Smoke Detection Solutions for Challenging Environments
Agenda

- The Detection Triangle – A Balancing Act
- Harsh and/or Industrial Environments
- New advances in Open Area smoke detection
  - Traditional Beam Detection Challenge
  - Technology Breakthrough – OSID
  - Field-proven applications
- Industrial Very Early Warning Smoke Detection
  - ASD Overview
  - ASD in Industrial Environments – The VLI (Industrial)
  - Field-proven applications
- Beyond Smoke – Air Sampling ‘Gas’ Detection
  - Leverage Vesda to provide gas detection
  - Overcomes spot gas detector challenges
- Q & A
Optimum Protection Requires a Balance

Challenging environments complicate achieving optimum protection
The Detection Triangle

- Provides the highest level of detection to ensure protection of...
  - Life
  - Property
  - Business continuity
  - Environment

- Without false alarms that
  - Create disruptive false or nuisance alarms
  - De-sensitize personnel and occupants to alarms
  - Ultimately leading to disregarding alarms or disabling safety systems
  - Place an extra burden on local first responders

- At an affordable cost
  - Initial installation cost
  - Long term operating, servicing, and testing costs
Challenging Environments

A ‘Challenging Environment’ is a space where:

- **Detection is difficult due to:**
  - Environmental conditions that cause false and nuisance alarms
  - Environmental conditions that shorten detector life
  - High and variable airflows
  - High ceilings

- **Detector sensitivity and longevity are compromised in ‘harsh’ environments due to:**
  - Dirt and dust
  - Temperature extremes
  - High EMI
  - Moisture, fog, steam, water condensation
  - Birds and insects
  - Building movement
  - Sunlight
  - Detector location
  - Toxic and corrosive gases
Challenging Environments

A ‘Challenging Environment’ is a space where:

- **Maintenance is difficult**
  - Extreme environmental conditions
  - Inaccessible areas
    - High ceilings
    - Roof or floor spaces
    - Within elevator shafts
    - Equipment racks
  - Restricted access
    - High security areas
    - Production areas
    - 24/7/365 operation

- **Unobtrusive detection is required**
  - To prevent vandalism or tampering
  - Not disruptive to architectural designs
  - Preservation of historic buildings and artifacts

- **Evacuation may be challenging**
  - High concentration of large number of people
  - Exit paths are restricted
  - Occupants require assistance
New Advancements in Open-area Detection

Open-area Smoke Imaging Detection
- Technical obstacles overcome
- Applications

Very Early Warning Smoke Detection
- ASD Overview
- Deploying ASD in industrial environments
- Field-proven applications
- ASD requirements matrix
Awards and Recognition

- 2012 Poznan International Fair Gold Medal
- ASIS 2011 Accolades
- New Product Innovation Award in Fire & Life Safety - North America, 2011
- 2011 Fire Excellence Awards - Best Detection and Alarm Product Award
- 2011 New Product Showcase (NPS) - Judge’s Choice Award at the ISC West.
- 2010 Hot Technology by Network Products Guide
Challenges with Beam Detectors

False alarms due to…

- Dirt
- Dust
- Steam
- Insects
- Banners
- Fork lift trucks

- Ladders
- Banners
- Building movement
- Building vibration
- Sunlight
- Reflected sunlight
The improvements over traditional beam detectors stem from four core design ideas:

- Dual-wavelength light frequencies
- Digital imaging vs. photodiodes
- A unique method for aligning
- Smarter algorithms
Overcoming Conventional Challenges

- **Large particle obscuration rejection**
  Use of UV & IR in specific wavelengths assist in evaluating whether obscuration is caused by small particles in the physical size resembling smoke or from larger particle (i.e. dust, steam, insects, fork-lift, ladders, etc.)

- **Tolerance to building shift and vibration**
  The multiple pixels of a CMOS imaging chip as opposed to a photodiode along with the uniquely coded light beam from an emitter provides the ability to track the position and tolerate movement

- **Foreign light intrusion**
  The Imager is fitted with a dyed glass filter, designed to be almost opaque except to all but two wavelengths of interest
Dual-wavelength vs. Single IR Beam

- Active emitter LEDs transmit wide beam IR and UV to the Imager
  - IR and UV have differing wavelengths
  - Respond differently to smoke
- Relative strengths of the UV & IR are compared
  - Detect smoke
  - Discriminate against particulates that cause nuisance alarms on traditional beams
- Software locates illuminated pixels on the CMOS imager
  - Each emitter is uniquely coded
- Imager software tracks building movement
  - No controlled motor drives
**Powerful Benefits**

