■ Tidelands Oil Production Company installed a Waukesha VHP P9390 GSI engine and pump package. The 2000 hp (1491 kW) natural gas-fueled engine drives a high-pressure centrifugal pump that's being used to inject water into several old oil reservoirs. The package replaced one of three electric motor-driven units previously used.

FUEL CONTROL KEY TO MEETING EMISSIONS LIMITS

Water Injection Application Opts for Engine Rather Than Electric Power

Enticed by a grant offered by the state of California's Energy Commission, Tidelands Oil Production Co. of Southern California found a way to make good use of on-site gas and lower its utility bill at the same time. Tidelands recently installed a Waukesha Engine VHP P9390 GSI and pump package fueled by gas previously flared into the atmosphere. The package replaced an electric motor-driven unit, but it was only after controls from Continental Controls Corp. were installed that the engine operated efficiently within the strict air quality limits.

Air quality limits in California are among the most stringent found anywhere. The Waukesha VHP P9390 GSI engine emits below 1 ppm NO_X and 12 ppm CO, well below half of the strict limits using a nonselective catalyst supplied by DCL International, designed for a rich-burn engine. The CO_2 varies with the Btu of the gas, and the Continental fuel valve quickly increases or decreases the amount of fuel entering the carburetor allowing the engine to run within the tight limits so the exhaust oxygen level stays the same. The site uses GE/Fanuc controls, and the engine and pump were packaged by Pump Systems International, Houston, Texas, U.S.A.

The recently completed project is unique for Tidelands in that the other water injection pumps on-site are driven by electric motors. The decision to use a natural gas engine-driven pump was prompted by two things: first, on-peak electrical power is very expensive in Southern California, but more important is the fact that the engine could perform within limits running on nonutility gas recovered on-site and associated with the oil production. The 2000 hp (1491 kW) natural gas-fueled engine drives a high-pressure centrifugal pump used to inject water into several old oil reservoirs. The pump boosts the water from 70 to 1800 psi (5 to 124 bar). The water is reinjected in order to force more oil out of the wells, thereby increasing oil production.

"Where you find oil, you'll find gas," explained Rick Cassinis, chief facilities engineer, Tidelands Oil Production. "Unfortunately, the gas is not of the best quality at this site because it has been contaminated over the years with a high CO_2 concentration of anywhere from 40% to 60%. Therefore, it's not commercial quality and we can't sell it as a marketable commodity, like the oil. So we either have to flare it, or find another use for it such as using it as fuel for a natural gas engine. The idea of displacing an electric motor-driven pump with a gas-fueled engine makes a lot sense."

There is also one more incentive to the project: The state of California Energy Commission had recently announced a rebate for projects using noncommercial gas to displace on-peak power. "That fit us like a glove," Cassinis recalled. "We got the approval for the project in three weeks, along with a grant of approximately $325,000 in rebate money once the project was completed. We were fully operational in October, once all the air quality permits were in place. The total cost of the project was around $1.6 million."

Cassinis notes that the emissions reductions required by the SCAQMD (Southern California Air Quality Management District) are significant, and the engine had to come in within the strict levels set (7.5 ppm NO_X and 60 ppm

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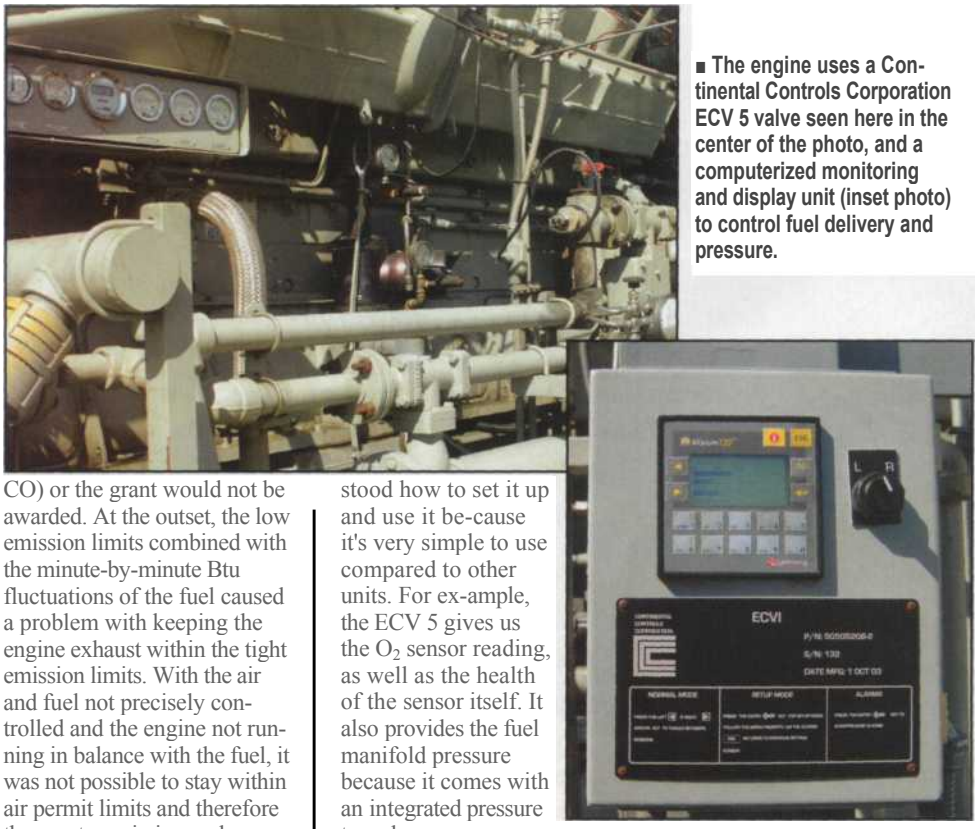

