Using Wireless Gas Detection
To Prevent Refinery Incidents From Becoming Disasters

RAE Systems, Inc.
Overview
A series of explosions rocked the production facility at one West Coast refinery just before the flames began to rise and engulf one of the plant’s crude processing units. The fire intensified rapidly as a plume of heavy black smoke – visible for miles – billowed into the atmosphere and darkened the skies of nearby communities. Early reports pointed to a “gas-oil” leak in a line at the unit as the likely cause that lead to a vapor-cloud release, and subsequent explosion and fire. Workers were evacuated just before the initial explosion, narrowly escaping the highly flammable vapor cloud before it ignited. With workers’ out of harm’s way, the biggest casualty of this refinery incident might be the company’s public reputation.

Even as emergency sirens wailed to alert nearby residents to remain “sheltered in place,” online articles and posts emerged discussing failed communications systems, crowded hospitals and previous plant fires – all of which appeared to contribute to a sense in the surrounding community and beyond of a corporate failure. More coverage followed with articles pointing the finger at a poorly regulated industry; reports that not enough was done to protect nearby residents; an article on a lack of air monitoring; and articles noting the incident as the cause of skyrocketing gas prices at gas stations statewide.

In today’s real-time world of information sharing – where a celebrity can have an argument with a stewardess and have it revealed worldwide before he steps off the jet walkway – protecting the company brand has become harder than ever before. Real-time social media and Internet websites, combined with traditional broadcast and newspaper outlets, instantly spread major news events to audiences worldwide. And while the energy field has always involved significant safety risks, major incidents today get amplified through the array of alternative communication channels – often driven more on speculation than fact – especially early on as an incident unfolds.

And for the company’s that become the focus of such negative reports – whether they are true or not – this kind of publicity that can quickly erode consumer confidence and impact sales, while spurring seemingly endless lawsuits, government scrutiny and new regulations.

This article discusses key downstream oil-and-gas production threats, along with the latest gas-detection solutions capable of raising worker and public safety, and helping protect the brand reputations of refineries doing business worldwide.
Prevention: The Key To Preserving an Organization’s Reputation

While major events involving explosions, fires and worker injuries have long been risks at industrial oil refineries, popular new communication platforms today – such as Twitter and Facebook – can amplify negative and misleading messages that can harm a company’s reputation in the wake of such incidents. This makes employing preventative measures, such as deploying additional gas-detection monitors, a critical step to avoid a major event.

Worker and community safety is part of every refinery’s mantra. However, infractions such as utilizing outdated equipment or failing to keep up with new technology trends capable of improving safety can become issues in the event of a major incident and in the investigations that ensue. At the onset of a major incident, Twitter comments can instantly spring to life speculating about a cause of the incident; unnamed bloggers can reintroduce long-forgotten disaster episodes into the discussion; and traditional media outlets often default to a narrative declaring poor safety standards across the industry.

“The best strategy is one of prevention through using a combination of personal, handheld and portable area gas-detection monitors to avert a major incident in the first place, and to provide real-time, continuous protection from toxic atmospheres after an incident occurs,” says Thomas Negre, vice president of products and marketing for RAE Systems, an innovative global gas-detection and wireless-system manufacturer based in Silicon Valley, Calif.

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**Explosive Risks at Oil Refineries**

Oil, gas and petroleum refineries use and store many chemicals utilized in the complex process of converting crude oil and natural gas into the raw petrochemicals that create the everyday products used in industries such as energy, transportation, textile, cosmetic and construction. Risks include not only the chemicals used in the refinement processes, but also those used for product treatments, plant maintenance and wastewater treatment.

Leaks, high-pressure pipe failures, equipment malfunctions, plant turnaround accidents, and spills while transferring or distributing chemicals, raw materials, or final petrochemical products are all common causes of accidents at refineries. The health effects of accidental chemical releases, spills or fugitive emissions can range from eye, nose and throat irritation, and headaches for moderate short-term exposures, and irritated respiratory passages and fluid buildup in the longs that can result from continued exposure.

**Gas Refinery Threats**

**Hydrogen Sulfide (H₂S):** A colorless gas with a strong odor of rotten eggs, even in low concentrations. It’s a very poisonous and flammable gas often produced through the natural decay of organic materials under low-oxygen conditions or through its separation from sour gas, which is a natural gas with a high content of H₂S. Health effects include eye, nose and throat irritation, nausea, dizziness and headaches for moderate short-term exposures, and irritated respiratory passages and fluid buildup in the longs that can result from continued exposure.

**Sulfur Dioxide (SO₂):** A toxic gas with a pungent, irritating odor similar to that of burnt matches. Sulfur found in coal and petroleum generally creates sulfur dioxide as part of a combustion process at refineries. Health effects can include breathing problems and respiratory illness, especially for those with existing lung and cardiovascular disease.

**Volatile Organic Compounds (VOCs):** Organic chemicals that exhibit high vapor pressure at standard room temperatures whereby the vapors enter the surrounding air. Refineries are the single largest point sources of VOCs, while automobile traffic is the largest emission source. Common VOCs found at refineries include benzene, toluene and xylene.
Companies in the U.S. oil and gas industry are making significant investments to strengthen their public images, including several companies that are running broadcast television commercials to showcase their innovation, environmental sensitivity and promote an overall positive image about their business.

