The Engineer's Role in Homeland Security

Panel 1: Protecting Critical Assets

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April, 2003

Outline

- Prologue
- The Homeland Security Mission
- The Threats
- The Defense Industry's Role
- Programs to Protect Critical Assets
  - Nationally
  - Regionally
- The Engineer's Role: Pre/Post 9/11/01
- The Engineering Society's Role
- Recommendations/Conclusions
- Epilogue

The Threatened Infrastructure

Buildings

Sea Ports

People

Tunnels

Bridges

Airports

Power/Info/Comm Systems

Types of Terrorism

- Type I – Traditional, Carried Out by an Individual or Small Group for Reasons of Their Own
- Type II – Conducted by Dysfunctional State Against Its Own People or Others
- Type III – When Type I Finds and Obtains Resources From Type II

Louis M. Branscomb – 27th AAAS Colloquium on Science & Technology Policy, April , 2002, Washington, D.C.

Challenges to Our Ability to Treat Terrorism

- Is It a War or Is It a Crime?
- Is It a Domestic Problem or a Foreign Problem?
- Is It a Short-Term Issue or a Long-Term Issue?
- Is It the Government's Responsibility or Is It the Citizens' and the Private Sector's Responsibility?

Our Vulnerable Society

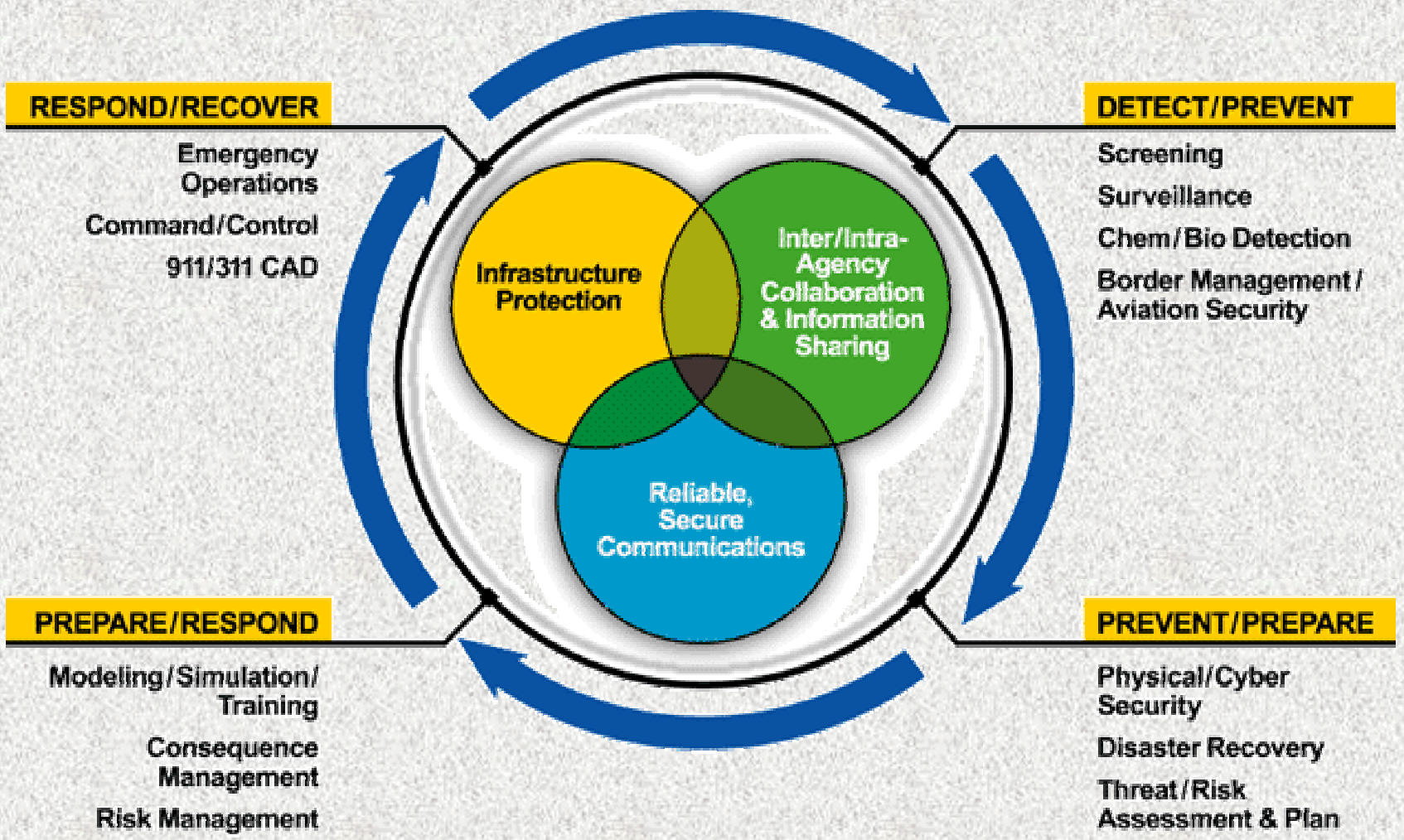
- An Open, Accessible Society
- Ubiquitous Infrastructure
- Emphasis on Efficiency and Competitiveness
- Globalization

Homeland Security Mission

Objectives

- Deterrence – Detecting, Denying, and Discouraging
- Prevention – Denying the Means
- Preemption – Denying the Opportunity
- Crisis Management – Immediate Effects
- Consequence Management – Downstream Effects
- Attribution
- Response

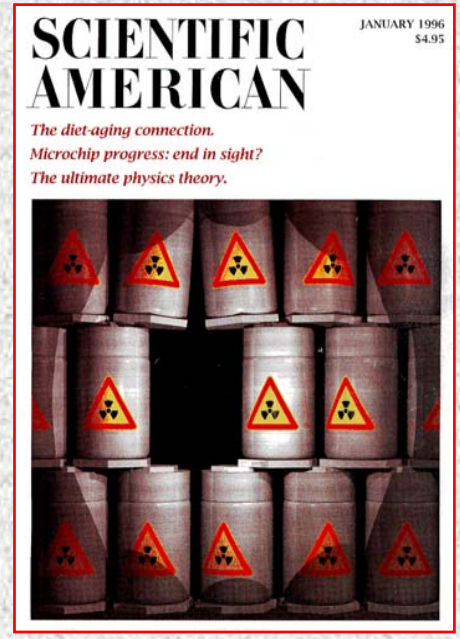
Homeland Security Cornerstones

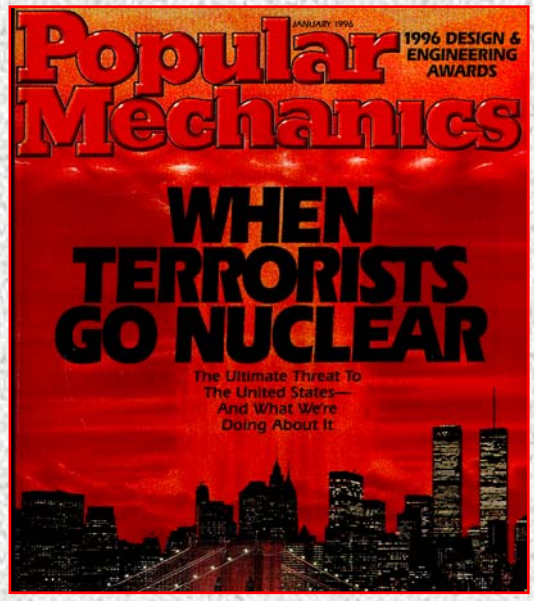


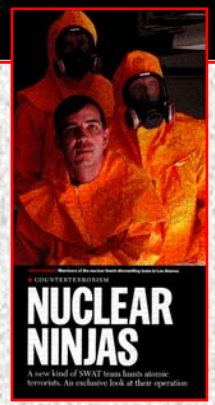
The Defense Industry's Role

- The Defense Industry (DI) Is a Leading Provider of Technology Solutions and Services Across the HLS Mission Spectrum:
  - Detection, Intelligence, Reconnaissance and Surveillance
- DI Has a Major Presence in All HLS-Related Mission Agencies
  - DoD
  - Intelligence Community
  - Civil Federal, USPS
  - State/Local

