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## Vector Gas: control under pressure



New Zealand gas transporter and technical operator for the Maui Pipeline, Vector Gas, upgrades the Mokau Compressor Station, using advanced process and safety control solutions from Rockwell Automation.

Natural gas is the most versatile of all the fossil fuels – having the best inherent energy-efficiency and being the most transportable. Industrial, commercial, and residential users alike tend to take the benefits of natural gas and its supply infrastructure for granted, however. Little consideration is generally given to the challenges presented by the recovery, refining, and transportation of this flexible fuel. The transportation structure alone comprises a complex network of pipelines, valves, and compressor stations. These require skilled management and maintenance by experienced operators to ensure the end-user receives an adequate supply of natural gas at the correct pressure to meet their needs.

A major player in New Zealand's high-pressure gas transmission industry is Vector Gas Limited. With a network over 2,500km in length, Vector Gas delivers 100PJ of gas every year. Some 85PJ of this is used by industrial and commercial consumers and the remainder is reticulated to



around 250,000 homes across the North Island. In addition to the pipework infrastructure owned by the company, Vector Gas is also responsible for the operation and maintenance of third-party-owned pipelines, such as the Maui Pipeline. The 850/750mm-diameter Maui Pipeline – which runs from the Oaonui production station to the Huntly Power Station, south of Auckland – is the largest-capacity high-pressure gas transmission line in New Zealand. This 307km-long stretch of pipeline forms a vital component of the North Island's gas transmission network, and this is pressurised by a single compressor station – the Mokau Compressor Station – located approximately 100km from the Oaonui Production Station. When Vector Gas required an upgrade to the station controls in the Mokau Compressor Station, it turned to long-standing systems integrator partner,



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Engineering Control Limited (ECL). In keeping with Vector Gas's decision to standardise control across its compressor stations, ECL founded the new system on the powerful Allen-Bradley ControlLogix platform from Rockwell Automation.

### Safety is everything

The primary function of the Mokau Compressor Station is to receive gas from the south and 'line-pack' it to the north. Line-packing involves pressurising the gas to allow a greater quantity to be 'packed-in' to the pipe, effectively utilising the pipeline itself as a large pressurised gas reservoir.

According to Vector Gas instrument and electrical engineer, Alan Taylor, the Mokau Station comprises two centrifugal compressor-sets, each powered by a gas turbine engine. "The compressors are designed to increase the gas pressure – in excess of 50bar, if required," he says. "This enables it to flow north by pressure differential alone, without need for additional pumping stations."

The station has five operating modes – Run; Ready; Inhibit; Emergency Shut Down (ESD); and Backflow.

The station is designed to operate in run mode for extended periods, although seasonal demand dictates that from October to March the station only needs to run sporadically in order to maintain the pressure to the north of Mokau. Of the other operating modes, the ESD mode is arguably the most important, as this is activated in the event of an emergency to put the station into a safe condition. Upon activation, ESD mode stops the compressors and depressurises the station pipework through emergency venting. The gas in the Maui Pipeline is allowed to bypass the station as it flows from south to north.

Three controllers are needed to operate the station – one each for the gas turbines, and one known as the 'station controller'. The gas turbine controllers were upgraded to Allen-Bradley ControlLogix a few years ago, leading Vector Gas to follow suit with the station controller when it became unserviceable. "Replacing the station controller with a ControlLogix programmable automation controller (PAC) made a lot of sense, both to enhance the automation control functionality and to improve the communications between controllers," says Taylor. "Moreover, we have extremely good support for Rockwell Automation solutions, so this was another major driver for using ControlLogix for the station controller upgrade."

The station controller supervises the entire station, and its primary roles are to manage the operating modes, and to safely administer the valves of the compressor station. Importantly, in the event of a pipe rupture or other incident, the station controller is responsible for initiating the ESD mode in order to mitigate damage to the Mokau Station and the Maui Pipeline, and to ensure the safety of any personnel on-site.

The station controller also controls the variable speed drives for the gas and oil-cooler fans and receives inputs from all station instruments and sensors not controlled directly by the gas turbine controllers. It communicates with the dedicated gas turbine controllers, which directly control the gas turbines and the compressors.

### Enhanced functionality

The primary brief given to ECL from Vector Gas was to replicate the base functionality of the legacy station controller. "The main problem with the legacy station controller is that it had reached the end of its design life, and was effectively obsolete," explains ECL senior control systems engineer, Peter Huitema. "Not only was it difficult to get spares, but there were also licensing issues, which made it difficult for technicians to get on-line to diagnose problems. Moreover, the programming code for this controller was very specific to this station, and this presented further problems for fault-finding and rectifying issues."