- Up to $50 million is being spent by one energy company to help with the economic recovery of the Gulf of Mexico region and project a favorable corporate image.
- That follows spending $23 billion on the Gulf of Mexico cleanup and to cover claims relating to the largest offshore oil spill in the history of the petroleum industry.
- Expenditures for all oil and gas projects in North America are expected to increase in 2012, including spending $3 billion on marketing for U.S.-related projects. For many of these oil companies, image building is a key investment.

**Refinery Risks**

While many measures can be taken at petroleum and chemical refineries to enhance safety, increasing gas monitoring is an easy, cost-effective way to quickly improve safety and reduce the risk of catastrophic incidents. Petroleum refineries, chemical manufacturing plants, and similar industrial facilities use large quantities of hazardous and toxic substances that could be released during an accident, putting plant workers, first responders and members of the public in nearby communities at risk for short- and/or long-term injuries, illnesses, cancers or death.

Incidents – both large and small – at refineries are common. And refinery incidents also can be catastrophic.

- In the first half of 2012, two refinery fires occurred in California, two separate fires happened at the same refinery plant in Indiana, along with fires reported at refineries in Louisiana, Oklahoma, Tennessee and Washington.
- One of the worst industrial accidents of the 21st century was at a Texas City refinery in 2005, which killed 15 workers and injured at least 180 others.
- In 2010, five workers died with others injured during an explosion and fire at an Anacortes, Washington refinery. Causes for refinery accidents can include faulty repairs such as welds, aged or failed infrastructure, leaking pipes and pumps, tank overfills and spills, or breakdowns in following safety procedures or adequately utilizing safety equipment.
- One industry estimate suggests “that at least one fire occurs every week at a U.S. oil refinery.”

And the accidents are not just a challenge for refineries in the U.S. One of the deadliest oil refinery accidents occurred at Venezuela’s largest refinery in August 2012. Three tanks at the refinery exploded, which killed 41 and injured more than 80 people. Early reports said more than 200 nearby homes were damaged by the blast’s initial shockwave, and several news organizations accused the state-run refinery of failing to respond to early warning signs, including strong gas odors and a fog-like cloud at the plant in the days preceding the incident. The government has denied those claims.

**Prevention Through Detection**

In recent years, a host of updated gas-detection instruments and systems incorporating new, field-proven technologies have been designed to enhance worker, responder and public safety. The manufacturers of gas-detection tools today offer more automated features to capture and store more data readings than in the past, accurately documenting events and exposures in real time for use in potential litigation or
remediation. In locations where several competing plants operate in refinery clusters, GPS (global positioning satellite) capabilities allow monitor readings to verify responsible parties, while keeping workers and the public alerted of potential risks.

The use of standalone personal monitors, which alert the user to elevated and unsafe levels of dangerous, toxic and/or flammable gases in the immediate area, are being augmented with instruments and systems capable of sending alarms and data readings wirelessly to a laptop computer, typically located at a central operations center. These wireless systems provide key advantages, including low installation costs, fast set up times, and the flexibility to be easily moved or repurposed for uses where toxic-gas monitoring is needed most.

“Portable and stationary wireless gas-detection instruments are being used to continuously quantify and provide immediate communication of airborne contaminant concentrations during routine operation, maintenance and emergency-response events,” says Chuck Whitman, an industrial hygienist for the Marathon Petroleum Company. “This allows for more timely assessment of potential exposures and implementation of appropriate exposure-control measures.”

Portability and rapid speed of deployment make RAE Systems wireless air-monitoring solutions for the oil and gas industry ideal for downstream operations, such as refinery turnarounds, where alternative hard-wired fixed solutions are several orders of magnitude more expensive and time-consuming to install.

In recent years, wireless detection systems have become an attractive replacement to traditional fixed-wired systems that require large trenching projects and running cables to power fixed sensors. Such projects often take weeks to execute, and involve trained technicians or electricians. Alternatively, a wireless mesh system, such as RAE Systems’ wireless MeshGuard gas-detection system, with its self-forming network of monitors, can be installed and fully operational in 30 minutes. These portable wireless monitors enable faster commissioning of a system to minimize downtime. What’s more, if one of the sensors goes offline for any reason, the network reconfigures itself and continues to operate without interruption.

A key advantage to this new generation of wireless detection monitors is the ability to broadcast alarms and data in real time. The ProRAE Guardian Wireless Safety System enables corporate visibility into sensor readings and alarm status at multiple remote sites and supports automatic alarm notification through the ProRAE Guardian interface and via e-mail.

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Advantages of Wireless Gas Detection

Adding wireless gas-detection monitors from RAE Systems to existing personal and fixed gas-detection strategies can reliably increase safety while providing a host of benefits for safety managers and industrial hygienists charged with safety at oil, gas and chemical refineries.

