

True STORY



Wireless Gas-Monitoring Technology Proves Itself at Kilauea Volcano on Hawaii's Big Island

Hawaii County Civil Defense Agency adopts wireless monitoring system after a successful two-year field study to monitor toxic volcano emissions

“There was this huge explosive event... several thousand tons per day of sulfur dioxide was being discharged into the atmosphere...”

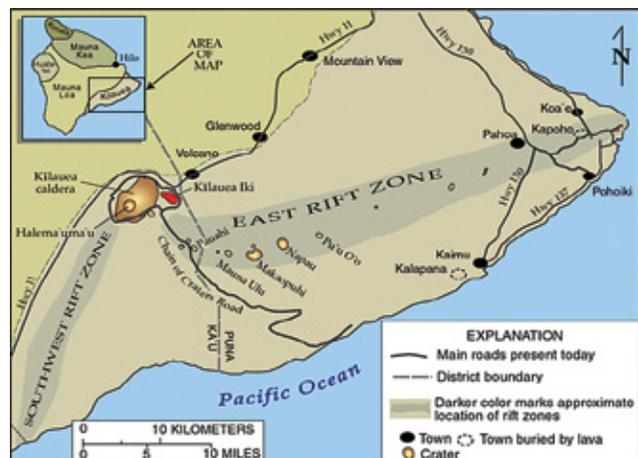
The rumbles came first, followed by the sounds of rock breaking – all driven by shallow earthquakes likely caused by hydrothermal or gas sources exploding beneath the active Kilauea Volcano on Hawaii's Big Island.

Within minutes, a sudden explosive eruption occurred and

a noxious gas plume spewed from the volcano's east wall, propelling debris over a 75-acre area and inundating the southern tip of the island with a sour, rotten-egg smell during a March 19, 2008, event. It was the volcano's first explosive eruption in 84 years.

The explosion occurred at Halema'uma'u Crater at the summit of the Kilauea Volcano in the state's Volcanoes National Park at 3 a.m. local time, damaging a nearby lookout area, and closing roadways and parking areas. It produced a small crater along the east wall up to 100 feet in diameter, and left a wide debris field, which included a 35-cubic foot block found 230 feet below the crater's rim.

The pungent, gaseous plume included toxic sulfur dioxide (SO₂), and was likely dangerous for areas downwind of the Halema'uma'u Crater. The park was closed for a short time to keep visitors safely away from increased levels of the gas, which could cause burning of the nose and throat, breathing difficulties or severe airway obstructions. At high levels (100 parts per million or greater), exposure can be life-threatening.



“The CST happened to be here for a multi-agency exercise that week...”



“There was this huge explosive event, and all of a sudden several thousand tons per day of sulfur dioxide was being discharged into the atmosphere, along with particulate and other materials,” said Civil Defense Administrator Darryl Oliveira, who heads the Hawaii County Civil Defense Agency.

Realizing the risk SO₂ posed to public safety, the civil defense agency coordinated with the Hawaii Army National Guard’s 93rd Civil Support Team (CST) and local fire departments to perform hazard risk assessments to evaluate sulfur dioxide levels outside of Volcanoes

National Park. Residential communities are located within a mile-and-a-half of the park, with other housing and business areas farther out that potentially could be in harm’s way.

“The CST happened to be here for a multi-agency exercise that week,” said Oliveira. “We changed the plan from an exercise to an actual mission where we worked side-by-side to conduct a series of downwind readings and assessments, employing a variety of hand-held and portable detection instruments.”

Those instruments included RAE Systems’ QRAE Diffusion and MultiRAE multi-gas detection instruments, along with other devices, that were used to test initial air samples from points nearest the caldera to locations 20 miles downwind. The readings ran the gamut, including some that exceeded U.S. Occupational Safety and Health Administration

(OSHA) thresholds for SO₂ exposure to other readings where gas levels were barely detectable.

Officials from participating agencies determined weather variables and environmental factors on the island were changing the dispersion characteristics of the plume, making it difficult to accurately monitor the gas emissions using random and periodic air samples. It was determined that more extensive monitoring would be required to provide the information county officials needed to adequately assess potential safety risks and to notify communities when SO₂ levels spiked in specific areas.

