Public Event Protection Through Detection of Gas and Radiation

Rae Systems, Inc.

Introduction

Are you prepared for a large scale radiological, gas or chemical incident at your event venue?

The tragic events of September 11, 2001 showed that terrorist armaments and tools are not limited to traditional explosives and chemical warfare agents. In late 2001, the Department of Homeland Security was created to "develop and coordinate the implementation of a comprehensive national strategy to secure the United States from terrorist threats or attacks." As part of this comprehensive strategy, there is an increasing focus on building and venue protection.

In today's uncertain world, wide-area monitoring of public locations where large crowds of people gather has become more commonplace, but remains a daunting task. Proper planning – including contacting local first responders and safety services – and selecting the best detection equipment for the job can make all the difference in keeping people safe at public-venue events.

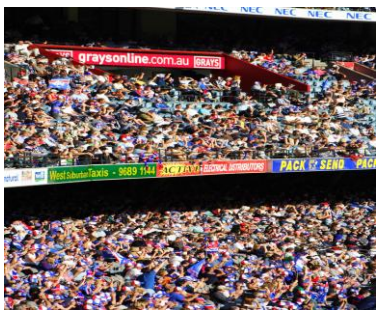
The most prudent approach to discovering, identifying and neutralizing explosives and chemical warfare agents, as well as toxic industrial chemicals that might be used in terrorist attacks, is to use an integrated approach that includes both substance-specific gas-detection technology and a well-planned response.

This paper provides an overview of how to prepare and defend an event, public gathering or sports contest from potential attacks or accidents involving volatile organic compounds (VOCs) and other gases or gamma radiation that could adversely affect a large group of people – as well as first responders.

This eBook will cover:

1. Event and Public Protection Background
2. Baseline for Protection: Preparation
3. Event Protection and Preparation
4. Chemical Warfare Agents (CWA)
5. PID Detectors for WMD and TIC Protection
6. Combining Preventive Measures and Sensor Arrays
7. Deploying CBRN Sensors
8. What to Do When an Alarm Triggers





Event and Public Protection Background

Terrorist attacks in the United States on both the Federal Building in Oklahoma City (1995) and the World Trade Center in New York City (1993 and 2001), along with international incidents such as the Tokyo subway attack with sarin gas, prompted the United States Congress to look at domestic preparedness for attacks utilizing Weapons of Mass Destruction (WMD). The initial response by the U.S. Congress was legislation known as the Domestic Preparedness Act. These bills funded training in the U.S. for emergency responders and acquisition of equipment to support their efforts. The following organizations are impacted by the law.

- Fire/HazMat (hazardous materials)
- Police
- EMS (emergency medical services)
- Hospitals

Baseline for Protection: Preparation

The Domestic Preparedness Act and the planning of first responders yielded increased insight into the challenge – as well as the realization that the greater the understanding of the hazards that are potentially present, the more feasible it is to implement a risk-based response at the lowest level necessary to prevent undue risk to responders while still protecting the public.

- Under-preparation and not having early recognition of potential chemical and radiation threats can lead to devastating consequences. Both first responders and the public will be at risk; and staff will not be able to monitor or get a cohesive depiction of the actual chemical or deadly atmospheric gas releases and potential airborne attacks.
- Over-responding can erode community confidence and public support for the responding agency if the response is perceived as unnecessary, expensive and time-consuming, especially if businesses are impacted, highways closed, or other measures that affect the community.
- Under-responding can lead to panic, mass-hysteria, injuries and loss of life. Additionally, subsequent news coverage might focus on the potential lack of preparation and/or response.

Chemical Warfare Agents (CWA)

Chemical Warfare Agents (CWA) are chemical compounds designed to either kill or debilitate opposing military forces, and is a concern today for security experts who acknowledge they can pose a lethal threat to civilians as well. These chemical agents have been subsequently refined for their particularly gruesome purpose, often using multiple chemicals to create so-called "dirty bombs." Safety experts refer to toxic industrial chemicals as TICs and toxic industrial materials as TIMs when the CWAs are developed from compounds and chemicals used in industry. Ironically, many chemical compounds designed to either kill or debilitate opposing military forces were originally developed from civilian TICs.

WMD preparedness programs initially focused only on military CWAs. However, it's clear that WMD and CWA response programs must include the many other equally deadly types of toxic chemicals that are widely available in many industries. Responders at the federal, state and local levels must look at ways to effectively measure these CWA compounds so decisions can be made with the confidence that comes with having actionable information about the threat.

PID Detectors for WMD and TIC Protection

HazMat responders are the front line of chemical response in the U.S. One of the primary tools responders use to measure toxic chemicals at ppm (parts per million) and now ppb (parts per billion) levels is a photoionization detector, or PID.

