Tunnelling into the Future

Auckland’s first urban road tunnel’s innovative design melds old and new, partly housing an advanced monitoring and control system in a restored heritage building.

Challenge

- The city’s first urban road tunnel built through a busy heritage-rich area involved traffic management and diversion of major services
- To integrate the monitoring and control systems of the Victoria Park Tunnel’s mechanical and electrical systems

Solutions

Plant monitoring and control system (PMCS)

- The tunnel’s plant is monitored & controlled by a dual Allen-Bradley ControlLogix system to provide redundancy in the event of system failure

Results

State-of-the-art control and integration system

- The PMCS is responsible for controlling drainage, ventilation, lighting and low voltage areas of the plant
- The PMCS acts as the critical interface between fire systems, plant and traffic management systems

Reliable monitoring and control for the Victoria Park Tunnel

- The PMCS is hardwired to 10 remote I/O locations inside and above the tunnel comprising a mix of sensing switches fans and pumps
- The PMCS interfaces with a number of third party products including drives, power monitors and the NZTA’s Transdyn Traffic management system in Takapuna which is six kilometers away
- Sets the benchmark for future road projects

Background

In 2009, the New Zealand government announced the Roads of National Significance project, an ambitious undertaking to build or upgrade seven essential state highway links to support national economic prosperity. The first of these projects, the Victoria Park Tunnel, completed in March 2012, paved the way for a new era in Auckland’s intra-city commuting.

A government-funded upgrade to State Highway 1, the Victoria Park Tunnel provides increased safety and reliability for trips on Auckland’s central motorway system for 150,000 vehicles each day. Designed and constructed as a 450 metre cut-and-cover tunnel, it lies adjacent to the existing Victoria Park Viaduct and carries all northbound traffic formerly flowing over the viaduct. The viaduct has been reconfigured to carry four southbound lanes. This is Auckland’s first major urban road tunnel. The decision to go underground stemmed from the need to protect the character of Victoria Park, the sensitive and historically significant inner-city green space which it runs through.
Peak time trip reduced

According to Helen Cook, Communications Manager with the Victoria Park Alliance, the northbound peak-time trip between Greenlane and the Auckland Harbour Bridge reduced by approximately 10 minutes when the full capacity of the tunnel became available in late March. “It is still early days but indications are that the Victoria Park tunnel project has achieved its main objective, to remove the last major traffic bottleneck on Auckland’s central motorway network.” The opening of the tunnel’s third lane was the final stage of project delivery, following the opening of two northbound lanes in November 2011. This staged completion was necessary due to the project’s complexity, which involved major traffic and service diversions.

The project was delivered by the Victoria Park Alliance, comprised of the New Zealand Transport Agency (NZTA), Fletcher Construction, Beca Infrastructure, Higgins Contractors and Parsons Brinckerhoff. Designed and commissioned by Rockwell Automation, the tunnel’s plant is monitored and controlled by a dual Allen-Bradley ControlLogix® system to provide redundancy in the event of system failure.

Auckland’s First Tunnel

As the city’s first urban road tunnel, built through reclaimed land in a busy and heritage-rich area, Victoria Park Tunnel presented some unique challenges. It involved the diversion and upgrade of major services, including New Zealand’s largest sewer; the International Telecommunications Cable which links New Zealand to the rest of the world, and water supply pipelines for Auckland’s North Shore. Contamination from previous land usage needed to be contended with, as did frequent encounters with unrecorded pipelines, power cables and drainage.

Traffic diversions were necessary during tunnel construction and associated motorway widening. “There were definitely challenges around traffic management—keeping traffic flowing while digging a huge hole in the ground.” says Wernher Roding, Mechanical and Electrical Design Leader with the Victoria Park Alliance. According to Roding, diversions were managed through good planning: traffic was diverted to local roads overnight and on weekends, minimising disruptions during the working week.

Monitoring and Control

Integrated monitoring and control of the tunnel’s mechanical and electrical systems was also a challenge. According to Roding, the project required a plant monitoring and control system (PMCS) which had no single point of failure and a could achieve a hot-changeover—where control is handed over seamlessly from the main controller to the backup controller, so the plant doesn’t experience any glitches or interruptions. The Alliance selected the Allen-Bradley Control Logix system supplied by Rockwell Automation as it met these criteria,
and because of their previous experience in road tunnel projects.

