CHEMICAL TERRORISM

THE ROLE AND LIMITS OF SCIENCE TECHNOLOGY

American Center for Democracy

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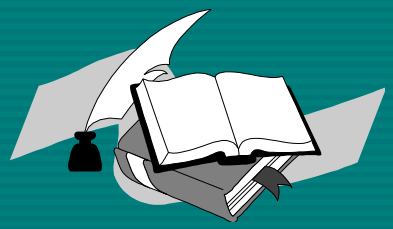
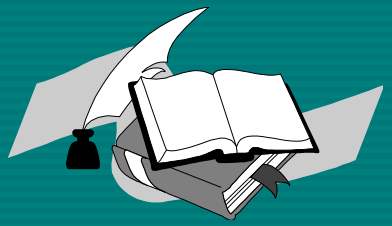


TERRORISM DEFINED

The term "terrorism" means premeditated, politically motivated violence perpetrated against noncombatant targets by subnational groups or clandestine agents, usually intended to influence an audience.

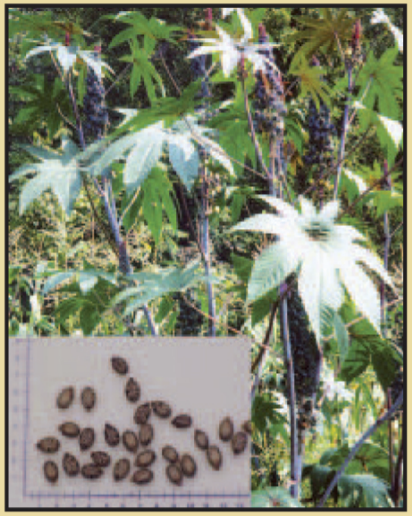
Title 22 United States Code, Section 2656f(d).



KEEPING TERRORISM IN PERSPECTIVE

- Terrorism is less frequent but more violent
- Terrorists have no defense but simplicity, secrecy and stealth unless they are given sanctuary
- Terrorist cells are highly disciplined and rational
- Terrorism targets the weakest points of society
- Compared to other dangers we face, terrorism is an abnormal and relatively rare occurrence
- Low probability/high consequence threats present the most difficult challenges

AL-QAEDA HAS SHOWN INTEREST IN CHEMICAL AGENTS



Castor beans, which grow on a common ornamental plant, can be processed by terrorists using crude equipment and common chemicals to produce the toxin ricin.

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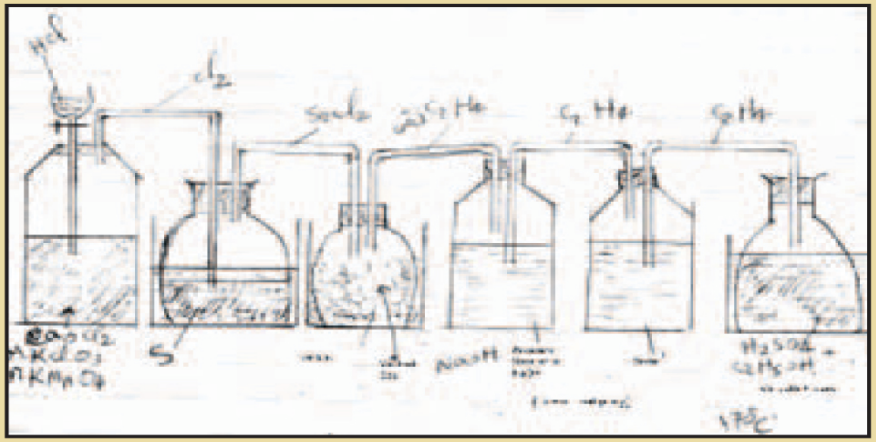
Several groups of mujahidin associated with al-Qa'ida have attempted to carry out "poison plot" attacks in Europe with easily produced chemicals and toxins best suited to assassination and small-scale scenarios.