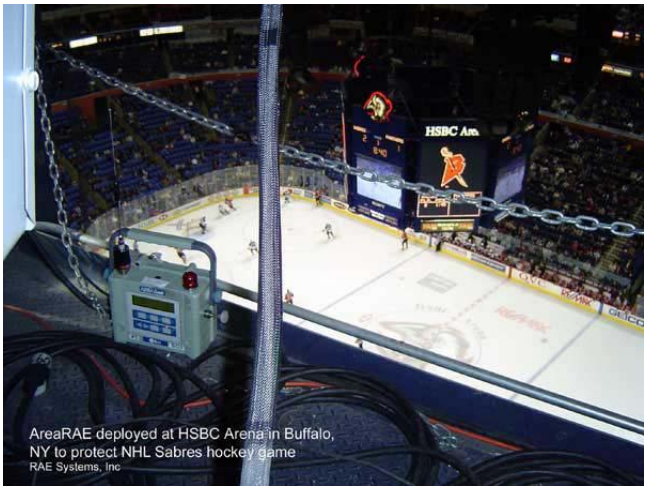
What is a PID?

A PID (photoionization detector) measures VOCs and other toxic gases in low concentrations from ppb (parts per billion) up to 10,000 ppm (parts per million or 1% by volume). A PID is a very sensitive broad-spectrum monitor, like a low-level LEL monitor. A PID uses an ultraviolet (UV) light source (photo = light) to break down chemicals to positive and negative ions (ionization) that can easily be counted with a detector.

Many HazMat responders use PIDs with confidence on most calls as a screening tool or to confirm an environment is safe to enter. These monitors accurately measure concentrations for identified chemicals. The role of PIDs as a primary screening tool for risk-based response to chemical hazards is illustrated here. Each circle represents the range of chemicals seen by a specific chemical detection technique.

PIDs can detect many substances that traditional CWA detectors are unable to measure. Also, PIDs are able to detect a wide variety of recognized military CWAs and nerve agents, such as Lewisite, mustard gas (sulfur mustards), phosgene ($COCl_2$), sarin (GB), soman (GD), tabun (GA), VX and GF. It also protects against vapors associated with many common explosives, such as ammonium nitrate/fuel oil (ANFO), nitroglycerin, blasting caps, blasting cord, semtex, C4 and dynamite.

No technique by itself is adequate to identify and measure all types of CWAs and TICs. By overlaying multiple detection techniques, however, first responders can provide a balance between broad-range and substance-specific detection necessary to develop the most prudent response.



Combining Preventive Measures and Sensor Arrays

Determining the level of risk of a CBRN attack or accident at any given location is extremely difficult. However, there are several preventive measures that building owners and operators can take to reduce the likelihood of a CBRN event occurring at their location. In addition, should an event occur, the strategic use of CBRN sensors throughout the building can significantly help mitigate damages and provide emergency personnel with life-critical data as they direct building occupants to safety.

1. **Know your building.** The quickest way for airborne CBRN agents to disperse through a building is through the heating/ventilation/air conditioning (HVAC) system. It is extremely important that facility managers and security personnel have a thorough understanding of the building's air circulating zones and how to alter or disable the system if necessary.
2. **Prevent access to outdoor air intakes.** The National Institute for Occupational Safety and Health (NIOSH) recommends that HVAC air intakes be placed a minimum of 12' above the ground and have a metal mesh cover angled at a minimum of 45º to prevent foreign objects from entering the HVAC system. Air intakes are also an ideal spot for CBRN sensors. A sensor placed at a building's air intake gives the earliest possible warning to security personnel of an outside CBRN threat.
3. **Prevent access to HVAC equipment and building plans.** Personnel with access to the mechanical HVAC equipment have full control of the building's air supply. Similarly, building plans with information such as how many ventilation zones the building has, and which air vents serve which rooms, should be kept in a safe, secure location with highly restricted access. HVAC equipment rooms are also ideal locations for CBRN sensors, as more air passes through these areas than anywhere else in the building.
4. **Develop and train an emergency response team.** A team of people with well-defined responsibilities should be created to ensure a safe and orderly response to a CBRN event. Some key responsibilities that need to be designated are: contacting the local fire department, shutting off or manipulating the building HVAC system, directing building

occupants to the safest location, and coordinating first aid. Part of the emergency-response training should include planning and rehearsing a typical response to a CBRN event.

