Homeland Security

S&T Stakeholders Conference

CHEMICAL DETECTION PROGRAM

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PARTNERING FOR A SAFER NATION

OUTLINE

- Introduction
- Chemical Detection Projects
  - ARFCAM / LACIS
  - Integrated CBRE Detection Demo
  - Low Vapor Pressure Chemicals
- Summary

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DHS S&T Chemical Detection Program

OBJECTIVES

- Develop chemical detection systems for facility monitoring, deployment to special events, and first responder usage.

Goals

- Ability to detect and identify a wide range of chemical substances of concern for civilian defense against acts of terrorism
- Ultra-low false negative and false positive response rates
- Form partnerships with the private sector to develop detection systems that can be acquired by localities under various homeland security grants programs

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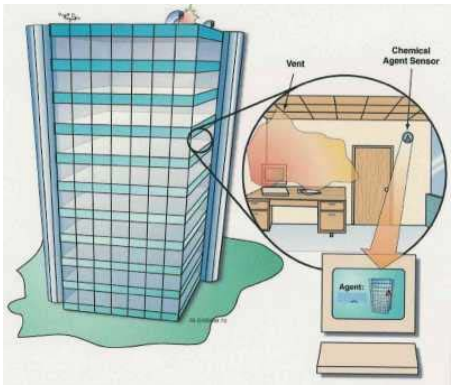
Autonomous Rapid Facility Chemical Agent Monitor (ARFCAM)



Bruker

***Objective*:** Develop, demonstrate, and commercialize a networked capability to continuously and autonomously detect and identify the presence of a broad range of toxic chemical hazards for facility protection.

Challenges:

- *Selectivity* for target agents and against common backgrounds
- *Wide dynamic range*: IDLH to PEL
- Ultra-low false alarm rates
- Varying temperatures and RHs
- *Speed:* target <1 min (IDLH)/15 min (PEL)
- *System cost:* $1,000/10k units

Schedule:

- FY04: Initiated program
- FY05: Down-select for lab prototype
- FY07: Down-select for "field" prototypes
- FY08: Complete "field" prototypes
- FY09: Complete test bed trials and IT&E
- FY10: Down-select prototypes for developmental field testing (DT&E)
- FY11: Complete DT&E, transition

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Lightweight Autonomous Chemical Identification System (LACIS)

Smiths Detection

***Objective*:** Develop, demonstrate, and commercialize a networked responder capability to detect and identify a broad range of toxic chemical hazards to assess a scene for contamination and provide guidance on PPE use.

Challenges:

- Selectivity for target agents and against common backgrounds
- Wide dynamic range: IDLH to LOD
- Speed: ≤ 10 min warm-up
  ≤ 2 min response (IDLH & LOD)
- System cost: $2,000/10k units

Schedule:

- FY04: Initiated program
- FY05: Down-select for lab prototypes
- FY07: Down-select for "field" prototypes
- FY08: Complete "field" prototypes
- FY09: Complete test bed trials and IT&E
- FY10: Down-select prototypes for developmental field testing
- FY11: Complete DT&E, transition

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Current ARFCAM and LACIS Technologies

ARFCAM	IMS	DMS	GC
Bruker Daltonics	✓		
Smiths – Watford	✓		✓
Hamilton Sundstrand	✓	✓	

LACIS	IMS	Chemi-resistors	Metal Oxides	MS
SRD Corp			✓	
Smiths – Edgewood	✓	✓		
Purdue University				✓

IMS = Ion Mobility Spectrometry
DMS = Differential Mobility Spectrometry
GC = Gas Chromatography
MS = Mass Spectrometry

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TIC LIST - LACIS/ARFCAM Prototype Testing

TIC	IDLH (mg/m^3)*	PEL (mg/m^3)**
Acrolein	4.59	0.23
Acrylonitrile	184.47	4.34
Ammonia	208.96	34.83
Arsine	9.56	0.2
Chlorine (gas)	29	2.9
Cyanogen chloride (CK)***	50	0.6
Ethylene oxide	1441.41	1.8
Formaldehyde	24.56	0.92
Hydrochloric acid	74.5	7
Hydrogen cyanide (AC)	55.27	11.05
Phosgene	8.09	0.4
Sulfur dioxide	262	13

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Documentation for Concentrations:

* NIOSH Chemical Listing and Documentation of Revised IDLH Values

** NIOSH Pocket Guide to Chemical Hazards

*** Extrapolated and estimated from AC data

CWA / Interferents - LACIS/ARFCAM Prototype Testing

CWA	IDLH (mg/m^2)	PEL (mg/m^2)
Lewisite (L)	0.23*	0.003
Sarin (GB)	0.1	$3x10^{-5}$
Sulfur Mustard (HD)	0.7	0.0004
Tabun (GA)	0.1	$3x10^{-5}$
VX (Nerve Agent)	0.003	$1x10^{-6}$

* AEGL 2 value at 30 min (www.epa.gov/oppt/aegl/chemlist.htm)