Training videos found in Afghanistan show al-Qa'ida tests of easily produced chemical agents based on cyanide.



Documents found in Afghanistan highlight al-Qa'ida's interest in the production of more effective chemical agents such as mustard, sarin, and VX.

CHEMICAL AGENTS

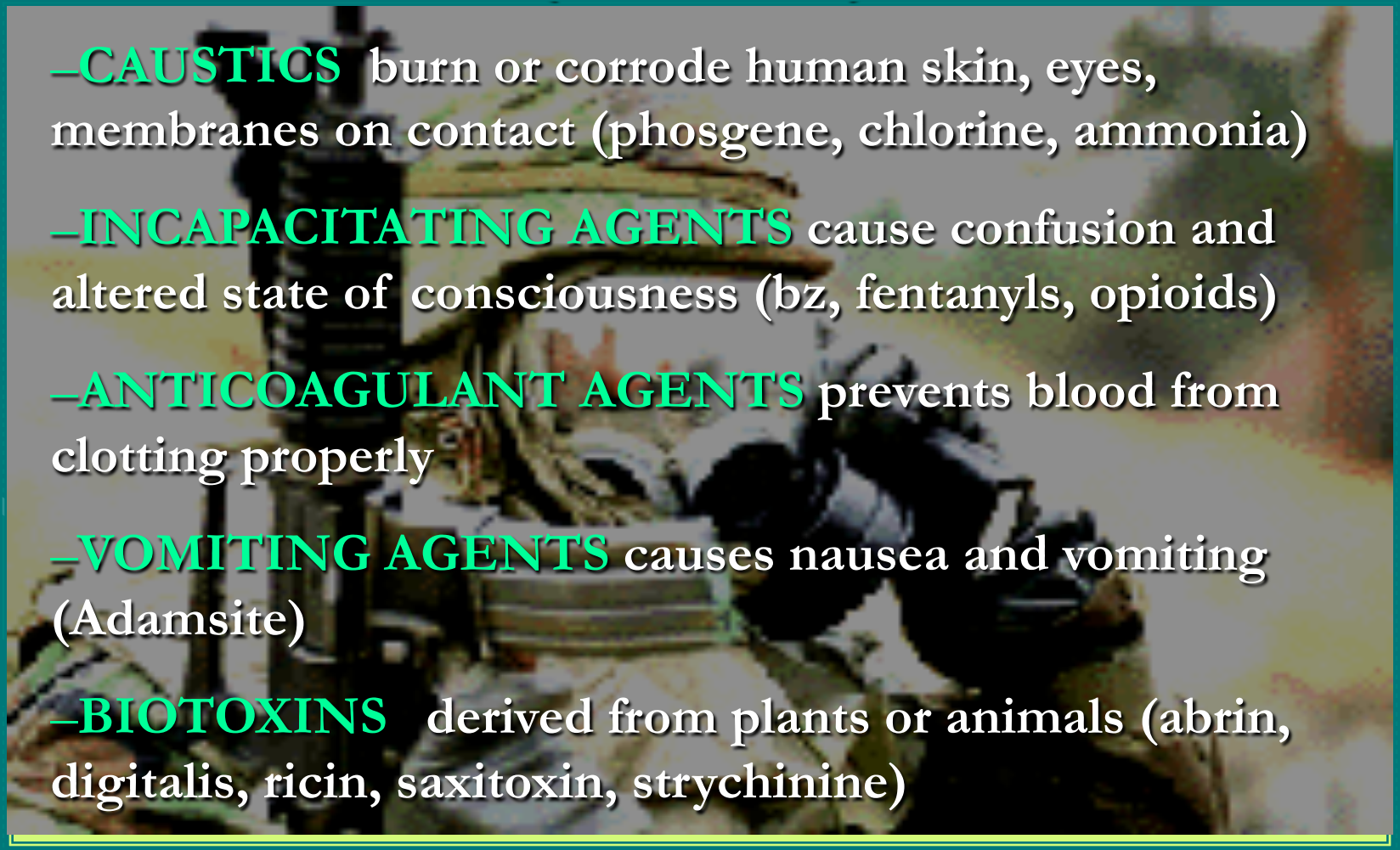
–**BLOOD AGENTS** form irreversible complexes with hemoglobin, e.g. hydrogen cyanide or cyanogen chloride