■ The engine uses a Continental Controls Corporation ECV 5 valve seen here in the center of the photo, and a computerized monitoring and display unit (inset photo) to control fuel delivery and pressure.

CO) or the grant would not be awarded. At the outset, the low emission limits combined with the minute-by-minute Btu fluctuations of the fuel caused a problem with keeping the engine exhaust within the tight emission limits. With the air and fuel not precisely controlled and the engine not running in balance with the fuel, it was not possible to stay within air permit limits and therefore the grant was in jeopardy.

The solution came with the installation of a Continental Controls Corp. ECV 5 valve which easily handled the wide Btu range and at the same time reduced emissions to within the limits. San Diego, California, U.S.A.-based Continental Controls Corp. produces controls systems and components for gas turbines and reciprocating engines. The Continental control unit was suggested by Stewart & Stevenson, the local Waukesha Engine distributor.

"The wide range of the Btu value in the gas causes a real problem for most air-fuel ratio controllers," Cassinis said. "For the catalyst to be able to properly eliminate the NO_X and CO, the air/fuel mix has to be precisely controlled. Since we've added the Continental ECV 5, the engine has been able to react to these changes more quickly than ever before.

"Installation was also quick, compared to a previous control that took almost two weeks to install and never really did handle the fuel mixture problem. The ECV 5 was installed within two days, and our operators quickly understood how to set it up and use it be-cause it's very simple to use compared to other units. For ex-ample, the ECV 5 gives us the O_2 sensor reading, as well as the health of the sensor itself. It also provides the fuel manifold pressure because it comes with an integrated pressure transducer.

"We instantly can tell if the O_2 sensor is out of range, then there is probably some-thing going on. The ECV also monitors the pre- and post-catalyst temperatures to ensure that the catalyst is working well. On some systems, this would require an additional monitor."

Tidelands is proceeding on the next phase of the project, without any funding, that involves retiring several smaller engines, from different manufacturers, at a nearby production site by the end of the year. This is due to emissions rules and the fact that they are more than 20 years old and require high maintenance.

According to Cassinis, the engines can be replaced with electric motors, but he feels that new gas engines would be better. "There are two reasons for this. One is that we can use the noncommercial-grade gas we get from the wells to run them. We don't want to flare this gas and it would cost too much to remove the CO_2 in order to sell it to the utility. Second, we can replace five smaller engines with one Waukesha VHP, similar to the one we have running now.

"Well also use the ECV 5 on future engine applications because it has the ability to alert us if there's a problem with **the** O_2 sensor and that it needs changing," said Cassinis. "In the meantime, until we make a trip to the site and change it, the valve goes into a default pressure mode that keeps the engine running in an acceptable range, unlike most other systems that would immediately go out of compliance.

"The big surprise is that the Btu value changed constantly not only from well-to-well, but even at different times during the day. But the engine runs well 24/7, and is only taken down for maintenance. So far we've achieved more than 95% runtime availability.

"We've found this is a good way to get rid of the gas, if you can meet the air quality limits, plus, we're saving on electrical energy charges. There's a lot of noncommercial gas available out there, and using it is a 'win-win' for everybody."

Tidelands Oil is a Long Beach, California, U.S.A.-based operating company jointly owned by a Taiwanese enterprise and by Paramount, a local manufacturer of asphalt and jet fuel. The crude oil is pumped from a site near the harbor, the Wilmington Oil Field. Managed by the City of Long Beach Department of Oil Properties, the sulfurous, or sour; crude has the basic-make-up that makes it ideal for producing both of the above-mentioned commodi-ties. The field is owned by and is a source of revenue for the State of California, the City of Long Beach, and the Port of Long Beach, as well as many smaller owners. The site produces 7000 barrels of heavy, sour crude each day. The thick oil is highly asphaltic, but can be successfully treated at local refineries.

Tidelands won the bid to produce on a portion of the field, which has been in production for more than 30 years. There is a lot of activity on the many sites in the area and on nearby offshore platforms. ■

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■ The entire engine and pump package uses a GE/Fanuc control system for overall control and monitoring functions.