Solar-Powered CRP® Pumping System

Unico continues its tradition of oilfield innovation with development of the CRP® Crank Rod Pump, an ultracompact sucker-rod pumping system that can be powered by solar energy. The economical CRP® system is intended for shallower, low-flow wells, particularly those in remote locations.

Much like the LRP® Linear Rod Pump, the CRP® system eliminates the cumbersome mechanics of conventional pumping apparatus. It uses a simple crank mechanism to convert variable-speed rotary motion into vertically reciprocating motion that drives the rod string. The unit mounts directly to the wellhead and is compact, lightweight, and easy to transport and install.

The CRP® system can operate at very low speeds to keep low-volume wells producing without pumping off, making it the ideal solution for reworking legacy wells. It can easily be moved from well to well for temporary installations or to prove reserves. Sophisticated SRP sucker-rod pump control software optimizes production while protecting the pumping system.
The unique ability of the CRP® system to operate using solar energy makes it an environmentally responsible choice for locations isolated from the power grid. Flywheel energy storage levels power demand, while a power utilization control ensures that the entire output of the solar collecting array is utilized at all times, allowing the unit to pump in a broad range of solar radiation. A battery option is available for overnight carryover. Solar operation is quiet and requires little maintenance compared to gas-powered engines.

If desired, the system can be configured to operate with an engine-driven generator. A peak power limiting feature extends engine life and allows use of a smaller generator by preventing stalling and by minimizing the wear caused by repeatedly revving the engine to accommodate load fluctuations.

As with all Unico oil and gas products, the GMC™ Global Monitoring and Control service is available to provide powerful Web-based real-time monitoring, data analysis, automated reporting, and alarm notification.

For more information about the CRP® system or solar-powered pumping, please contact us.

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**Technically Speaking**

**Controlling Casing Fluid Level in Electric Submersible Pumps (ESPs)**

by Rick Tennessen oil and gas division manager

In the last issue of Solutions, we examined the use of an automated, sensorless method of measuring casing fluid level in an electric submersible pump (ESP). We showed that fluid level can be determined continuously without using a downhole pressure sensor. In this issue, we’ll take a look at the natural extension of that capability—automated fluid level control.
Fluid level control is a powerful concept. Preventing pump-off conditions with an ESP pump is difficult with manual speed control since underload fault limits are difficult to determine and subject to human error. The resulting cyclic operation is extremely inefficient. Automated casing fluid level measurement and control completely protects the pump, maximizes fluid production for changing inflow characteristics, avoids lost production due to underload shutdowns, and minimizes the recovery time from power outages.

The viability of sensorless fluid level automation was demonstrated on ESP wells in western Texas. In one test, closed-loop fluid level control was compared with manual control. Fluid level measurement and control software was installed on a well already equipped with a Unico ESP variable-speed drive. Analog sensors were used to record tubing and casing pressure at the surface. The drive was set to sample casing fluid levels every 15 minutes associated with changes in pump control modes, pump operating speeds, and casing fluid level setpoints. Fluid level data was recorded with the drive in both manual speed control and closed-loop fluid level control.

Under manual speed control, the event history log recorded that the well had been going down on underload faults as often as nine times per day, as shown below in the first circle chart of motor current. The pump was running at a speed of 61 Hz or about 3,600 rpm, which produced a flow of 360 bpd. Unfortunately, the well was only capable of yielding 300 bpd. The pump was shutting down every couple hours, then waiting a preset one-hour delay before restarting.

Circle charts of motor current with and without fluid level control showing
Cyclical operation is eliminated by regulation. When placed in casing fluid level control mode, the drive was given a fluid level setpoint of 300 feet and run for a day. The pump automatically sought the correct speed of about 3,000 rpm and settled in within five hours to maintain the desired fluid over the pump. Under closed-loop control, the drive maintained adequate fluid over the pump and prevented underload faults, as seen in the second circle chart above. The fluid level setpoint was then varied from 100 to 300 to 50 feet to evaluate the response. Changes in the desired fluid level were quickly and automatically achieved by the drive. The response was slightly underdamped to both increases and decreases in the request level with a time constant of about two hours. While actual production was not measured, there was likely a significant increase running in level control versus the original cyclic operation. Average well flowing pressure was certainly reduced by continuous operation, and no production was lost by having to refill the tubing.