–**BLISTER AGENTS** cause eye and lung damage and can cause blisters on the skin, e.g. sulfur mustard and lewisite (2-chlorovinyldichloroarsine)

–**NERVE AGENTS** block acetylcholinesterase and thus the transmission of nerve impulses, e.g. Tabun, VX and Sarin (isopropyl methylphosphanofluoridate)..

–**CHOKING AGENTS** cause breathing difficulties and can lead to severe chemical pneumonia, e.g. chlorine or phosgene

CHEMICAL AGENTS (cont'd)



–**CAUSTICS** burn or corrode human skin, eyes, membranes on contact (phosgene, chlorine, ammonia)

–**INCAPACITATING AGENTS** cause confusion and altered state of consciousness (bz, fentanyls, opioids)

–**ANTICOAGULANT AGENTS** prevents blood from clotting properly

–**VOMITING AGENTS** causes nausea and vomiting (Adamsite)

–**BIOTOXINS** derived from plants or animals (abrin, digitalis, ricin, saxitoxin, strychinine)

CHEMICAL TERRORISM -- THREAT WITH NEW DIMENSIONS

- Increased notoriety as the result of Iraqi and Aum Shinrikyo use of SARIN nerve agent
- Many precursors for chemical warfare agents are dual-use and available in bulk
- Rogue states could collaborate with terrorists
- Recipes for all chemical agents are on the Internet
- Milligrams of nerve agents can be fatal
- Attacks with industrial toxins have the highest probability
- Syrian chemical agents captured and used by ISIS

CHEMICAL AGENT USE -- RECORD

- Chemical agents were used to kill troops in trenches, 1915
- Iraq used Sarin and mustard against the Kurdish residents of the city of Halabja, March 1988 and other Kurds later in 1991
- Minnesota Patriots Council members were convicted for attempting to use ricin to kill law officers, 1992
- Iraq used Sarin against Iranian forces and cities, 1980-1988
- Aum Shinrikyo used Sarin against Matsumoto City, 1994, and Tokyo Subway, 1995
- A package containing ricin and a note threatening to poison water supplies was discovered in a South Carolina postal facility, October 2003
- Dioxin poisoning caused the disfigurement of Ukrainian presidential candidate Viktor Yushchenko, 2004
- A white powder found in the office of Senate Majority Leader Bill Frist was confirmed to be ricin, Feb 2004
- Chemical agents used by and against insurgents in Syria, 2014
- Mustard gas used by Islamic State against Syrian Kurds, 2014

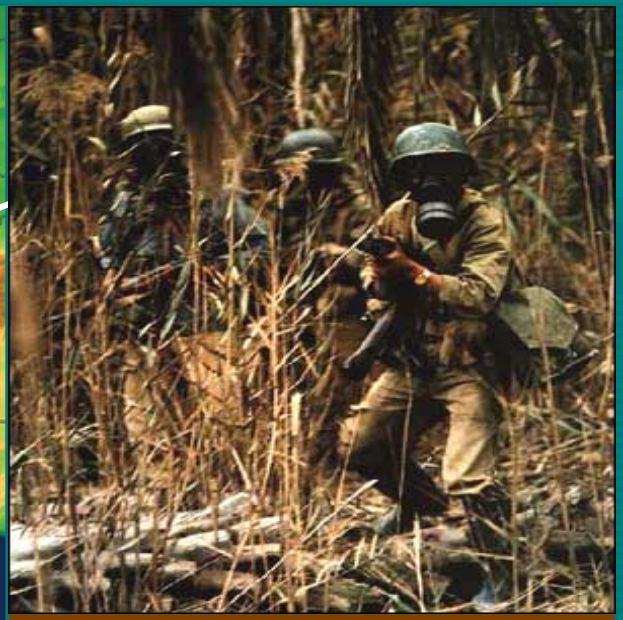
The use of gas against French forces at Langemarck, New York Tribune, 27 April 1915