Deploying CBRN Sensors

The quickest, safest and most accurate way to detect a CBRN threat is by using sensors. For facility and venue protection, several key areas should be monitored. As with any sensor array, the level of detection is largely determined by the overall number of sensors in the array. At a minimum, it is recommended that the following locations within a facility or venue be monitored with CBRN sensors:

- **HVAC outdoor air intakes.** The air intake system of a building offers the first response of any outside threat.
- **HVAC return air grilles.** Similar to outdoor air intakes, these internal grilles are used by the HVAC system to recirculate air within a building. If a CBRN event occurs close to a return air grille, there is risk of contaminating the entire building.
- **HVAC exhausts.** If a CBRN event occurs anywhere inside a building, a portion of the contaminant will eventually reach the building exhaust. In addition, in certain weather conditions, building exhausts can actually intake air into the HVAC system.
- **Mechanical areas.** These areas provide access to centralized mechanical systems, including filters, air handling units, and possibly boilers and water filtration units.
- **Lobbies and entryways.** Areas of buildings with public access are at greater risk for a CBRN event.
- **Densely populated areas.** Response time is critical for these areas, and a direct reading immediately followed by the sensing monitor's visual and audible alarms is the quickest way to inform nearby occupants of possible danger.
- **Mailrooms.** Due to the large amount of unmonitored packages entering the building, mailrooms are highly susceptible to terrorist threats.
- **Loading docks.** Areas where large packages enter the building should always be monitored.
- **Storage areas.** These areas provide ample space and are rarely monitored by security personnel. This makes storage areas an attractive target for CBRN events.
- **Stairwells.** Stairwells are typically used as the primary evacuation route for occupants on higher floors. It is important that any escape path is monitored for safety during an evacuation.

Response Scenarios Using Detection

Prevention is key to successfully keeping major events safe. While terrorist attacks are a real threat at large, high-profile events, other dangerous gas or combustion risks also can range from innocent gas leaks to carbon monoxide poisoning.

- *During the Special Olympics 2009 Winter Games in Idaho, many propane-heated tents were used throughout the event. RAE Systems' monitors detected propane leaks from several tanks used to heat the tents. As a result of monitoring, the tank-line seals were replaced before an incident could occur.*
- *At two separate events – NASCAR and Super Bowl XLV – RAE Systems' detectors went into alarm with readings for high radiation. In both incidents, event attendees had recently undergone Barium stress tests. The people were identified and given special badges to alert security personnel.*
- *Carbon Monoxide (CO) from vehicles is another common risk at large events. CO gas can build up in overcrowded loading zones, inside staging areas or from inbound/outbound traffic. Carbon Monoxide is a colorless, odorless, tasteless gas that is toxic and poses health risks. It can only be detected by using a CO-detection monitor.*

What to do When an Alarm Triggers

Once an alarm is triggered, timely decisions must be made that will ensure the safety of as many building occupants as possible. Responses to different alarms will vary greatly, depending on the location and nature of the alarm. Below are general guidelines that should be followed in the event of a sensor alarm.

1. **Validate the alarm.** Not only can false alarms be costly and time consuming, they also can diminish the sense of urgency thereby putting first responders and others in danger. This makes it extremely important to validate triggered alarms. First, check for alarm sustainability. If the monitor returns to normal operation after only a few seconds of alarm status, the alarm likely can be attributed to a temporary atmospheric condition or a system malfunction. Regardless, sensors should be inspected following a suspected false alarm.
2. **Alert local authorities.** If a triggered alarm is real and sustainable, the first step is to immediately alert the local authorities, typically the fire department or local HazMat team. When alerting local authorities, it is important to identify the type of alarm so emergency responders can come prepared with the proper equipment.
3. **Adjust the HVAC system.** Once the proper authorities have been alerted and additional help is on the way, the next step is to adjust the building's HVAC system to minimize the spread of the CBRN contaminant. Adjustments to the building HVAC equipment should only be performed by someone who is properly trained and knowledgeable about the system. Improper adjustments could result in increased injuries or casualties. For an outdoor CBRN event, the first indication of danger typically comes from a sensor deployed at the building's HVAC air intakes. A "protect-in-place" strategy should be deployed as building occupants will likely be safer inside the building than they would be if evacuated outside where the CBRN event occurred. When a monitor at an HVAC air intake is triggered, security personnel should direct all building occupants to stay indoors and immediately shut off all of the building's HVAC systems. All doors or windows that lead outside, along with all internal doors, should be shut to minimize airflow inside the building. At the same time, elevators need to be disabled to ensure that a "piston effect" is not created that can cause outside contaminated air to be drawn indoors. Building occupants should gather in a pre-identified location, typically a room with little to no air exchange with the outdoors or building.
4. **Get occupants to safe locations.** The next and most crucial step is to instruct all building occupants to the safest locations. For an outdoor CBRN event, building occupants should gather in a pre-identified indoor location, typically a room with little to no air exchange with the outdoors or the rest of the building. For an indoor CBRN event, building occupants should be evacuated if the escape route is shown to be free of contaminants. A sensor placed in a stairwell or by emergency exits can typically verify the safety of escape routes. Many buildings have equipment that can pressurize the stairwells with outdoor air as a standard fire-safety technique. Once outdoors, security personnel should direct occupants to gather at a pre-defined location that is upwind from the CBRN event. Portable monitors also should be used at gathering points to ensure each location is free from potentially hazardous contaminants.