Casing fluid level for both manual speed control and automatic fluid level control (left). The negative fluid levels just prior to the underload fault detection exhibit a distinctive signature associated with gas entering the intake of the pump. (Right) Fluid level response as requested setpoint changed from 100 to 300 to 50 feet.

Closed-loop control also allows a well to recover gracefully from a power outage. In tests conducted on another well, the control rapidly restored the desired fluid level once power was restored. The charts below show the fluid level and fluid flow response to a temporary outage.
Casing fluid level and pump speed response to a power outage.

Closed-loop control can also be achieved using a pump intake pressure sensor. The drive uses intake pressure, along with other well and pump parameters, to estimate pump fluid flow and casing fluid level.

Casing fluid level control is most advantageous on wells with significant variation in the inflow characteristics, such as those found in coal-bed methane (CBM) production and those involving various types of enhanced oil recovery stimulation.

To learn more about sensorless fluid level control, please contact us.
expensive to extend electrical service to the site. One alternative is to use an engine-driven generator or “genset.” In so doing, however, the producer essentially becomes its own utility and assumes a host of additional expenses that may not be apparent at the outset. Over the lifetime of the system, these expenses may far outweigh the initial expense of installation. To help get a handle on these costs, Unico offers the Genset Financial Calculator, a simple online tool that lets you compare the lifetime costs of using a genset versus running the system electrically.

Much like an automobile, a genset requires fuel and oil, periodic maintenance, and eventually, when enough runtime “miles” are accumulated, an engine overhaul. Given the continuous operation of most units, this can be every two to three years. The Genset Financial...
Calculator compiles these service intervals and costs and, using basic pumping system information and energy prices, determines the energy consumption and total annual cost of each alternative, assuming around-the-clock operation. It then derives the net present value for each alternative, taking into account the initial purchase investment, system life expectancy, inflation rate, as well as the opportunity cost of spending the money up front rather than investing it. The result is a comparison of the total cost of each system, including all future expenses, in today's dollars.

The calculator defaults to representative values taken from field experience. Costs will vary by locality and other factors, so feel free to enter your own. The calculator allows you to evaluate what-if scenarios to determine the best solution for your situation. In the online example, a genset costing $10,000 is compared to electrical service costing $5,000 to install. Over the 20 year life of the system, the genset costs, in today's dollars, over $220,000 versus nearly $79,000 for electrical service.

### Typical Genset Service Data

<table>
<thead>
<tr>
<th>Service</th>
<th>Interval</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine Service</td>
<td>2 months (without lube tank)</td>
<td>$100 materials (plugs, oil, etc.)</td>
</tr>
<tr>
<td></td>
<td>3 months (with lube tank)</td>
<td>$100/hr. labor, including travel</td>
</tr>
<tr>
<td></td>
<td>Labor:</td>
<td>0.5 to 3.5 hours/unit</td>
</tr>
<tr>
<td></td>
<td>Service several units/day in a group</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Travel:</td>
<td>0.5 to 1.5 hours to a group</td>
</tr>
<tr>
<td>Alternator Replacement</td>
<td>4 to 6 months</td>
<td>$500</td>
</tr>
<tr>
<td>Engine Rebuilding</td>
<td>20,000 to 24,000 hours</td>
<td>$6,500</td>
</tr>
<tr>
<td>(350 cubic inch)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Unico offers two energy-efficient remote power options, including a gas-powered generator that operates from wellhead natural gas, rather than purchased gas, and an even more economical solar-powered pumping system that is ideal for shallower applications (see article above).


Questions? Just [contact us](mailto:contactus@unicous.com).

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Look for the following articles in upcoming issues of *Oil & Gas Automation Solutions*:

- Field tests of methods to eliminate rod pump gas locking and interference
- Reducing power consumption and improving power factor of beam pumps
- Using a torque economizer mode to improve efficiency and reduce gearbox stress
- Control options to ride through power disturbances
- Loss of methane gas production due to overpumping CBM wells
- Use of low-profile CRP® and LRP® pumping units with traveling irrigation systems
- Air counterbalance increases LRP® linear rod pump lift capacity