Iraqis Loading Chemical Warhead

Iraqi nerve-agent attack against Kurdish civilians (~5,000 killed)

and mustard was also used……..

Al-Faw Peninsular Campaign



In February 1986, Iraq used mustard and nerve agents against Iranian forces, killing up to 10,000 soldiers.

Use of Chemical Agents in Syria

Chemical Agents in Area Held by Rebel Forces

Chemical Use by Syrian Rebels

Tons of "COLD WAR" chemical weapons remain in secure storage or abandoned

Pallets of mustard agent in 155 mm artillery shells in Pueblo Depot Activity

Abandoned Soviet chemical weapon canisters found in Albania

Common chemicals that could be used as improvised chemical weapons

- EYE, SKIN AND RESPIRATORY IRRITANTS (chlorine, hydrogen chloride, ammonia, bromine, acrylates, aldehydes, fluorine, cyanogens, alkaline hydroxides, and isocyanates)
- CHOKING AGENTS (hydrogen sulfide and phosgene)
- BLOOD AGENTS (hydrogen cyanide, hydrogen sulfide)
- CONTAMINANTS (benzene, cyanides, mercuric compounds, organophosphates)
- ASPHYXIANTS (ammonia, aniline, nitrile, and hydrogen cyanide)
- BLISTER AGENTS (dimethyl sulfate, sulfuric acid)
- NERVE AGENTS (organophosphate pesticides)