Heightened Public Awareness of Terrorism

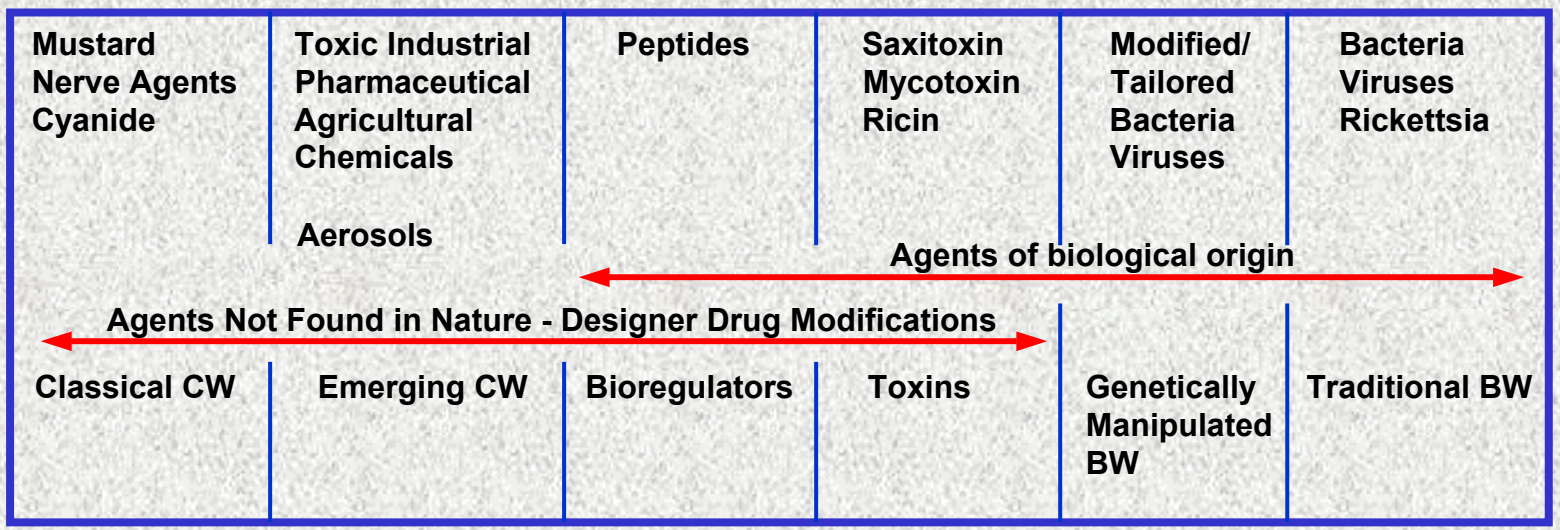






Senator Richard Lugar: "Illicit trafficking in nuclear material is the most serious direct threat to US interests today and in the foreseeable future"

Threat Spectrum of CB Weapons of Mass Destruction

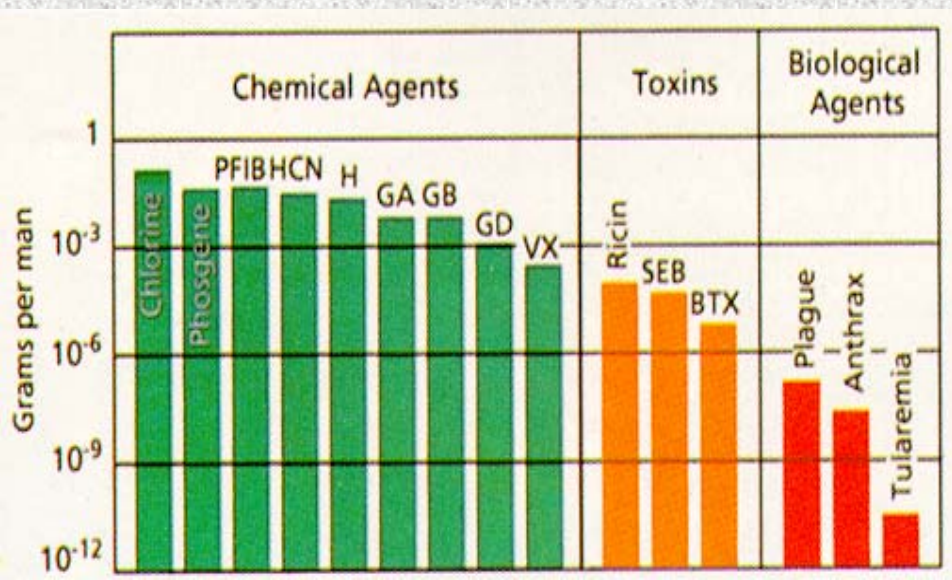


- Potential CBW Spectrum is Broad and Extends Beyond Vintage WW I Agents
  - Toxicity Increases from Left to Right
  - Feasibility of Use and Ability to Produce in Quantity Has Increased

Source: Pearson, G.S. "Biological Weapons: A British View," Biological Weapons, Weapons of the Future? : Center for Strategic and International Studies, 1998.