LACIS Phase II Interferents
Aqueous Film-Forming Foam (AFFF)
Diesel Exhaust
Gasoline (87 octane) exhaust
Second Hand Smoke

ARFCAM Phase II Interferents
Clorox Bleach
Diesel Exhaust
Paint Fumes (Glidden America's Finest Interior Latex Flat Wall Paint - HM1224 White)
Windex
Zep Perimeter Floor Stripper

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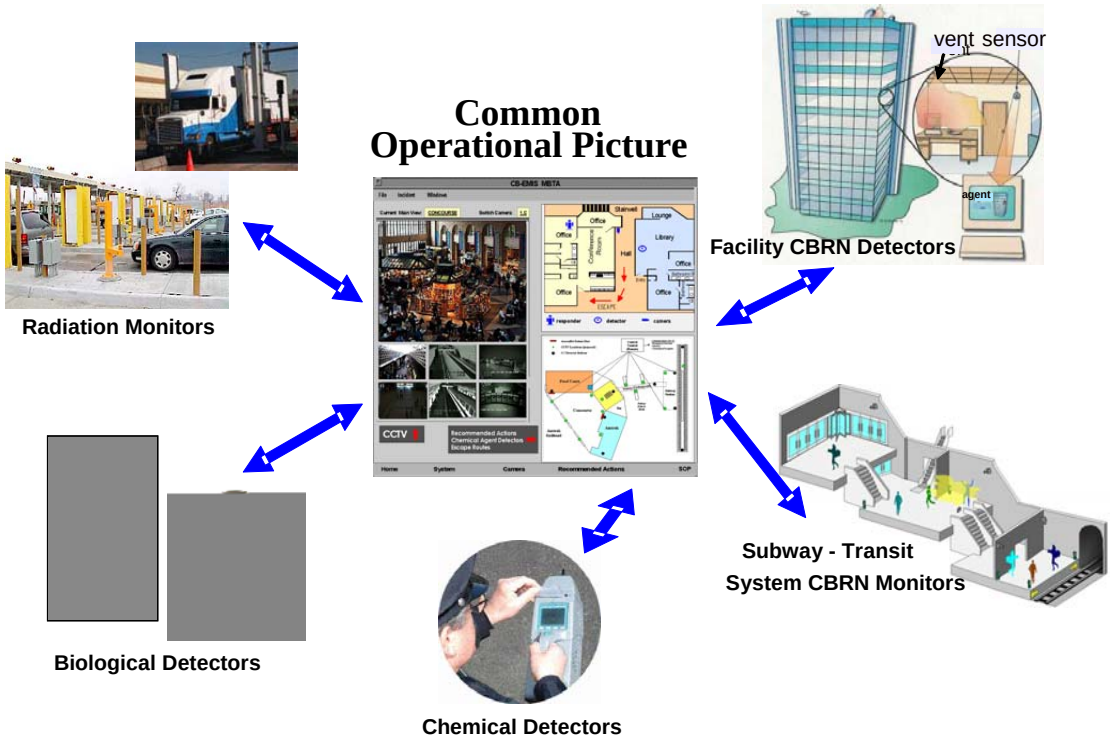
Integrated CBRE Detection System

Objective:
An architecture that integrates reporting from disparate chemical, biological, radiological, and explosive detection and collection systems. This 'system-of-systems' provides timely CBRN(E) detection, identification, and assessment of the threat, and enables response actions by appropriate local, state and federal officials.

Schedule:
- FY07 - Architecture Study
- FY08 - Pilot chem / bio system in two cities
- FY09 - Integrate rad / exp systems in large-scale demo
- FY10 - Complete technical data package, commercialize



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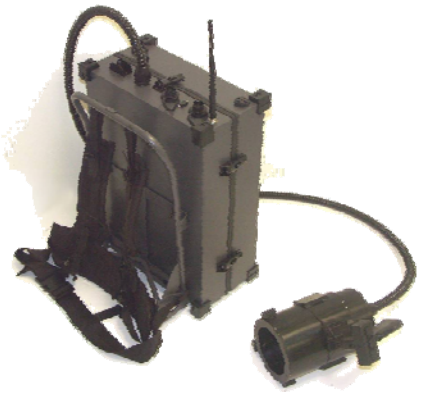
Low Vapor Pressure Chemical Detector

Objective:

- Stand-off surface detection of persistent chemical threat substances having low vapor pressures (<10^{-4} Torr)

Advantages:

- UV-Raman for stand-off detection – no need to collect/transfer analyte to spectrometer for detection and identification
- Leverages extensive DoD development
  - JCSD-ACTD (vehicle mounted)
  - LISA Inspector (cart mounted)
- No consumables



Backpack < 18 kg

LISA Manportable: UV-Raman Sensor

Challenges:

- Miniaturization
- Time to scan large surface areas when contaminant location is unknown
- Fluorescent surfaces

Schedule:

- FY06 – Project Initiation
- FY07 - Prototype developed
- FY09 – Engineering Development Model
- FY10 – DT&E

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