CHEMICAL TERRORISM AGENTS AND SYNDROMES: Watch for these signs and symptoms

Agents	Signs	Symptoms	Onset	Clinical Diagnostic Tests	Exposure Route and Treatment	Differential diagnosis
Nerve Agents: Sarin (GB); Tabun (GA); Soman (GD); Cyclohexyl Sarin (GF); VX; Novichok agents, other organophosphorus compounds including carbamates and pesticides	Pinpoint pupils (miosis) Bronchoconstriction Respiratory arrest Hypersalivation Increased secretions Diarrhea Decreased memory, concentration Loss of consciousness Seizures	**Moderate exposure:** Diffuse muscle cramping, runny nose, difficulty breathing, eye pain, dimming of vision, sweating, muscle tremors. **High exposure:** The above plus sudden loss of consciousness, seizures, flaccid paralysis (late sign)	Aerosols: Seconds to minutes Liquids: minutes to hours	Red blood cell or serum cholinesterase (whole blood) Treat based on signs and symptoms; lab tests only for later confirmation	**Inhalation and dermal absorption** Atropine (2mg) IV; repeat q 5 minutes, titrate until effective, average dose 6 to >15 mg – use IM in the field before IV access (establish airway for oxygenation) Pralidoxime chloride (2-PAMCl) 600-1800 mg IM or 1.0 g IV over 20-30 minutes (maximum 2 g IM or IV per hour) Additional doses of atropine and 2-PAMCl depending on severity Diazepam or lorazepam to prevent seizures if >4 mg atropine given Ventilatory support	Poisoning from organophosphate and carbamate pesticides may occur as a result of occupational exposure Cyanide poisoning Myasthenia gravis
Cyanides: hydrogen cyanide (HCN), cyanogen chloride	**Moderate exposure:** Metabolic acidosis, venous blood-O_2 level above normal, hypotension, "pink" skin color **High exposure:** Above signs plus coma, convulsions, cessation of respiration and heartbeat	**Moderate exposure:** Giddiness, palpitations Dizziness, nausea, vomiting, headache, eye irritation, increase in rate and depth of breathing (hyperventilation), drowsiness **High exposure:** Immediate loss of consciousness, convulsions and death within 1 to 15 minutes	Seconds to minutes	Bitter almond odor associated with patient suggests cyanide poisoning Metabolic acidosis Cyanide (blood) or thiocyanate (blood or urine) levels Treat based on signs and symptoms; lab tests only for later confirmation	**Inhalation, ingestion and dermal absorption** 100% oxygen by face mask; intubation with 100% FiO_2 if indicated Amyl nitrite via inhalation, 1 ampule (0.2 mL) q 5 minutes Sodium nitrite (300 mg IV over 5-10 minutes) and sodium thiosulfate (12.5 g IV) Additional sodium nitrite should be based on hemoglobin level and weight of patient	Similar CNS illness can result from: industrial/occupational exposure to HCN and derivatives; carbon monoxide (CO) exposure from incomplete combustion of natural gas or petroleum fuels (exhaust fumes in enclosed areas); hydrogen sulfide (H_2S) exposure from sewers, animal waste, industrial sources) Poisoning from nerve agents
Vesicants/Blister Agents: sulfur mustard, lewisite, nitrogen mustard, mustard lewisite, phosgene-oxime	Skin erythema and blistering; watery, swollen eyes; upper airways sloughing with pulmonary edema; metabolic failure; neutropenia and sepsis (esp. sulfur mustard, late in course)	Burning, itching, or red skin Mucosal irritation (prominent tearing, and burning and redness of eyes) Shortness of breath Nausea and vomiting	Lewisite, minutes; Sulfur mustard, hours to days	Often smell of garlic, horseradish, and/or mustard on body Oily droplets on skin from ambient sources Urine thiodiglycol Tissue biopsy (USAMRICD)	**Inhalation and dermal absorption** Mustards no antidote For lewisite and lewisite/mustard mixtures: British Anti-Lewisite (BAL or Dimercaprol) IM (rarely available) Thermal burn therapy; supportive care (respiratory support and eye care)	Diffuse skin exposure with irritants, such as caustics, sodium hydroxides, ammonia, etc., may cause similar syndromes. Sodium hydroxide (NaOH) from trucking accidents
Pulmonary/ Choking Agents: phosgene, chlorine, diphosgene, chlorpicrin, oxides of nitrogen, sulfur dioxide	Pulmonary edema with some mucosal irritation (greater water solubility of agent = greater mucosal irritation) leading to ARDS or non-cardiogenic pulmonary edema Pulmonary infiltrate	Shortness of breath Chest tightness Wheezing Laryngeal spasm Mucosal and dermal irritation and redness	1-24 hours (rarely up to 72 hours); May be asymptomatic period of hours	No tests available but history may help identify source and exposure characteristics (majority of incidents generating exposures to humans involve trucking with labels on vehicle)	**Inhalation** No antidote Management of secretions; O_2 therapy; consider high dose steroids to prevent pulmonary edema (demonstrated benefit only for oxides of nitrogen) Treat pulmonary edema with PEEP to maintain PO_2 above 60 mm Hg	Mucosal irritation, airway reactions, and deep lung effects depend on the specific agent, especially water solubility
Ricin (castor bean oil extract)	Clusters of acute lung or GI injury; circulatory collapse and shock, tracheobronchitis, pulmonary edema, necrotizing pneumonia	**Ingestion:** Nausea, diarrhea, vomiting, fever, abdominal pain **Inhalation:** chest tightness, coughing, weakness, nausea, fever	18-24 hours 8-36 hours	ELISA (from commercial laboratories) using respiratory secretions, serum, and direct tissue	**Inhalation and Ingestion** No antidote Supportive care For ingestion: charcoal lavage	Tularemia, plague, and Q fever may cause similar syndromes, as may biological weapons and chemical weapon agents such as Staphylococcal enterotoxin B and phosgene
T-2 mycotoxins: Fusarium, Myrotecium, Trichoderma, Verticimonosporium, Stachybotrys	Mucosal erythema and hemorrhage (intestinal necrosis) Red skin, blistering Increased salivation Pulmonary edema Seizures and coma Liver/renal dysfunction	Dermal and mucosal irritation; blistering, necrosis Blurred vision, eye irritation, tearing Nausea, vomiting, and diarrhea Ataxia coughing and dyspnea	2-4 hours	ELISA from commercial laboratories Gas chromatography/Mass spectroscopy in specialized laboratories	**Inhalation and dermal contact** No antidote Supportive care For ingestion: charcoal lavage Consider high dose steroids	Pulmonary toxins (O_3, NO_x, phosgene, NH_3) may cause similar syndromes though with less mucosal irritation.