Benefits include:
- Fast, simple and low-cost monitor installations
- Greater monitoring access and control
- Local and remote alarms for reduced downtime and faster incident response
- Easy portability and scalability for location flexibility
- Added safety with man-down capabilities
- Cascade data from multiple locations to corporate headquarters
- Low-cost wireless fixed-detection solutions
- Easy calibration and maintenance
- Certified intrinsically safe instruments
Advances in secure Internet access and the ability to get data onto the Internet from almost anywhere have made these real-time interactions possible. Such access to data has now become an operational advantage to globally distributed safety teams as well as multinational firms. This provides several advantages; including allowing wireless system users to engage remote industrial hygienists, safety experts or plant managers in the same way doctors working in remote locations can work with medical-center specialists.

**Innovative Wireless Monitoring**

It’s the potential for catastrophic events like these that prompted Total Petrochemicals & Refining USA, Inc. to install nearly 50 wireless gas-detection monitors at the tank farm at its Port Arthur (Texas) Refinery. The plant’s health supervisor and industrial hygienist Alan Brown worked with several companies, including RAE Systems, to develop a cost-effective system for providing around-the-clock monitoring for about 100 storage tanks, including tanks located several miles away.

The system represents the world’s first automated wireless gas-detection system integrating radio frequency-enabled gas-detection monitors with intrinsically safe solar power and plume-modeling software. “We saw a significant cost savings on this project by going with a wireless solution instead of a fixed-wired approach,” says Brown.

A local company developed a weatherproof enclosure – capable of withstanding hurricane-force winds – to house a wireless AreaRAE multi-gas monitor from RAE Systems, along with providing a solar-powered energy source, which greatly reduced the need for battery maintenance. To meet strict Class 1, Division 2 intrinsic-safety requirements, RAE Systems developed a safe connector to link the AreaRAE battery to the solar panel. The system is certified as intrinsically safe in the U.S. and capable of powering a multi-threat monitor for up to 14 days without sun, says Brown.

The final element of the system was integrating the wireless-monitor data with the facility’s two meteorological stations, and its plume measurement and modeling software. The decision-support software estimates downwind concentration levels, and models the direction and altitude of a release in real time.

Brown, who was skeptical at first to use a fixed-wireless solution, later received company accolades and an award for his innovative approach to enhancing safety at the plant. Says Brown, “I am a big proponent of wireless technology and the capabilities it brings to providing and enhancing safety in industrial environments.”

Through increased use of the latest gas-detection tools – including reliable, field-proven wirelessly networked gas-detection systems – oil refineries can proactively diminish threats from combustible and flammable gases and vapors to increase safety throughout their facilities. At the same time, these wireless instruments and systems help speed deployments, reduce costs and keep the refinery in compliance. At a time when information sharing enables fast and widespread communications, and when local voices can be amplified onto a national stage, avoiding the major incidents that put lives at stake and attract negative attention is the best way to protect the company brand.
Learn More: Additional Useful Information and Ideas

1. Register for a free Facility-wide Wireless Gas Detection Assessment and demonstration HERE (http://www.raesystems.com/support/request-information)
2. Learn more about Oil & Gas wireless detection HERE (http://www.raesystems.com/industry/oil-and-gas)
3. Watch a video on use of the ToxiRAE Pro and ToxiRAE LEL single-gas monitors in Oil & Gas use cases HERE (http://www.youtube.com/watch?v=bVwoBFg9QU&feature=player_embedded)
4. Watch a video on the new MultiRAE, the world’s first wireless portable multi-threat monitors that give safety professionals unprecedented visibility into chemical threats HERE (http://www.youtube.com/watch?v=DY8p_uCy6lo)

About RAE Systems, Inc.

RAE Systems is a global sensor and wireless-system innovator that designs and manufactures a full line of fixed, portable, handheld and personal chemical- and radiation-detection instruments. The company’s life- and health-saving detectors are used in 120 countries by many of the world’s leading industrial corporations, first responders and government agencies. RAE Systems offers a variety of rapidly deployable and custom-configurable sensor solutions for incident response and Oil & Gas site monitoring. RAE Systems delivers cohesive, wirelessly connected threat-detection solutions that create a layered defense against gas and VOC threats and other gas and combustible risks. RAE Systems’ solutions for Oil & Gas monitoring and protection are:

- **Versatile**: RAE Systems’ easily deployable fixed and portable monitors placed in sensitive areas transmit sensor information in real-time to a central location for quick interpretation, analysis and action.
- **Wireless**: Wireless atmospheric monitoring that utilizes cost-effective equipment that is easy to install and operate can assist plant managers and operations commanders and first responders with real-time information on potential hazards.
- **Proven**: With more than 23 years of experience, RAE Systems’ innovative solutions have a verified track record.

The company offers a wide range of rugged, yet easy-to-use monitors that enable continuous, real-time safety- and security-threat detection in nearly every environment, along with wirelessly connected solutions that lead the industry in performance and reliability. RAE Systems’ intrinsically safe and globally certified monitors help elevate safety for workers, responders and the public at large; reduce project downtime; and maintain regulation compliance.

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4. BP television commercial that aired 26 August 2012.
8. Ibid. (The estimate comes from the United Steelworkers using industry-reported data).