Chem/Bio Threat – Toxicity and Cost

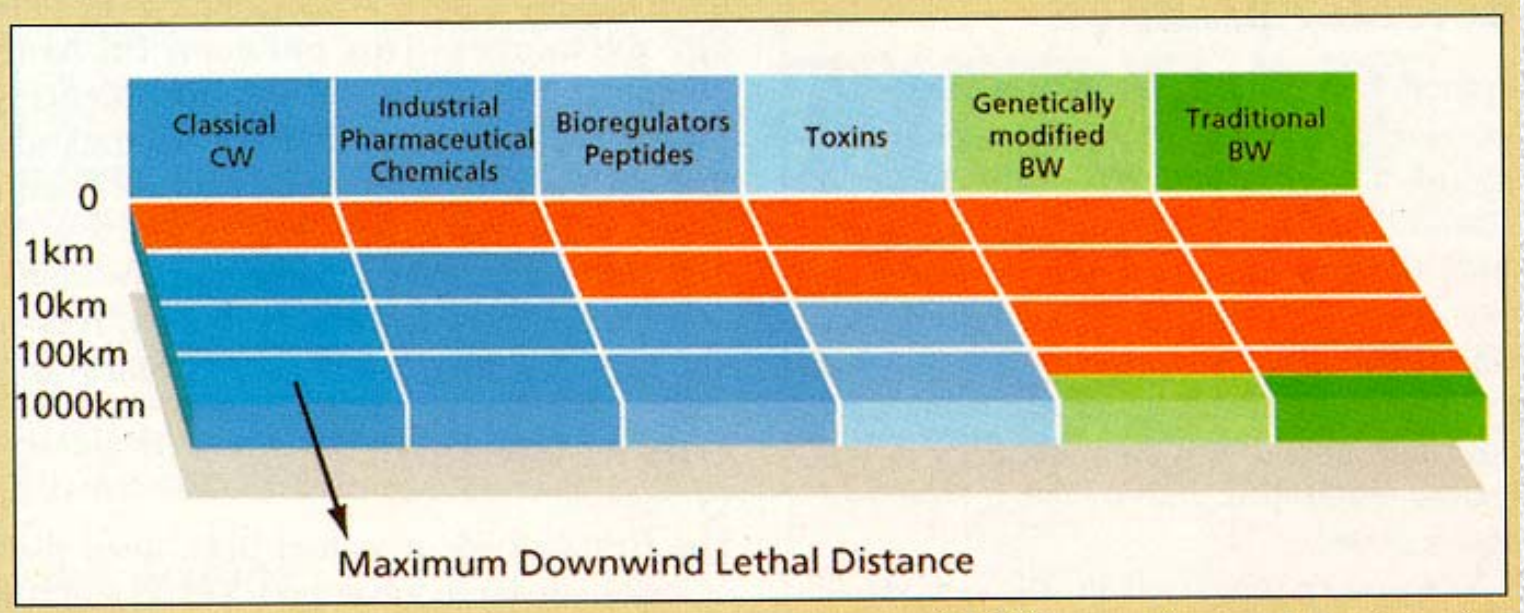
- Small Quantities Can Have a Tremendous Effect
  - Pound-for-Pound Lethality Comparable to Nuclear Weapons
- Small Quantities Are Relatively Easy to Manufacture
- Inexpensive – Costs of Development (Order of Magnitude)
  - Nuclear $ 10-200 M
  - Chemical $ 100 K
  - Biological $ 1 K



Source: Pearson, G.S. "Biological Weapons: A British View," Biological Weapons, Weapons of the Future? Center for Strategic and International Studies, 1998

Chem/Bio Threat – Area Coverage

Maximum Downwind Lethal Distance

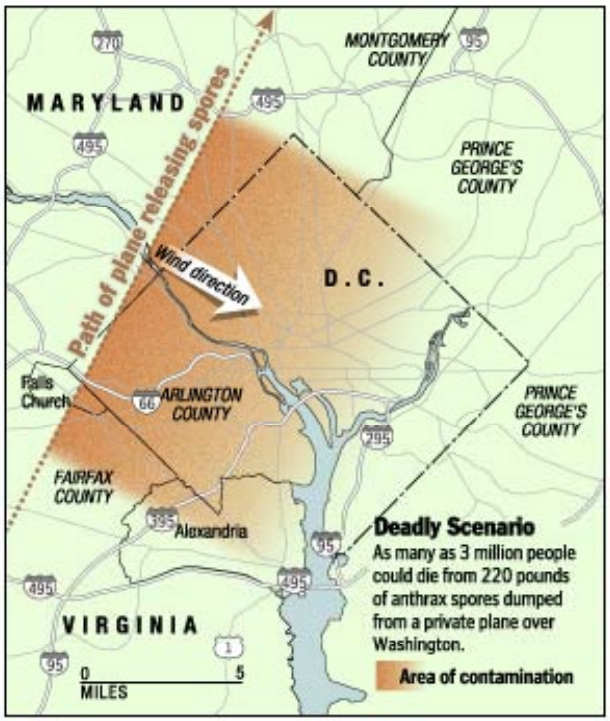


Biological agents have a far greater footprint in effective use than chemical agents or toxins — well in excess of 100km under certain terrain and meteorological conditions. (source: UK MoD)

- **Red Indicates Area of Maximum Effectiveness or Lethality**

Source: Pearson, G.S. "Biological Weapons: A British View," Biological Weapons, Weapons of the Future? Center for Strategic and International Studies, 1998

Chem/Bio Threat – Line Source Scenarios



Sowing a Silent Massacre

Easier to obtain than nuclear devices, but with equally deadly potential, pathogens used as weapons pose a significant threat to heavily populated areas.

Anthrax

A cloud of anthrax spores inhaled by a city's inhabitants would create widespread severe flu-like symptoms, killing 80 percent of those infected within one or two days after their symptoms appeared.

Once spores enter the lungs, anthrax bacteria require two to 43 days to incubate.

In the event of a bioterrorist attack, vaccinations and antibiotics would be essential. However, current supplies of vaccine are very limited.

FILE PHOTO

Anthrax vaccine

Smallpox

The world has been free of smallpox cases since 1978, but some strains are maintained in laboratories. The former Soviet Union reportedly stockpiled large amounts of the virus for use in weapons.

Vaccinations in the United States ceased 25 years ago. People vaccinated years ago are likely to have diminished immunity.

An aerosol release of smallpox infecting only 50 people could unleash an epidemic killing 30 percent of those infected with the painful, disfiguring disease.

The United States has limited stores of vaccine.

IMAGE COURTESY OF STATE UNIVERSITY OF NEW YORK

Smallpox wiped out many Native Americans during colonization.

Plague

If 110 pounds of an aerosol of Black Death bacteria were released over a city of 5 million, about 150,000 people would contract the disease. More than 35,000 of those would probably die.

One to six days after exposure, victims would begin to show symptoms of severe respiratory and gastrointestinal problems.

The Soviet Union produced massive quantities of the germ for weapons use.

Treatment with antibiotics would be effective during early stages of the infection.

NATIONAL LIBRARY OF MEDICINE

The plague killed a third of Europe's population in the 14th and 15th centuries.

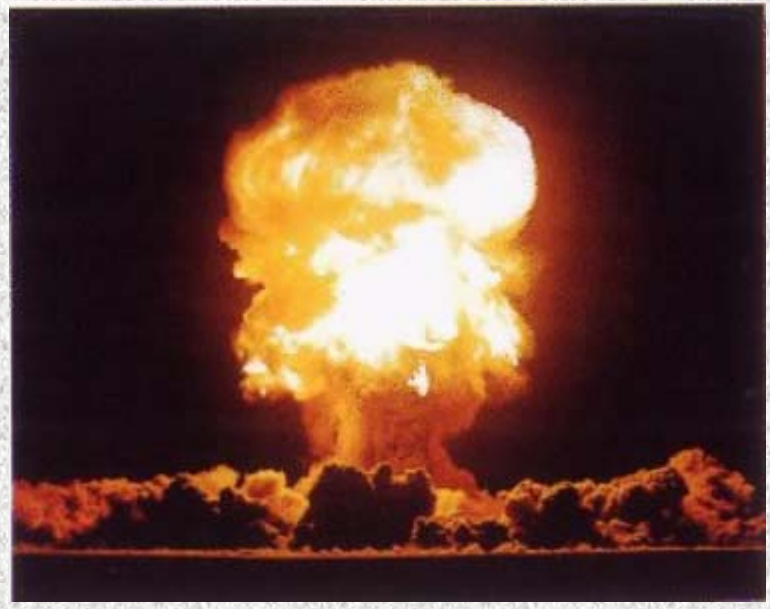
SOURCES: Office of Technology Assessment; Journal of the American Medical Association; Centers for Disease Control and Prevention