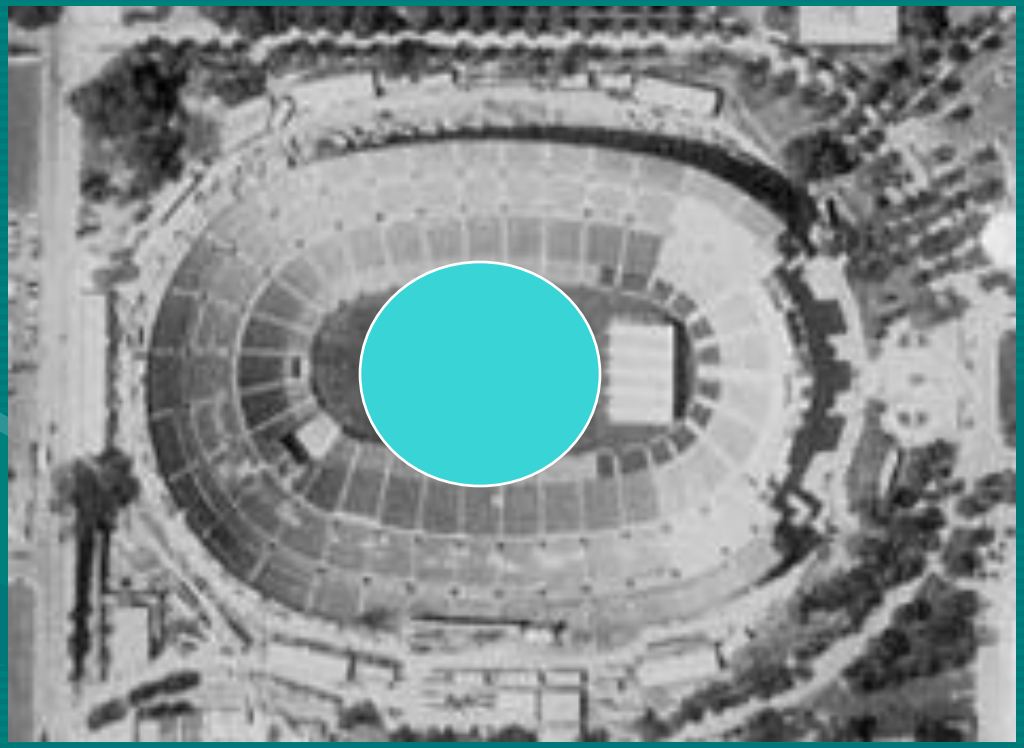
Industrial vulnerabilities…….

