

CASE STUDY

Vigilante Air Quality Station™

Return safely and quicker to the face.



Improving mine ventilation monitoring and control at Vale's Totten Mine to reduce energy consumption and to improve worker safety



Opened in 2014, Vale's Totten Mine is located in Worthington approximately 40 kilometres to the west of their Copper Cliff complex within the Sudbury Basin. Totten Mine aims to produce copper, nickel and precious metals over the next 20 years and provide employment for approximately 200 people. The probable reserves at the mine are estimated to be 7.89 million tonnes of ore graded at 2.07% copper, 1.47% nickel and 0.04% cobalt.

Totten Mine is using some of the most advanced technologies to improve worker safety, automation and mine production. Blasthole stoping methods are used to mine the vertically dipping orebody. The mine is accessible by drifts and ramps and comprises of two mining fronts – one at 3150 level and another at 3850 level.

Vale installed ventilation controls at Totten Mine to deliver air where and when required. This reduces overall energy consumption and allows for increases in production intensity and mucking output.

The primary surface fans, via variable frequency drives, adjust to the total overall underground ventilation demand. On each level, two automated regulators adjust the airflow rate based upon the total mine level demand. Underground auxiliary fans are controlled to provide ventilation for equipment and personnel in each heading. Blast clearance is achieved through scheduled events.

Ventilation controls provided a 49% reduction in energy and 10% productivity improvement.



Vale's Digital Transformation Roadmap includes the modernization of underground mining that historically has been elusive and difficult to execute due to the tough environmental conditions and lack of robust, mine-wide communication networks. Starting at Totten Mine, Vale reviewed and tested several competing solutions underground to monitor and control air quality and ventilation. Totten required a system that had a proven track record in the underground environment; one that kept workers safe and helped achieve significant savings. Maestro's **Vigilante AQS™** air quality station met the requirements and was successfully tested; becoming the primary system at Totten Mine. Since 2015, hundreds of Maestro's **Vigilante AQS™** are in use at Vale's underground operations.



The Challenge

Since achieving full production, Totten Mine has made advances in the ability to monitor and control the ventilation equipment over digital Ethernet protocols. As part of the current efforts to minimize and reduce capital and operational costs at the mine site, Totten Mine completed a study to compare the automation and control hardware currently in use with new proven

technologies available in the market. The idea was to identify technologies with the potential to reduce the implementation cost for new mining levels that will be developed as part of the life of mine plan; but without compromising the current communication and control capabilities.

Totten is equipped with state-of-the-art technology in terms of monitoring and control for ventilation systems. The mine has realized the benefits of such systems mainly in three areas: health and safety, production and energy savings. Monitoring the different levels and ramps from the surface control room enables the monitoring of gas and temperature conditions during the complete shift. The ability of controlling main fans speed, doors and regulators, allows the control room operator to allocate different airflow demands in different levels based on operation requirements and modify them during the shift as requested within the ventilation system limitations.

To increase the automation capabilities and reduce the cost and time required to advance the automation infrastructure, the Automation team began to look at alternatives in hardware and technology. The objective was to minimize costs by removing unnecessary and expensive hardware and software and at the same time improve the control and monitoring capabilities of the existing control system.

As the evaluation continued, the focus shifted to fully explore the capabilities of moving from remote I/O over Profibus directly to Ethernet and avoiding large unnecessary expensive cabinets and hardware much like what Vale did years ago with their migration from their legacy PBX phone systems to their new digital VoIP systems. The ability to use Ethernet as a communications standard would allow the mine to leverage the extensive underground Ethernet and Wireless network.

*Source: **Improving monitoring and control hardware cost at Totten Mine**, by Ozzy Flores, Enrique Acuña, Totten Mine, Vale Canada Limited, Sudbury, Ontario, Canada*

The Solution

Identifying *Vale's* demand for real-time data to monitor and control air quality, *Maestro Digital Mine* worked with *Vale's* Totten Mine to address the challenges associated with working in the harsh underground mining environment by protecting miners from acute or chronic gas related health conditions. To develop a solution that was cost effective and could be used with existing infrastructure. Totten Mine tested and then integrated *Maestro Digital Mine's* vital and life saving digital technology, the **Vigilante AQS™** air quality stations, to measure environmental conditions in real-time for worker health and safety and to reduce the total installed infrastructure costs.