BY PATTERSON CLARK — THE WASHINGTON POST

Aircraft, 100 m alt, 10-50 km line, ~ 10-100 kg/km Dispensed Results in 3 Million Casualties in Washington Metro Area

Effects of Nuclear (Fission, Fusion) and Radiological ("Dirty Nuclear Bomb") Events

Conventional Nuclear Weapon



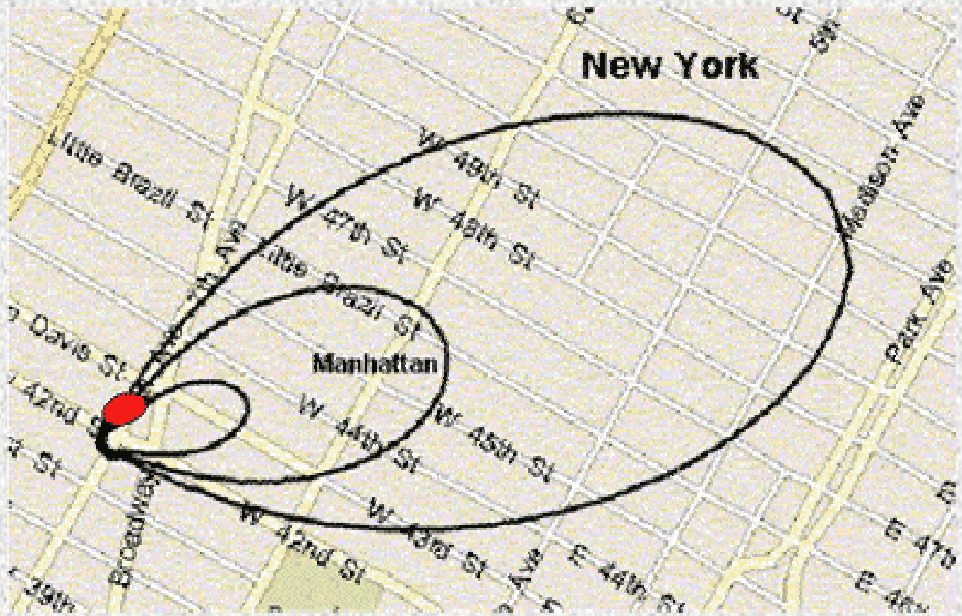
Destruction from Blast-Thermal Damage and Radiation Contamination Over Large Areas (Several Miles in Extent)

Radiological Weapon

Testimony of Dr. Henry Kelly, President
Federation of American Scientists
before the
Committee on Foreign Relations
March 6, 2002

Effects of Radiological ("Dirty Nuclear Bomb") vs. Conventional Explosives

Conventional Nuclear Weapon



Inner Ring:	All people must receive medical supervision
Middle Ring:	Maximum annual dose for radiation workers exceeded
Outer Ring:	Area should be evacuated before radiation cloud passes

Conventional Explosive

- **Radiological "Dirty Bomb" Spreads Nuclear Particles Using Conventional Rather Than Nuclear (Fission, Fusion) Explosive Reactions**
- **Example Shown Uses Americium Blown Up With One Pound of TNT**
- **A Region Covering 60 City Blocks Would Be Contaminated in Excess of EPA Safety Guidelines**
- **If Buildings in This Area Had to Be Demolished and Rebuilt, the Cost Would Exceed $50B**

Testimony of Dr. Henry Kelly, President
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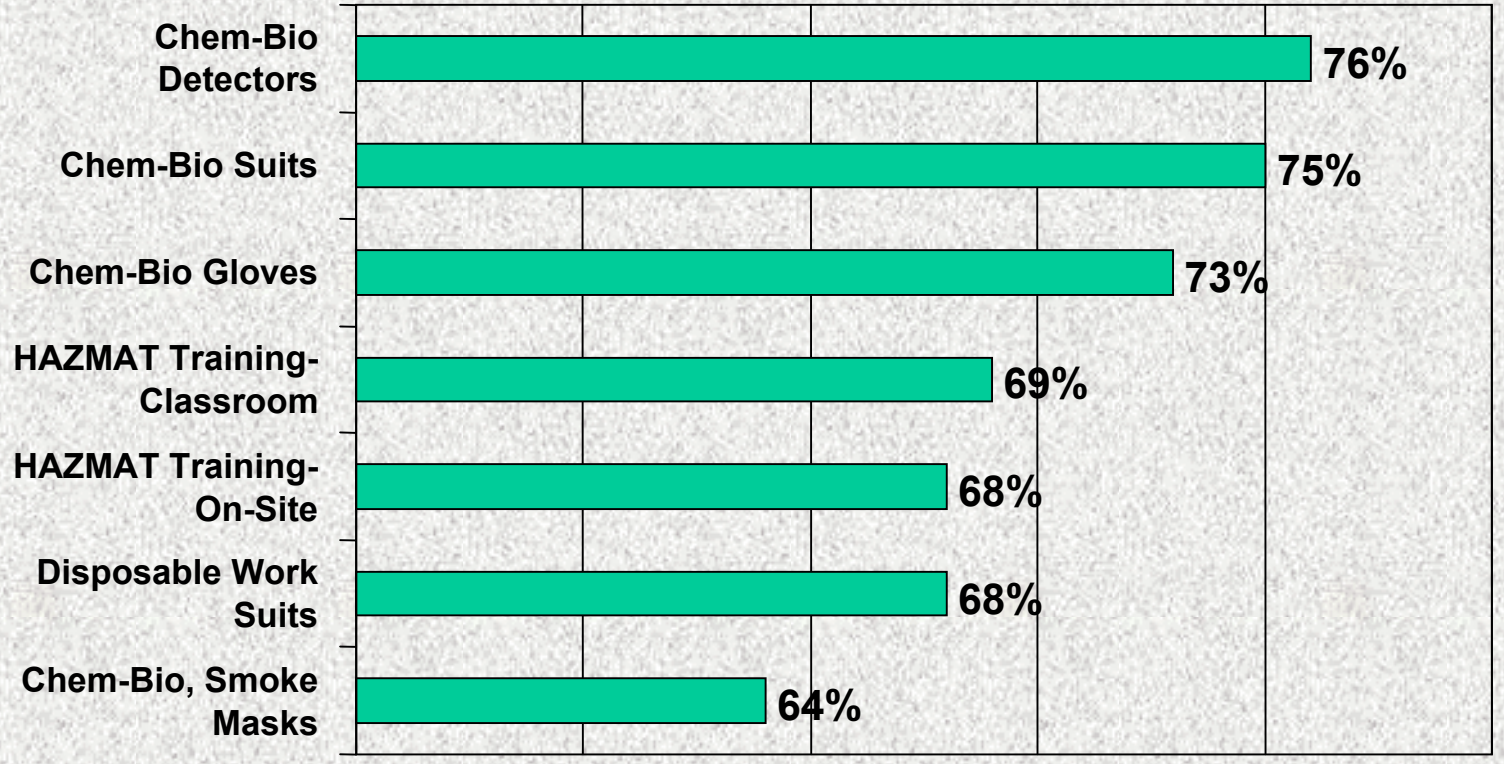
CB Detectors Top List of HLS Needs for Cities

From Federal, Down to Local…



"U.S. Cities Plan to Spend $2.6 Billion Through the End of This Year on Homeland Security Measures."