REAL-TIME THREAT-ASSESSMENT MONITORING

Wireless gas-detection systems collect continuous data at pre-determined intervals and send it wirelessly to a host computer. These systems can easily collect and aggregate thousands or millions of data points with automated tools that can dramatically improve the quality and reliability of the information derived from raw sensor readings. These real-time interactions are possible because of advances in secure Internet access and the ability to get data onto the Internet from almost anywhere.



“When the 93rd CST unit introduced us to the RAE Systems monitor, there was no question it was a reliable instrument...”

“We actually used the Internet to put the monitors so far from the host computer...”

Using monitoring software, readings and alarm information can be viewed on a site map that displays the location and real-time alarm status of every sensor on the network. Real-time monitoring



provides an early warning system for detecting a broad spectrum of threats, immediately sounding multiple alarms at the detection site (including integrated man-down alarms) and simultaneously at an Emergency Operations Center (EOC) when dangerous gases or vapors are detected. The system also logs sensor data for later review, threat-assessment analysis, or to evaluate and improve safety protocols.

The civil response teams deployed two wireless AreaRAE Rapid Deployment Kits (RDKs)—provided by Hawaii National Guard’s CST—to continuously monitor eight strategic points from the southwestern area near the Ocean View community to the southeast side of the island and north to Hilo. The rugged stainless-steel monitors operated

24/7, giving the agency and other key stakeholders real-time access to the monitoring data.

However, this unique application required unconventional monitor deployments in order to cover the many communities downwind of the volcano.

Convenient power sources were made possible by placing the monitors primarily at residences near the populated areas to be monitored. Typically, wireless detection instruments are designed to operate in remote and harsh conditions using battery or solar-energy sources, but the response teams used this approach to eliminate battery maintenance and increase the overall life of the widely distributed detection monitors.

Mounting the monitors at residential locations also provided handy access to Internet connections. Because the distances between the wireless detection units and the host computer exceeded the two miles recommended by the manufacturer, the monitors could not send data wirelessly. Several of the monitors were more than 80 miles from the agency’s EOC in Hilo, with the nearest monitor 15 miles away. Instead, the monitors were connected through various residential Internet or cable-connected services to transmit data to the EOC.

“All eight monitors were graphically displayed on our computer screen, logging what we were measuring in the field as it happened...”

LESSONS Learned

“We actually used the Internet to put the monitors so far from the host computer,” said Oliveira. “The sensors communicated back to our office, where all eight monitors were graphically displayed on our computer screen, logging what we were measuring in the field as it happened, and sending alerts when emissions spiked beyond our preset limits.”

LESSONS LEARNED AFTER TWO YEARS

The AreaRAE monitors were in the field and communicating information for two years. Routine maintenance, such as replacing sensors and testing functionality, were performed regularly. As a result of the effort, the field survey helped to provide useful information about monitoring emissions on the island, in addition to giving the civil response teams invaluable experience monitoring dangerous gases.



The survey confirmed the need to monitor key locations of the island to discern real-time information about air quality. Much of the information gathered by the civil defense agency was forwarded to other

“Wireless systems allow you to perform threat-detection monitoring without putting personnel in harm’s way.”

county departments, including the Hawaii State Department of Health. That department has since installed transportable monitors in some of the key locations to replace the AreaRAE monitors, which were retired in 2010.

The monitoring study also revealed the challenges to developing an accurate forecast model for gaseous material, given the extreme weather patterns on the island. Despite its reputation for perfect weather, Hawaii has severe meteorological patterns due to the island’s multifaceted terrain, which causes extreme weather variability from one spot to the next. Hawaii is the only U.S. state that experiences such a wide range of natural anomalies, including tornadoes, blizzards, hurricanes, flash floods, earthquakes and volcanic eruptions.

For Oliveira’s civil defense team, the study introduced them to the benefits of wireless monitoring and its advanced capabilities designed to keep responders, assets and the public safe.

“Wireless systems allow you to perform threat-detection monitoring without putting personnel in harm’s way,” he said. “It enables you to put your technicians on more urgent tasks, instead of standing in a remote location holding a portable monitor and relaying monitor readings over the radio.”