In addition to replacing the station controller, the project also entailed upgrades to the onsite Motor Control Centre (MCC). This incorporated the replacement of the legacy drives for the gas coolers and the oil coolers with six Allen-Bradley PowerFlex 40 variable speed drives (VSDs), fitted with soft starts. These VSDs allow greater refinement of motor speed, and improve the ability to achieve optimal temperature settings for both the compressor oil and the natural gas under compression, resulting

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in significant increases in operational efficiencies of these processes.

Allen-Bradley E3 Plus overload relays were used to replace the legacy overload relays fitted to the turbine enclosure fans. These feature advanced protective and control capabilities, and facilitate the transmission of increased operational data and status information to the controller.

Vector Gas was keen for enhanced functionality in terms of communications and reliability to be realised. "The upgrades have provided the Mokau Compressor Station with several additional capabilities over the legacy system," says Taylor. "The station controller communicates with the gas turbine controllers via ControlNet, and with the VSDs and overload relays over DeviceNet. This has afforded us unprecedented levels of communication within the station, which provides a foundation for enhanced diagnostics ability and increased scope for trend monitoring. This naturally helps improve the reliability of the whole station."

The implementation of an advanced HMI was a key element for improving the diagnostics capabilities of the system. "We used FactoryTalk View 5.0 with faceplate-driven control to develop a DCS-type feel," Huitema explains. "This improves the operator interface and enables personnel relatively unfamiliar with the system to access pertinent information far more easily than was previously possible. Given that this is an unmanned station – and that there is limited scope for information to be made available remotely – it is of paramount importance that the interface has an intuitive feel, to allow any technicians visiting the site to be able to interrogate the system easily and comprehensively."

#### **A safe future**

The project also enabled Vector Gas to increase the safety integrity level (SIL) of the control system to SIL2. A SIL study had found there was a potential for SIL2 events on-site, and these needed to be properly addressed to mitigate the risk to site personnel and the station itself.

"The adoption of ControlLogix across the board has radically simplified the implementation of SIL2 for the station controls," says Huitema. "We used RS Logix 5000 version 16 with function block code for configuring the new station ControlLogix controller, and this proved to be a straightforward process – simply a case of following the Rockwell Automation literature for ControlLogix. Having established SIL2 for the station controls, we now have the perfect foundation for the whole station to be brought up to a SIL2 rating in the future."

The project was completed on time with no operational impact, and has significantly improved the smooth running of the Mokau Compressor Station. However, the upgrades to the site have highlighted the instability of the electrical power used by the station. "The next stage is to investigate how we can improve the integrity of the electrical supply on site," Taylor says. "Rockwell Automation power monitoring devices – linked through the ControlLogix PAC – are likely to be employed to improve the management of the onsite generator operation to achieve a smoother transition from mains to generator power."

Vector Gas is happy with the outcomes of the project, and this goes beyond the increased efficiency and reliability of the operating system. "The real advantage of the Integrated Architecture solution from Rockwell Automation is the enhanced levels of communications we have achieved," says Taylor. "When a fault occurs now, it is far easier to remotely interrogate the system to discern the primary fault and pinpoint the cause of the problem. Technicians sent to site can now be equipped with the right tools and spares they need to rectify the fault in a single visit. This project has been such a success that we are using the Rockwell Automation solution at the Mokau Compressor Station as a template for future upgrades to numerous other compressor stations across the North Island."

#### **Company background**

Rockwell Automation Australia and Rockwell Automation New Zealand are subsidiaries of Rockwell Automation, Inc. – a leading global provider of industrial power, automation control and information solutions that helps manufacturers achieve a competitive advantage in their businesses. The company brings together leading

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global brands in industrial automation which include Allen-Bradley® controls and services and Rockwell Software® factory management software. Its broad product mix includes control logic systems, sensors, human-machine interfaces, drive controllers, power devices, and software.

Headquartered in Milwaukee, Wis., the company employs about 20,000 people serving customers in more than 80 countries. In Australia, the company's technical resources and national network of distributors provide technical and logistic expertise to ensure its customers meet their manufacturing productivity objectives.

For further information visit: [www.rockwellautomation.co.nz](http://www.rockwellautomation.co.nz)

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