- **Imager versus photodiode**
- One imager equals 100,000’s of photodiodes
- An Imager locates and tracks the position of an emitter anywhere in its field of view at pixel level
- Can operate reliably in all lighting conditions; bright day / sunlight to total darkness

Actual view from a 45 degree imager with 4 emitters in a 13,500 sq ft area
Installation & Commissioning

- Simple and easy installation using a unique Laser Alignment Tool
  - Requires only rough alignment due to the wide angle of view of the imager(s)
  - Up to 70% time saving compared to traditional beams

- Beam length up to 492 ft
  - Outperforming traditional beams by up to 50%
Reliability Benefits

- Excellent false alarm immunity to dust, steam, insects, objects and structural movement
- Eliminates false alarms by automatically compensating for building movement
- No moving motor parts eliminates hardware failures
- Operates in all ambient lighting conditions
- Not affected by nearby reflecting surfaces
- No false alignment due to reflecting on fog
- Ability to compensate for high air movement
Financial Benefits

- Low implementation costs because of simple and fast installation and alignment
  - *Only the Imager unit has to be wired (battery powered Emitters)*
  - *Power can be supplied from panel*
  - *Fast and simple coarse manual alignment*

- Lower maintenance cost for larger areas
  - *Test filter at the Imager or Emitter*
  - *No intervention costs for misalignment*
Real Field Challenges
Overcome by Open-area Smoke Imaging Detection
OSID Applications

- Atriums
- Stadiums
- Historic / Cultural Buildings
- Tunnels
- Logistics
- Generator Turbine Halls
- Stadiums
- Event Centers
- Concert Halls
- Airports
- Train Stations
- Long Corridors
- Industrial infrastructure
- Large Open Spaces
Long Distances

- Reliably detecting at 497 ft
- Allows for 20% setting at 430 ft
- Aligned through metal support structure of the roof
End-user was considering linear heat cable for ‘controlled’ burn down…
Semi-open Warehouse

- Example of the effect of condensation on the emitter
- No differentiation between IR and UV and hence no alarm nor faults
Chicken Farm

- Spikes with up to 20% when chickens run around.
- Estimated time between cleaning of lenses 2-3 month
Recycling Plant

Estimated time between cleaning of lenses 1 month
Direct Sunshine

Disregarding the ‘avoid East – West direction’ recommendations, Dual Wavelength only generates a saturation fault when exposed directly to the sun.
Industrial Very Early Warning
Smoke Detection
New Advances in VESDA

Open-area Smoke Imaging Detection and Applications

- Technology overview
- Field-proven applications

Very Early Warning Smoke Detection

- ASD Overview
- Deploying ASD in industrial environments
- Field-proven applications
What is Very Early Warning Smoke Detection

- A detection system that **actively** draws multiple air samples from a fire zone, via a pipe network, to a centralized detector.
Equivalency

- NPFA 72
- CAN/ULC-S529-02
- BS5839-1
- AS1670

Each sampling port of an Aspirating Smoke type smoke detector shall be treated as a spot.
Cumulative Smoke Detection

- ASD exploits the **cumulative effect**
  - all smoke entering a sampling hole contributes to the detector’s smoke reading

- Smoke diffuses throughout a space... the more diffuse the more holes it enters...

- An alarm can be triggered by
  - A localized high concentration of smoke
  - A widespread low concentration of smoke
Simplified Test & Maintenance

- ASD enables remote sampling and test
- Verify air flow and smoke transport time enables testing at last hole

Only smoke in last hole

Easy access test point
Why Very Early Warning?

1. When business continuity is paramount
2. When smoke is difficult to detect
3. When maintenance access is difficult
4. When unobtrusive detection is required
5. When evacuation is a challenge
6. When environmental conditions are difficult
7. When suppression systems are present
8. When smoke and gas detection is required
Very Early Warning Smoke Detection in Industrial Environments
Perceptions of ASD

- Designed for the cleaner environments
- Industrial applications beyond ASD capabilities
- Market skepticism still exist

ASD Comfort Zone
(Roots in Data Center and Telecommunications)

ASD Comfort Zone
(Roots in Data Center and Telecommunications)

Historically ASD system designs in all industrial environments required system application engineering
Industrial Applications Require More from ASD

- Improved general protection
  - Hardened product enclosure – IP/NEMA rated
  - Eliminate need for secondary enclosures

- Longer pipe run to accommodate larger facilities

- Greater visibility of status LED

- Improved filtration
  - External filtration can stress system maintenance
  - Eliminate need for external filters

- Field serviceable modules
  - Less down time
  - Lower spare part inventory

- Lower long term operating costs

- Establish standard to quantify contamination resistance
Fit for purpose Industrial ASD