Source: U.S. Conference of Mayors, National Survey, June 2002

NukAlert™
Personal Radiation Monitor & Alarm

NukAlert™
Personal Radiation Monitor and Alarm

NukAlert™ is a state-of-the-art personal radiation monitor designed to respond to gamma ray and x-ray radiation fields and produce audible alarm chirp groups at specific time intervals. Proven and verified tested by National Radiological Lab, the device is always “ON”, constantly monitoring for acutely dangerous levels of radiation. The long-life battery is rated for 10 years of service.
The device is based on a Cadmium Sulphide photocell and radioluminescent rare earth phosphor (scintillator).

DETECTS BOTH X-RAY AND GAMMA RADIATION
SENSITIVITY RANGE: 0.1 R/h - 50+ R/h

- 24/7 monitoring, ten+ year battery
- Verification testing by National Radiological Lab
- Instruction manual with nuclear survival strategies
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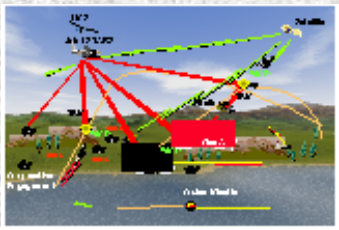
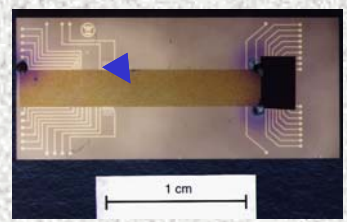
Northrop Grumman Technology Programs to Protect Critical Assets



Detect to Warn

Bio Detection System for USPS

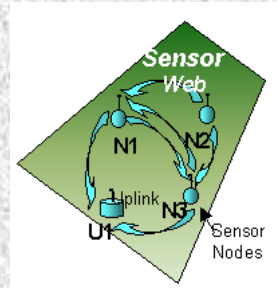


Chem/Bio Sensor

MCAD

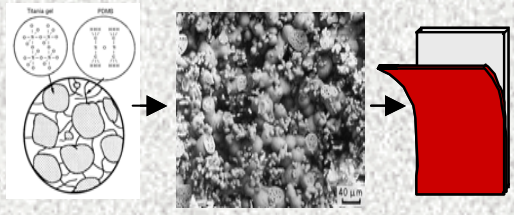
Flame Resistant Materials

- Coatings for Protection and Self-Decontamination
- WMD Reporting Software Systems (JWARN, DWARN)
- Early Warning, Long Range Chem/Bio Detection
- Port and Airfield Expert Management Systems
- Mobile Chemical Agent Detector (MCAD)
- Wireless Distributed Sensor Networks
- WMD and Explosives Sensors
- Postal Service WMD Detection
- Signal Detection and Location
- Data and Sensor Fusion
- Modeling and Simulation
- Damage Assessment
- Operations Analysis
- Operations Centers
- Battle Management
- Biometrics
- Security



