■ **The Compliance Controls MEC-L Lean-Burn Air-Fuel Ratio Control System has dramatically cut the rate of engine detonation and engine failure at San Juan Basin coal seam methane compression stations, Compliance Controls reports.**

REDUCED DETONATION CUTS MAINTENANCE COSTS

Air-Fuel Ratio Controller Helps Engines Deal with Changing Conditions

Few things can put a bigger dent in your day than catastrophic engine failure. In the Four Corners area of America's west, Compressor Systems Inc. (CSI) has found one way to help prevent such breakdowns caused by changes in fuel composition and ambient temperature. Compliance Controls' MEC-L Lean-Burn Air-Fuel Ratio Control (AFRC) System, introduced during 2004, has dramatically cut the risk of costly engine damage and failure caused by detonation, Compliance Controls reports.

"With the savings on equipment repair and replacement, these MEC-L systems will pay for themselves and then some," said Bill Clary, vice president of Compliance Controls.

In the San Juan Basin, near Farmington, New Mexico, U.S.A., CSI operates coal bed methane compression systems for marquee producers including ConocoPhillips/Duke Energy Field Services and Devon Energy.

Before the summer of 2004, both the harsh operating environment, with its swings from blazing heat to bitter cold, and the makeup of coal bed gas were causing high rates of engine failure, Clary explained. "The problems in the San Juan Basin are probably familiar to other companies involved in coal bed methane extraction or operating gas compression systems in desert environments," he said.

First, consider fuel composition. Methane drawn from coal seams tends to be loaded with CO_2, which makes up as much as 30% of wellhead gas, said Compliance Controls Technical Services Manager, Pat Runnels.

When the lean-burn engines that drive compressors are running at full-load, the CO_2 isn't a problem. The air-fuel mix can be set to compensate for the CO_2 concentration. But at engine start-up, the picture changes.

When engines and compressors are shut down, CO_2 tends to settle in the well bore, pushing methane up toward the top, Runnels explained. At engine start-up, the initial fuel drawn into the cylinders is much richer in methane than in normal operation. Unless you've set the air-fuel mix to compensate, "in effect, your lean-burn engine is running rich," Runnels said.

The result: detonation — the sudden, high-pressure, high-temperature "explosion" of end-gas remaining in the cylinder after combustion. Engine damage from such "explosions" often starts with detonation "hammering," which causes metal fatigue and mechanical wear. Worse yet, a detonating engine tends to burn lube oil off the cylinder wall, increasing friction. Severe detonation can produce a dry cylinder wall and a tight piston and lead to piston "galling," which is the abrasion of metal off the dry cylinder walls and the piston itself. Some researchers say that under a microscope, a galled piston or cylinder wall looks a little like Swiss cheese.

Prolonged detonation also tends to "snowball," with detonation leading to more frequent detonation, raising cylinder temperatures ever higher until "pre-ignition" occurs.

Pre-ignition, often confused with detonation, is the sudden, high-temperature combustion of fuel before spark firing, which can literally cause piston crowns to melt through in seconds. "When an engine is in serious detonation, you'll all of a sudden find tennis ball-sized holes in your piston crowns," Runnels said.

Beyond the abundance of CO_2, the San Juan Basin's desert environment itself also contributes to the risk of engine failure, Runnels said. Dramatic swings in air temperature create equally