- IP54 Enclosure
- Intelligent filtration
- 4 x 300ft. pipe runs
- High intensity status LED
- Field serviceable – modular construction
Intelligent Filtration

- Reduce contaminates entering detection chamber
- Innovative flow partitioning and HEPA filtration
- Continuous monitoring of filter and airflow
- Optimum detector sensitivity over detector life.
Modularity Delivers Lower Total Cost of Ownership

- Detection chamber
- Aspirator
- Electronics
- Filters

Fewer spare parts – less down time
Enhanced filtration & IP-rated enclosure can reduce Total Cost of Ownership by 40 to 60%
- Up to 2,000m² (20,000 sq. ft.) coverage
- 4 inlet pipes
- **Total pipe length up to 360m** *(1,200 ft)*
- Five (5) high-intensity status LEDs for greater visibility
- Referencing
- AutoLearn™ Smoke and Flow
- Air-path monitoring
- Five (5) relays (Fire, Fault and 3 configurable)

- Direct connection via USB
- Native TCP/IP
- Xtralis VSC, VSM and ASPIRE2 software support
- Easy mounting via steel support bracket
- Easy cable termination access
- Metric and imperial pipe entry ports
- Standard GPI feature
- IP 54 Enclosure (30 psi)
Illovo Sugar Mill – Pipe Network Design & Installation

ASD Detector in Protective Enclosure

Industrial ASD Detector
Cook Colliery – Underground Mine
Cook Colliery – Pipe Network Design

- 89 m approx. Pipe 4 run in Total to Pit bottom isolator – Approx 5m spacing
- 44 m approx. Pipe 2 run in Total Conveyor (CV3)
- 24 m
- 16 m
- 16 m
- 32 m
- 32 m
- All pipes – 3.0 m to Centre of
- 5.5 m
- 0.5m Pipe distance to Ceiling
- 44 m approx. Pipe 3 run in Total Conveyor (CV10) – Approx 6m spacing
- 10 m to Argo Seam Access Pipe
- 22 m Drop between Castor and Argo Seam
- 20 m approx. straight run
- 2 m Drop to Castor Seam Floor
- 25 m run to Pit Transfer Station
- 12.0 m pipe run across Tunnel
- 71 m approx. Pipe 1 run in total Conveyor (CV2) – 2.5 m spacing

CASTOR SEAM Pit Bottom Isolator Area
CASTOR SEAM Drive Units and Conveyors
ARGO Pit Bottom Tunnel – Drive Unit & Conveyor
Cook Colliery Installation
Wood Pellet Storage
Electrical Rooms
Battery Rooms
Cable Tunnels
- Mining
- Manufacturing
- Processing Plants
- Conveyor protection
- Petrochemical Plants
- Tunnels
- Power Generation
- Pulp & Paper Production
- Warehouses
- Water Treatment
- Transport
- Timber Production
- Fertilizer Plants
- Abattoirs
- Laundries
- Cold Storage
- Textile
- Lift shafts
- Stables, and more….
What about when the hazard is more than just fire?

Solution:

- ASD-based Gas Detection
- Environmental Monitoring

“ECO”
Multi-hole Aspirated Gas and Smoke Detection
VESDA ECO

24/7 Active Sampling & Detection

Air actively drawn through pipe network with multiple sampling holes to the **Aspirated Gas Detector** then to the **Aspirating Smoke Detector**

**Protects**
- ✓ Plant / equipment
- ✓ Personnel safety

**Detects**
- ✓ Toxic gases
- ✓ Flammable gases
- ✓ Oxygen deficiency
- ✓ Fire (Smoke)

**Potential for better performance**
- ✓ Remove guess work from detector placement
- ✓ Greater area coverage

**Potential for lower total cost of ownership**
- ✓ Lower initial install
- ✓ Lower long term operation
Inherent Advantages of VESDA ECO

• Active 24/7 monitored sampling versus diffusion
• Ability to condition air stream
  ─ Enables use in harsh environments
    ● Temperature extremes
    ● Wet
    ● High EMI
    ● Dirty
    ● Hard to access areas
  ─ Extends detector life
• Minimize / eliminate need to run cable and conduit
• Mount detectors away from detection spaces
  ─ Simplified installation
  ─ Ease of access for testing and servicing
  ─ Eliminate process / personnel disruption during servicing
• Take the guess work out of detector placement
• Lower total cost of ownership
• Non-intrusive sampling to satisfy architectural or security concerns