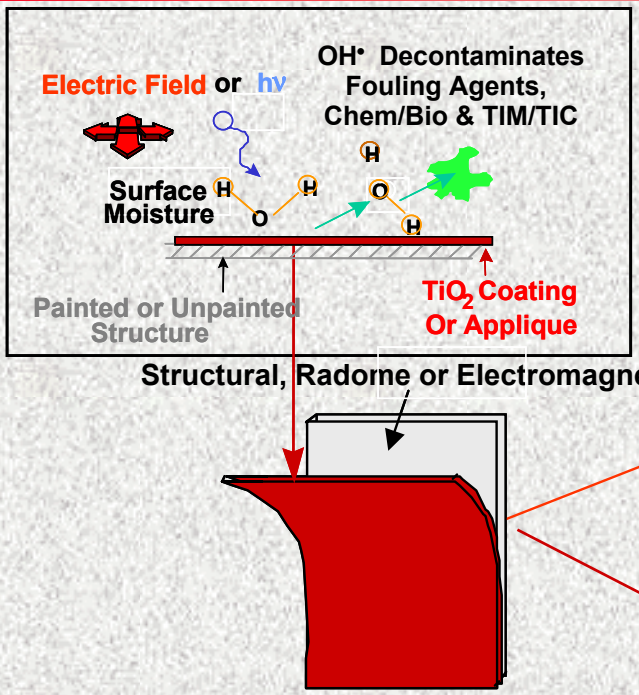
Wireless Sensor Networks

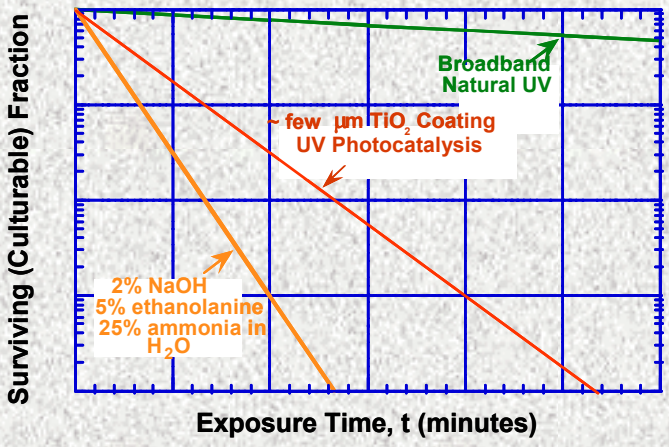
Energy Absorbing Materials



In-Situ Self-Decon Materials

Self-Decontaminating Coating – ONR



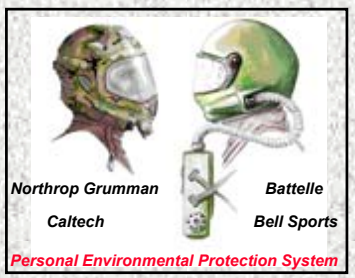


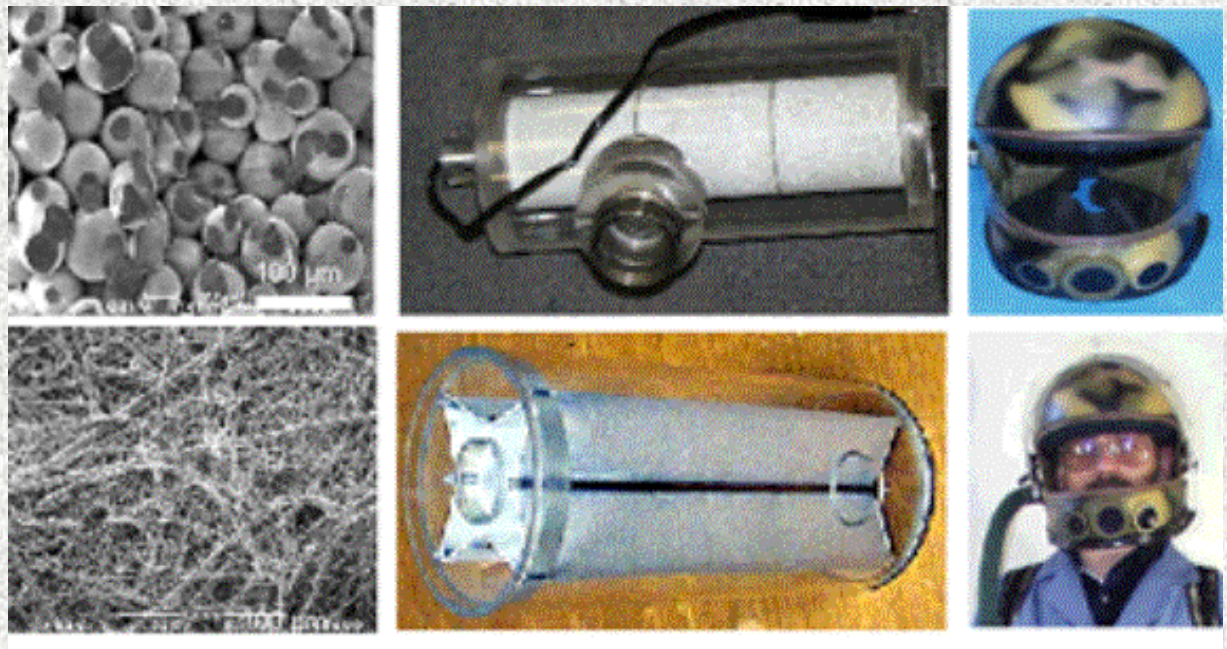
Bacillus globigii
(surrogate for anthrax)

Capabilities of Proposed System:

- Self-Sterilizing When Exposed to UV
- Protection Using Affordable Materials and Processing
- Flexible and Compatible With Many Types of Surfaces
- Durable and Maintainable

Photocatalytic Filters & Protection Systems Developed for DARPA



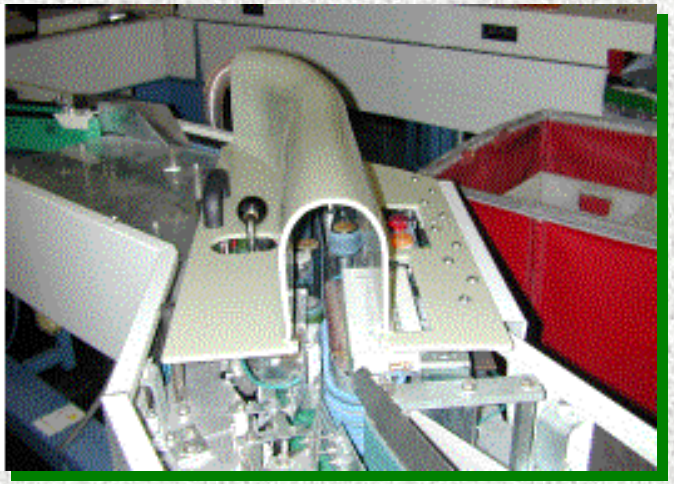


Benefits

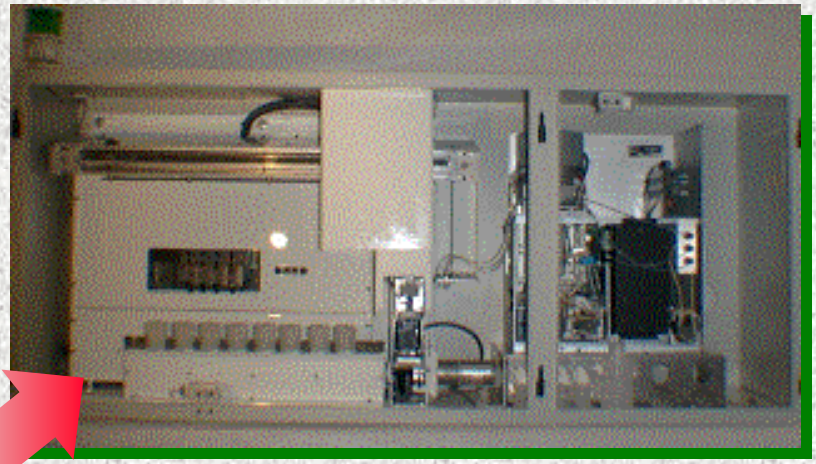
- Real-Time Decontamination Using Low Power UV (300-365 nm) Light or Electrical Stimulation
- Coatings That Are Not Degraded With Time or Exposure to Bio Pathogens or Chemical Agents (No Fouling)
- Coating Weight (<0.2 oz), Costs (< $1/filter), and Power (<10 Watts) Are Minimal
- Potential for Unmatched Aerosolized Biological Pathogen and Chemical Agent
- Capture, Protection, and Neutralization

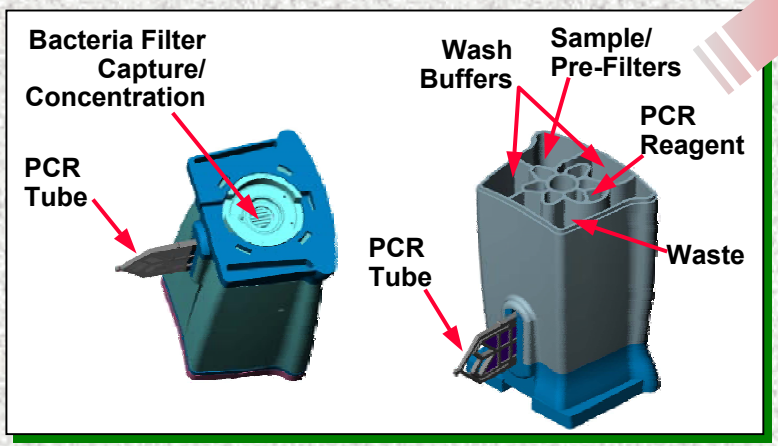
Northrop Grumman's Bio Detection System for the USPS