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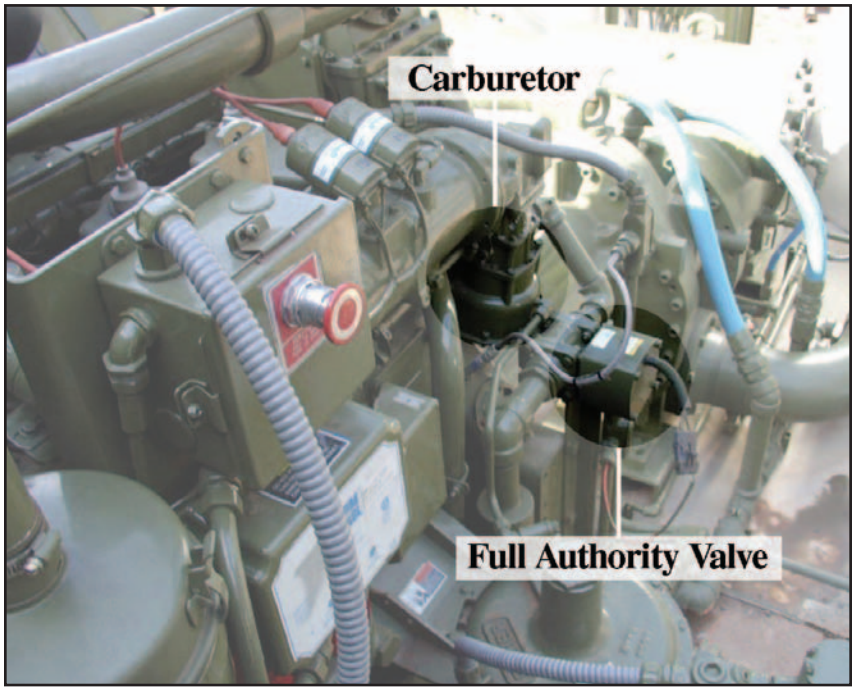

■ **For its MEC-L Air-Fuel Control System, Compliance Controls' San Juan Basin customer chose the "Full Authority" valve option, shown here. The Full Authority valve precisely regulates all engine fuel prior to introduction to the carburetor via a system-controlled butterfly valve.**

dramatic shifts in near-ground atmospheric oxygen density. Without compensating adjustments in the air-fuel mix, detonation, engine damage and catastrophic failure are all-too-common results, Runnels explained.

"Once we were aware of this situation, we knew that the answer was an air-fuel ratio control that could compensate for changes in fuel composition and intake manifold air temperature," Clary said. He said that tests against a competitor's system in June 2004 led to the operator selecting a Compliance Controls MEC-L.

Runnels said that operators like the fact that the MEC-L is easy to operate. "You don't have to keep an eye on the system, adjusting it to different conditions. It's all automatic. Basically, you can set it and forget it," he said.

Engineered specifically for lean-burn, spark-ignited, natural gas engines, the MEC-L is equipped with closed-loop, exhaust oxygen feedback control as well as open-loop valve positioning based on engine speed and load. The system minimizes engine emissions, maximizes fuel efficiency, and helps maintain engine performance by automatically adjusting the air-fuel mix to compensate for varying engine loads, speeds, fuel quality, ambient temperature and barometric pressures, Clary explained.

The system also offers comprehensive, "failsafe" diagnostic and troubleshooting capabilities, covering no fewer than 44 critical engine and emission control system parameters, from sticking valves and engine detonation to spark plug operation, according to Clary.

The MEC-L is built on a Microsoft Windows platform, according to Terry Baldwin, vice president of Compliance Controls. "For operators who want to take advantage of all its capabilities, Windows makes the interface a whole lot easier to use than other systems," Baldwin said.

The result is a system that constantly monitors and maintains optimum air-fuel mix for lean-burn operation with computer speed and precision. "It's like having someone adjusting the air-fuel mix 24 hours-a-day, non-stop," in Runnels' words.

"Soon after installing an initial set of MEC-L units on three engines, we saw the expected drop in detonation and engine failures," Runnels said. "By year's end, we'd installed about 40 more systems. The plan is to install a MEC-L whenever an engine is overhauled or shut down for header change. Ultimately, we expect to install MEC-L systems on the vast majority of San Juan Basin engines," Runnels added. "We expect these systems to yield significant cost savings over many years."

Compliance Controls was formed by Miratech Corporation and FW Murphy. The company offers two lines of MEC Air-Fuel Ratio Control Systems: the MEC-R for rich-burn engines, and the MEC-L for lean-burn engines. Backed by the parent companies' distribution networks, Compliance Controls focuses exclusively on delivering and supporting MEC solutions tailored to customers' specific requirements. ■

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■ **The Compliance Controls MEC-L Air Fuel Control System control box, installed at a coal-seam methane compression facility in the San Juan Basin of the four-corners area.**