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## Gases Detected

<table>
<thead>
<tr>
<th>Combustible</th>
<th>Toxic</th>
<th>Other</th>
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</thead>
<tbody>
<tr>
<td>Methane</td>
<td>Carbon monoxide</td>
<td>Oxygen deficiency</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>Ammonia</td>
<td>Oxygen enrichment</td>
</tr>
<tr>
<td>Propane</td>
<td>Hydrogen sulfide</td>
<td>Carbon dioxide</td>
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<tr>
<td>Pentane</td>
<td>Nitrogen dioxide</td>
<td></td>
</tr>
<tr>
<td>Gasoline</td>
<td>Sulfur dioxide</td>
<td></td>
</tr>
<tr>
<td>Alcohol</td>
<td>Chlorine</td>
<td></td>
</tr>
<tr>
<td>Ammonia</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
VESDA ECO Product Overview

- Plug and play factory calibrated replaceable sensor cartridges
- Single or dual sensor cartridges
- Two adjustable alarm thresholds per sensor
- On board relays, 4-20mA, and RS485 Modbus
- Event logging (50,000 events)
- Calibration port
- Class 1 Division 2 models available
- Can be installed in new or existing ASD systems
Value Proposition: Eliminate guess work in detector placement

- Increase sampling points provide better area coverage to detect smaller leaks
- Provides equivalent coverage with fewer detectors
- Better detection in ventilated spaces
- Reduced maintenance cost with easier access
Value Proposition: Lower Total Cost of Ownership

Conventional Point Detector Solution

- Smoke and gas detectors
- Detector installation and wiring
- Detector test and maintenance

ASD / AGD Solution

- Initial installation costs
- Operating and maintenance costs
Applications Expanding

- **Data & Telecom Centers**
  - Battery rooms

- **Power and Energy**
  - Gas fired equipment
    - Turbines
    - Boilers
  - Coal power generation (CO, Hydrogen)
  - Wood pellet (CO, Oxygen)
  - Hydroelectricity (Oxygen and Hydrogen)
  - Fuel Cells (Hydrogen)

- **Refrigeration / Cold Stores**
  - Distribution centers
  - Dairy operations
Latest Applications

- **Metal Processing/Refining**
  - Hot strip mills
  - H2S

- **Transportation**
  - **TUNNELS**
  - Loading bays
  - Car parks

Power of ECO – 1 ECO vs 5 point detectors
Steel Mill – Tunnel Protection

- 300 foot tunnel under electric reheat furnace
- Furnace utilizes nitrogen protective atmosphere – risk of oxygen depletion (asphyxiation)
- Cable trays – risk of fire

Solution: Industrial ASD + Oxygen
Cold Storage Facilities

Risk
A fire and toxic gas risk due to excessive build-up of Ammonia and reduced ventilation rates. Ammonia (NH3) is commonly used in the cooling process. Significant costs to maintain traditional gas detection. Challenges to late stage fire detection.

Vertical Markets
• Logistics
• Warehousing
UPS and Battery-charging Rooms

Risk
A fire and explosive gas risk due to excessive build-up of Hydrogen and reduced ventilation rates. Hydrogen ($H_2$) is generated during the charging phase of battery operation.

Vertical Markets
- Telecommunication Centers
- Data Centers
- Oil & Gas, Petrochemical
- Energy Production
- Transportation
- Commercial
Process Buildings, Shelters, etc.

Risk
A fire, explosive, toxic gas risk, due to leaks, a gradual build-up and/or inadequate ventilation. Methane, H2S, SO2, Piped gases. Oxygen depletion is also possible.

Vertical Markets
• Tele/data communication
• Oil & Gas, Petrochemical
• Energy Production
• Transportation
• Manufacturing
• Metals Refining
Risk
A fire, explosive, toxic and Oxygen depletion risk, due to a gradual build-up and inadequate ventilation. Methane & Hydrogen Sulfide ingress from local sewage systems or landfill decomposition, or Natural Gas from local gas main supplies. Piped gases.

Vertical Markets
• Tele/data communication
• Oil & Gas, Petrochemical
• Energy Production
• Transportation
• Education (Universities)
VESDA ECO…

• Reduces the guess work in gas detector placement
  — Sample an area, not a point in space
  — Better area coverage
  — More tolerant of changing environmental conditions (i.e. air flow)

• Potentially lowers initial equipment costs
  — ASD plus Gas
  — Easy to install to ASD
  — Little to no cabling
  — Fewer detectors possible

• Potentially lowers operating & maintenance costs
  — Easy access to ASD and AGD
  — Less test and calibration gas and labor
  — Fewer detectors to maintain and replace
Q & A
Contact Details

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  - Application Notes
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