“The PMCS is responsible for controlling drainage, ventilation, lighting and low voltage areas of the plant,” says Sean McGinity, Bid and Proposals Manager, South Pacific with Rockwell Automation. “It acts as the critical interface between fire systems, plant and NZTA’s traffic management system.” The PMCS is hardwired to 10 remote I/O locations inside and above the tunnel, comprising a mix of sensing switches, fans and pumps.

The PMCS interfaces with a number of third party products, including drives, power monitors and the NZTA’s Transdyn Traffic Management System, at the Auckland Motorway Control Centre in Takapuna, approximately six kilometres away. McGinity says that the key to making the project work was drafting an interface specification document to define each interface fully at the design stage. “Rockwell Automation authored the specification which included our requirements for integration. Each third party supplier added to the specification, outlining their requirements and answering our needs.”

According to Prasad Nory, Industry Manager, Rockwell Automation “ControlLogix is becoming a standard Programmable Automation Controller for tunnels in New Zealand due to its excellent reliability and performance, ease of use and local service and support.”

The specification then went through a three-way approval process: Rockwell Automation, third party suppliers and the Victoria Park Alliance before the code was developed, prototyped and tested, and finally deployed. The design and testing of the PMCS was completed in just 15 weeks. “Given the short project timeframe and high public profile, we needed to deliver on time and to requirement,” McGinity says.

Old and New

Finding a place to house the PMCS and other tunnel equipment was also an interesting process. According to Roding, the equipment needed to be located as close to the middle of the tunnel as possible to minimise the cabling required. Because the tunnel went under Victoria Park, a sensitive area reserved for community green-space, building a new equipment room there was not possible. An underground space was prohibitively expensive. Fortunately, another option presented itself in the form of Auckland’s (and New Zealand’s) first kindergarten building, which had lapsed into disrepair.

“We identified the Campbell Free Kindergarten as a potential building. We did an analysis and found equipment would fit, and we found that it would be economic as well,” says Roding. Following approval from the local council, the kindergarten was restored to its original state and is now dual purpose: tunnel equipment is housed partly on the ground floor and top storey, while the remainder of the building is for community use.

Some issues of safety, both for the public and the tunnel equipment arose from this arrangement, particularly that of fire protection. Although not required under New Zealand legislation, the Alliance chose to install fire doors and gas suppression systems in the rooms containing tunnel equipment to help protect the public from equipment fires, and help protect the equipment from fires in the public areas. “If one of the public areas became a coffee shop, for instance, we wanted to make sure that if there was a fire it didn’t affect tunnel equipment,” says Roding. Security systems and locked doors further protect the equipment from public access.

Sharing the Wealth

The New Zealand government’s Roads of National Significance projects, including the Victoria Park Tunnel, have been classified as ‘lead infrastructure projects,’ specifically designed to inject money into the local economy. “The government wanted the project to be split up in to smaller pieces—a philosophy of sharing the wealth, so to speak. We had to make sure we were up-skilling smaller organisations and also those that weren’t used to doing this kind of work. It wasn’t just about the money,” says Roding.

Tunnel work was new to many of the project’s suppliers and providers, and so design specifications had to be especially clear to keep things on track. This, along with careful monitoring and management of suppliers by the Alliance, lead to a successful outcome in this unusual project environment.

As part of the project evaluation, scores were given to project suppliers, and one of those receiving a high score was Rockwell Automation, who has also been working with the Victoria Park Alliance to make changes and improvements to the tunnel following its commissioning. “From a technical perspective they were easy to work with, professional, and did what they said they would without any fuss. It seemed that there was a genuine drive to get the job done,” says Roding.

The Alliance has received positive comments about the urban design initiatives included as part of the project, including the tunnel egress structures which incorporate artistic references to the importance of the area as a Maori fishery before European settlement. Early feedback from commuters on how the tunnel is working to improve their trip is that traffic through St Marys Bay is free-flowing for the first time in many years.

The Victoria Park Tunnel has been a complex, multistage project successfully completed on schedule. With its state of the art control and integration system, focus on protecting community assets and assistance to small local suppliers as well as experienced collaborators, it has set the benchmark for road projects of the future.