Summary

Nothing can protect public-venue events from chemical or radiation threats better than a well designed and practiced emergency-response plan. Preparation is key to securing any major event, including developing a plan that provides a balanced level of response to any specific threat. It's important not to over- or under-react to threats. Ideally, implementing risk-based responses at the lowest level of response necessary to prevent undue risk to responders and the public is the best approach.

At the same time, it's important to understand the kind of threats out there that could impact the event and make sure reliable, proven detection equipment to support continuous, around-the-clock monitoring efforts are being employed.

Finally, knowing the ins and outs of the venue location being protected can go a long way in making sure most contingencies are considered. Utilize experts to recommend the best monitoring strategy for the venue, while considering many of the best-practice approaches used by security experts to ensure monitors are placed in the most strategic areas for keeping people safe.

While no single technique or detection approach can identify all types of CWAs and TICs, a layered approach is considered by security experts as the most practical way of securing public-venue and sporting events. By overlaying multiple detection techniques, a balance between broad-range and substance-specific detection can be reached to develop the most prudent response plan.

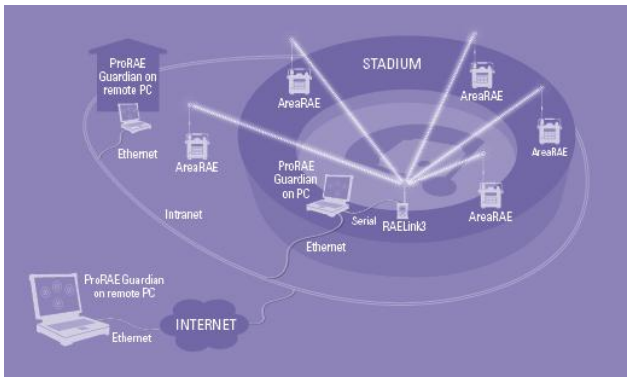
RAE Systems delivers a wide range of solutions with a demonstrated track record for keeping public-venue and sporting events safe from deadly chemicals, combustible gases and radiation.

Learn More: Additional Useful Information and Ideas

1. Download your free Venue Protection Checklist now **HERE** (http://bit.ly/noq7CO)
2. Register for a free Event Hazard Assessment **HERE** (raesystems.com/public-event)
3. Read about how RAE Systems protected the NFL Super Bowl, Kentucky Derby and other major and local events **HERE** (raesystems.com/public-event)
4. Download an eBook on Event Radiation Detection **HERE** (http://www.raesystems.com/radiation-white-paper)
5. For further information on how to safeguard buildings from CBRN events and how to respond to CBRN events, please reference the following documents:
    a. National Institute for Occupational Safety and Health (NIOSH), *Guidance for Protecting Building Environments from Airborne Chemical, Biological, or Radiological Attacks*, 2002.
    b. Lawrence Berkeley National Laboratory, *Protecting Buildings from a Biological or Chemical Attack: Actions to Take Before or During a Release*, LBNL/PUB-51959, 2003.
    c. US Army Corps of Engineers Protective Design Center, *Protecting Buildings and Their Occupants from Airborne Hazards*, Technical Instruction 853-01, 2001

About RAE Systems, Inc.

RAE Systems offers a variety of chemical, biological, radiological, and nuclear (CBRN) rapidly deployable and custom-configurable sensor solutions for incident response and public-venue monitoring. RAE Systems delivers cohesive, wirelessly connected threat-detection solutions that create a layered defense against CBRN threats and other gas and combustible risks at major venues.



RAE Systems' chemical- and radiation-detection equipment provides rapid, scalable and highly adaptable deployment at a wide variety of locations that require additional security against terrorist or accidental threats.

RAE Systems' experienced technical-detection consultants use the company's wide range of gas- and radiation-detection solutions to deliver around-the-clock monitoring for planned or accidental deadly atmospheric gas releases and potential airborne attacks. RAE Systems' solutions to venue 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 event officials and first responders with real-time information on potential hazards.
- **Proven**: With more than 11 years of experience, RAE Systems' innovative solutions have a verified track record.

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.

The Silicon Valley-based 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.