Air Collection System Interfaced To Mail Handling Equipment



Automated Northrop Grumman PCR-Based Bio Detection System





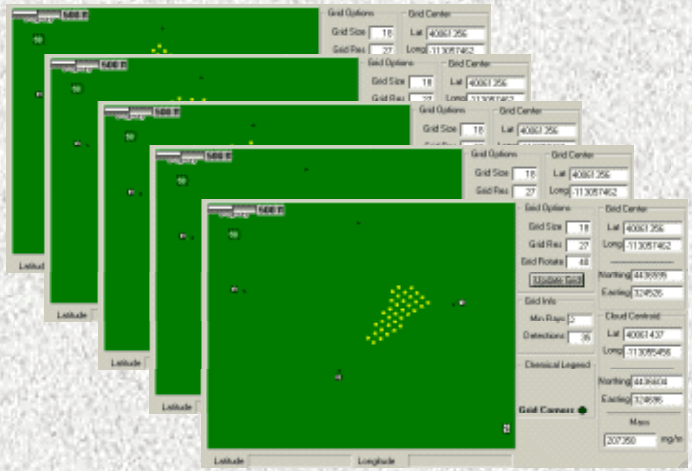
PCR Screening Cartridges

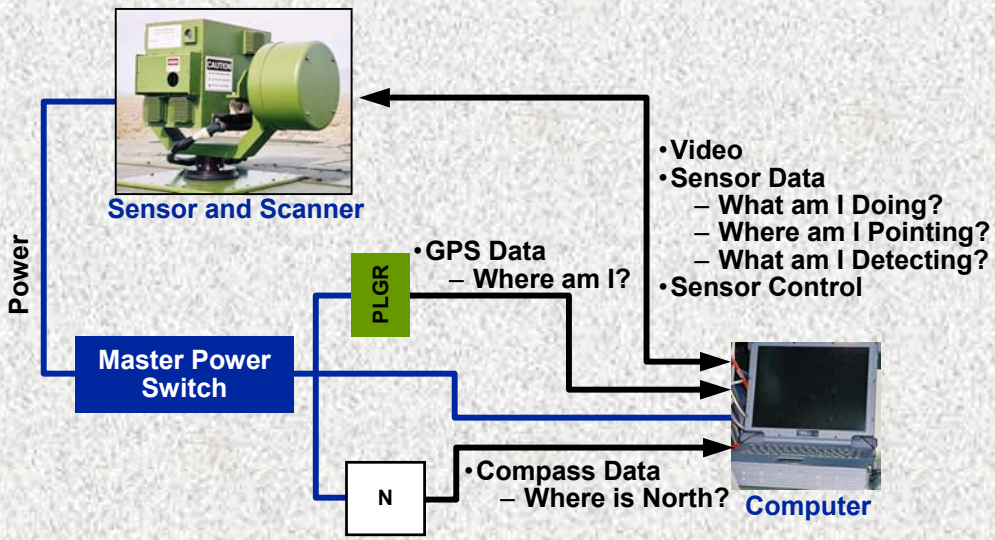
MCAD: Real-Time Multi-Sensor Cloud Mapping

MCAD: Mobile Chemical Agent Detector

MCAD System Features

- Michaelson FTIR Spectrometer
- Integrated GPS
- Integrated TV Viewer
- Scanner
- Field-Rugged Computer with Chemical Detection Software



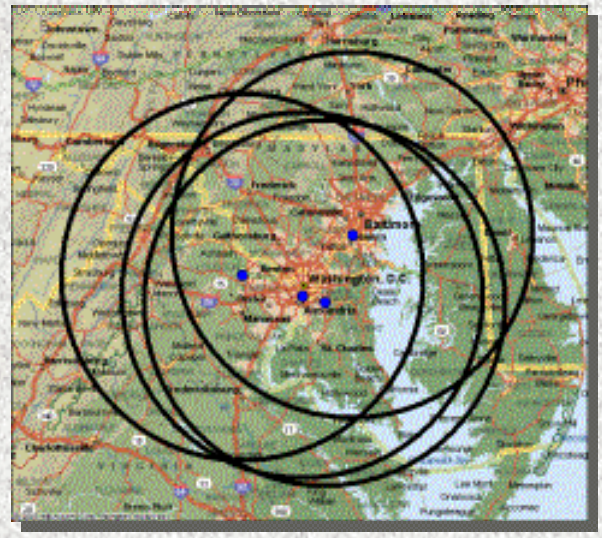


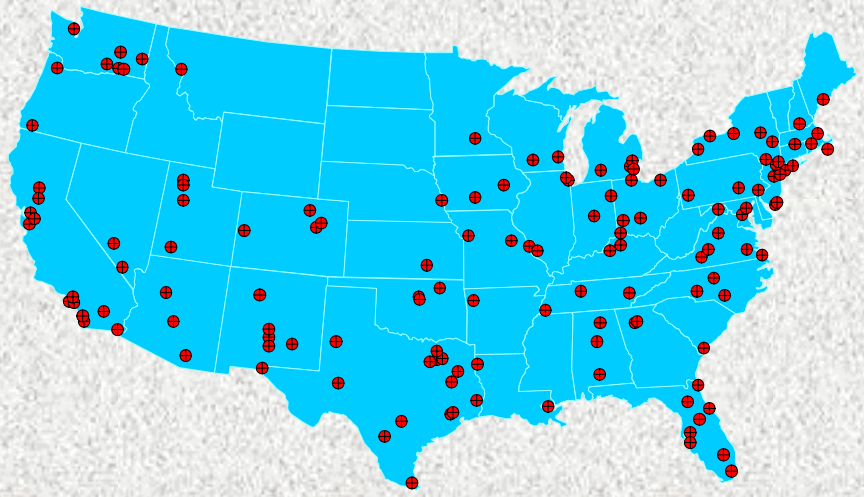
Cloud Mapping Features

- Sensor Network
- Detect, Identify, and Map Chemical Clouds Real-Time
- All Data Catalogued and Stored as Record of Events
- Three MCAD/ILSCAD Sensor Systems Provide Cloud Mapping and Ground Truth at Dugway Proving Grounds – October 2001

Early Detection of a Chem/Bio Release Using Radar

- Several Radar Systems Deployed at Major Cities Across the U.S. (NOAA, FAA, National Guard)
- Detection Upgrade Currently in Production and Deployment
- Chem-Bio Detection Testing With Army Planned for 2003 (Detect-To-Warn)