Since the two-year study of SO₂ emissions, the Hawaii County Civil Defense Agency has incorporated two AreaRAE Gas Monitoring Rapid Deployment Kits (RDKs) of their own to expand the unit's readiness and improve response capabilities to HazMat incidents, including natural, accidental or terrorist threats.

The AreaRAE RDK systems provide quick assessment of chemical and radiological threats. Each kit includes four wireless AreaRAE multi-threat gas and radiation detection monitors and a turn-key host controller that runs RAE Systems' ProRAE Guardian safety system. The RDK includes a military-grade self-contained case for easy transportability and deployment. The system also can be scaled up to 64 detectors and includes optional GPS capabilities.

The Hawaii County Civil Defense Agency reviewed other wide-area monitoring instruments, but opted for the AreaRAE system based on the instruments' performance during the field study,

and because AreaRAE instruments are widely used by sister agencies, including the Hawaii Army National Guard's CST.

"We always look to the military for leading-edge technology and response capabilities," Oliveira said. "When the 93rd CST unit introduced us to the RAE Systems monitor, there was no question it was a reliable instrument, based on its proven track record.

Although the Kilauea Volcano eruption continues, the volume of sulfur dioxide discharged today is a fraction of what it was in 2008, said Oliveira.

"We are not seeing the fallout that we saw then," he said. "But because of the resiliency of the AreaRAE monitors, our initial assessment helped the Department of Health place transportable detection monitors in key target locations, a new capability for us, thanks to the insights we gained from our unconventional AreaRAE deployments."



Low-level Threat Spurs Wake-up Call

Geothermal energy lies beneath the earth's surface as hot liquid, dry steam or hot dry rock. Thanks to Hawaii's "volcanic hotspots," it's also a viable alternative energy source.

The Puna Geothermal Venture (PGV) on the Big Island includes a power-generation plant owned and operated by Ormat Technologies, Inc. The plant uses underground geothermal energy to produce steam that runs power-generating turbines, and produces approximately 30 percent of the Island's power with near-zero emissions.

In March 2013, a low-threat release of "abated" hydrogen sulfide (H₂S) gas

occurred after an interrupted electrical transmission caused pressure to build up in the system, which initiated an automated safety shutdown of the plant. An "abated" release is one in which toxic gas is pre-treated to help neutralize toxicity before it's discharged into open air.

The release at the Puna plant was a 20-minute incident involving a low concentration of H₂S gas that did not pose significant health risks, said Darryl Oliveira, who heads up the Hawaii County Civil Defense Agency in Hilo. "The safety mechanisms at the power plant did what they were supposed to do," Oliveira elaborated. "But at any given time, if there

is a failure in the system, untreated gas at much higher concentrations could become a dangerous threat to plant workers, responders and neighboring communities. We saw this as a wake-up nudge to increase our monitoring capabilities to better address a wide range of incidents."

The agency recently purchased two AreaRAE Gas Monitoring Rapid Deployment Kits (RDKs) from RAE Systems Inc. to improve its situational awareness during HazMat (hazardous materials) incidents.

RAE Systems Inc.

Keeping emergency responders safe gets easier when you have the right gas-detection solutions.

Real-Time Information is Critical

When disaster strikes, incident commanders and emergency responders are tasked with making critical, split-second decisions about how and where to deploy limited resources.

RAE Systems instruments – including multi-gas monitors – can be used as stand-alone devices or connected to RAE Systems' wireless ProRAE Guardian Real-time Wireless Safety System or EchoView Host closed-loop team network to leverage its unique five-way alarm system.

RAE Systems' ProRAE Guardian network allows incident commanders to quickly

set up and establish a "mobile command center," receive real-time gas and radiation readings from more than 500 remote sensors, alarm status, responder location and biometric information from multiple teams and immediately evaluate the situation and better protect responders and the public.

RAE Systems' proven real-time safety and threat detection systems have been deployed by leading organizations, helping save lives and maintain safety in more than 120 countries. The company's industry-leading gas sensors and radiation detection solutions are widely recognized for their performance and reliability.

RAE Systems can help you prevent an incident from becoming a disaster. Learn more at <http://www.raesystems.com/firstresponder/>



Real-time gas detection
For real-time decisions

www.raesystems.com