Working in partnership with the mine to meet their requirements, *Maestro* aided in installing the **Vigilante AQS™** Air Quality Stations that feature digital gas sensors that can be calibrated on surface in a stable controlled environment. The digital sensors then can be "hot swapped" by a ventilation technician without the requirement of any sort of underground calibration. Built upon the IoT (Internet of Things), the digital sensors compensate for barometric pressure and temperature and have a complete suite of real-time diagnostics to help determine the health of the complete system and provide maximum system uptime.

Vale's Totten Mine completed their first trial by connecting a **Vigilante AQS™** to a CISCO wireless access point (AP) through the Power-over-Ethernet (PoE) port. Vale's AP provided a single point connection for both data and power thereby eliminating an additional 120VAC power source. Again, reducing the total cost of installation, complexity and unnecessary labour. This process was standardized on *Maestro's* Vigilante AQS stations moving forward.

Ozzy Flores, Automation and Electrical Supervisor – Totten Mine stated, "We approached *Maestro* and said, can you guys talk Ethernet? Out of the box *Maestro* already talked Modbus TCP/IP which is Ethernet. Its an Ethernet communication. We are using the *Maestro's* **Vigilante AQS™** moving forward in order to do our ventilation monitoring.

The huge advantage with the *Maestro* system is that you see the size of this, all the individual components..."

"The Vigilante is all integrated into one unit. It does the gas monitoring, it does the airflow, it does the relative humidity and the temperature on it, all in one box. There is no engineering associated with it because it's all in one package! Huge cost savings for the mine!"

The **Vigilante AQS™** accurately measures airflow and direction, wet and dry bulb temperature, worker heat stress, barometric pressure, gas concentration and dust particulate.

The air quality stations provide data to a ventilation control system that optimizes the airflow on each mine level. Carbon monoxide, humidity, wet and dry bulb temperature and airflow and direction feed the control system.

In addition to significant measured energy savings, miner safety is provided by monitoring gas levels, worker heat stress and monitoring for fires. The real-time data from the gas sensors also assure safe blast clearance allowing the miners a quicker and safer return to the working face providing an additional 10% productivity improvement.

The next technology the Totten Mine crew tackled were the regulators. Regulators control the amount of air on each level assuring adequate fresh air based upon strict regulations. Originally, the **MaestroFlex™** regulators were supplied with traditional analog and discrete inputs and outputs to control the louver position. This required expensive panels to be fabricated using remote I/O. The next generation of **MaestroFlex™** regulators delivered and all current regulators utilize Ethernet actuators.

"We talk directly to the actuator which essentially eliminated any type of remote I/O requirements underground. Again, eliminating the cost of the engineering, eliminating additional costs in terms of installation for the electricians because now they are wiring, they're sending two wires to the

actuator. They sent a communication cable which is an Ethernet cable and 600-volt cable to power it up. Boom and done. Whereas before we had all this other infrastructure that needed to be engineered, manufactured and installed.”

“The Distributed Control System (DCS) controller is located on the surface. Now, we leverage the fact that we have a communication infrastructure to talk to everything over Ethernet. We are now directly talking to the network switches, wireless access points, air quality stations and regulators. Its the same type of automation underground, but with a lot less infrastructure in terms or automation. Now we are leveraging that control network to get the same type of information, with far less cost and complexity”, stated Flores.

Outcomes

Now, at Vale’s Totten Mine, a Vigilante AQS goes up in less than a shift, followed by calibrating the airflow sensors. The Vigilante’s are running on the network cable because it can be powered over Ethernet (PoE), therefore one does not require a separate cable for power. With a network switch that offers PoE or a wireless access point that

offers PoE, you can power up the Vigilante AQS seamlessly. Essentially, running one cable to that Vigilante for communication and power.

Vigilante AQS™ air quality stations and **MaestroFlex™** regulators are now installed on every level now.

The automation team at Totten mine significantly reduced the installed costs, equipment advancement time and complexity of the monitoring and control hardware without compromising any of the previously available capabilities of their legacy method. In addition, more features became available in terms of the advanced diagnostics for trouble shooting from surface.

Flores remarked, “So, any ventilation monitoring station that we put in now is a **Maestro Vigilante AQS™** air quality stations. This also applies to our other Sudbury Operations: Creighton Mine, Copper Cliff Mines, Coleman Mine, Garson Mine, Thompson and Voisey Bay mines. **Maestro** ventilation solutions have been standardized for Vale mines and we can continue to learn and adopt it as needed.”