…Could Provide Chem-Bio Detection and Warning

Potential Unmanned Systems (UMS) Applications

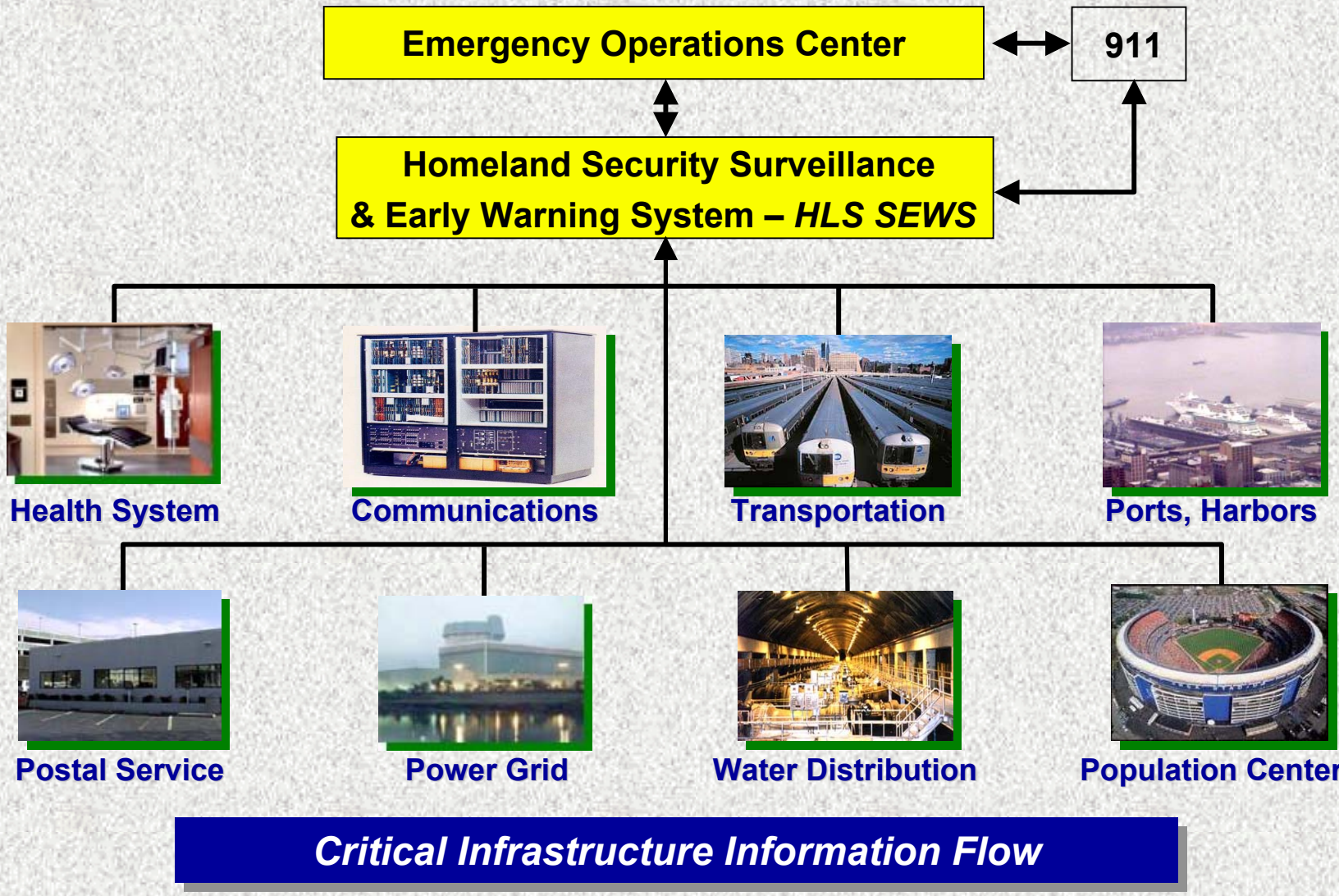
- Global Hawk
  - Potential Role in Coastal Security/ HLS Briefed to U.S. Coast Guard Officials
  - Potential Role for Border Security

- VTUAV/Fire Scout
  - Fire Scout (Vertical UMS Capability) Included as Part of Integrated HLS Concept Development
    - Part of Emergency Management Airborne System Concept

A Three-Layered Approach to Protecting Critical Assets

- Persistent Surveillance
  - Continuous Status Monitoring and Tracking of Access to Critical Infrastructure Facilities
- Interdiction
  - Rapid Response to Thwart Potential Threats
- Mitigation
  - To Minimize Consequences

HLS Surveillance & Early Warning System for Critical Infrastructure Protection



HLS Surveillance and Early Warning System (HLS SEWS)

- HLS SEWS Involves the Integration of Sensors (Airborne, Mobile, and Fixed), Networks, Information, and People to Provide Continuous Surveillance for Early Interdiction, Threat Mitigation, and Emergency Response/Consequence Management

Cutting Edge Science and Technology to Anticipate, Detect, and Respond

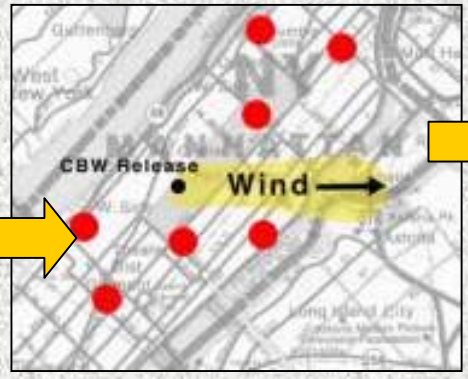
Urban Shield

Sensors | **Distributed Network** | **Data Analysis Center** | **First Responders**

Biological

Chemical

Radiological



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EDO

NORTHROP GRUMMAN Integrated Systems

symbol

BROOKHAVEN NATIONAL LABORATORY

Urban Shield Objectives

- Develop a Real-Time Monitoring and Notification System to Inform NYPD, OEM, and Critical Decision-Makers of the Onset of a CBR Event
- Define the Nature of the CBR Release
- Predict CBR Transport Patterns and Provide Data for Decision-Makers
- Map Areas That Are Safe/Unsafe on a Continuing and "Instant" Basis
- Provide Information to Help Specify the Actions and Resources Need to Protect First Responders and Citizens in Unsafe Areas

The Next Steps

- Establish a Long Island Partnership for Homeland Security and the Region to Implement Vision
  - Generate Requirements – Interface with NYC and Tri-State Region
  - Develop a Five-Year Regional Master Plan for Implementation
  - Create Detailed Proposals to Department of Homeland Security for Funding

The Engineer's Role: Pre - 9/11/01

For Mechanical and Structural Systems

- Analyses and Designs to Accommodate:
  - Form, Function, Performance, Aesthetics, and Cost
- Prescribed, Defined Requirements (Including Service Life) for Safety of Use
  - Consideration Given to Extreme Events
    - Natural Disasters – Earthquakes, Hurricanes
    - Nuclear Reactors

The Engineer's Role: Post - 9/11/01

- Terrorists Threats Resemble Extreme Events in Nature…Random and Unpredictable
- The Answers to the Questions: Where? When? What? Require "More Than Science"
- Events Are Dictated by Social, Political, Emotional, Irrational Causes – Engineers Must Consider the "Unthinkable"
- Lead the Use of Risk Technology
  - Risk Analysis to Aid Decision-Making
  - Risk Assessment and Management to Evaluate Consequences
- Integrate Biological Studies into "Tool-Box"

The Professional Society's Role: Post - 9/11/01

- Generate, Document, and Disseminate Engineering Methodologies for Threat Mitigation
- Provide Forums for Engineers to Teach Others
- Promote Coalitions for Interdisciplinary Projects
- Work With Policy-Makers
- Promote Development of Standards for Technology Testing and Performance Verification

Recommendations

- Foundation Is the Current 9-1-1 Emergency Response
- Build Upon These Capabilities
- Establish a Coordinated Crisis Management Plan
- Utilize Technology to Provide an Asymmetric Advantage
- Always Consider Integration and Interoperability (Don’t Build Stovepipe Capabilities)
- Employ Technologies to Collect, Analyze, and Distribute Vital Information to Facilitate Decisions
- Think, Train, Plan for the Worst-Case Scenario

Conclusions

- The Homeland Threats and Their Consequences Resemble Those on the Battlefield (Asymmetric)
- Meeting the Threats Requires Engineering Solutions for:
  - Infrastructure Hardening and Threat Mitigation
  - Command and Control Centers for Situational Awareness
  - Persistent Surveillance of Key Assets and Likely Targets
  - Detection and Reporting Systems that Cannot be Compromised
  - Sustained and Realistic Training and Evaluation
  - Informed Decision-Making at All Levels

The Failure of Imagination and Communication

The Failure of the Intelligence Community to "Connect the Dots" is Analogous to…

The Failure of Some Decision-Makers to Imagine the Unlikely and Act

The Failure of the Technical Community to Speak Loudly Enough

In the Post - 9/11/01 World, New Threats Mean New Priorities – and a New Level of Resolve…