customer and supplier. A value added, one stop shop, at its best...



Head/Discharge elbow lowered onto caisson.



Final installation.

Correction

We apologize for misspelling Keith Koster's name in the last edition of the Pumplines. Keith is located in Los Angeles and is a member of the Project Management Group. The GPM team oversees all key project parameters and provides our customers a single point contact.