Bhopal accident, 3 December 1984, ~3,000 causalities

Two transport trains collided in Graniteville, SC, releasing at least 90 tons of gaseous chlorine, 9 January 2005

Eight died from chlorine inhalation and 5,400 others were evacuated

Nature of problem



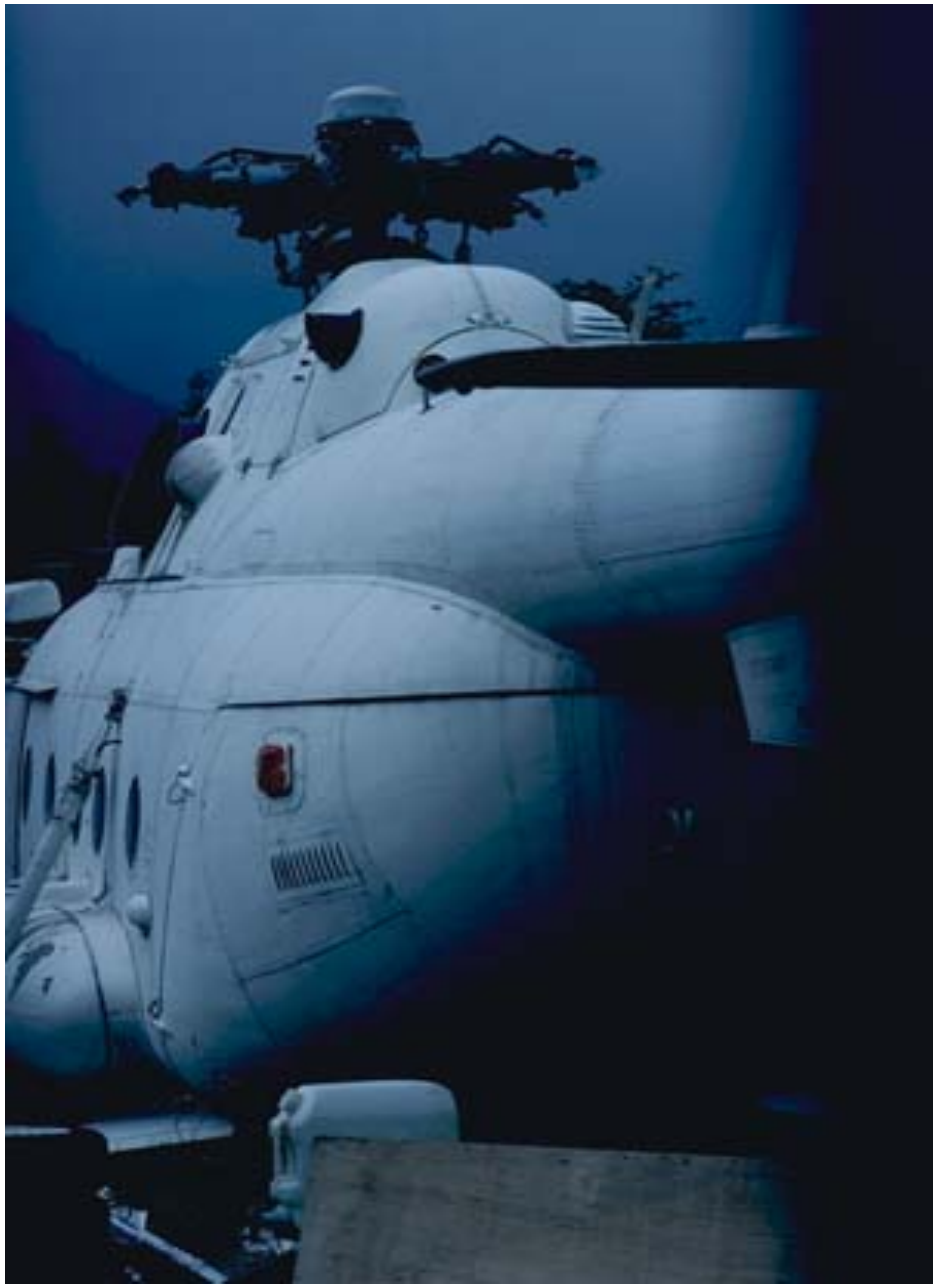
In the open, six pounds of Sarin distributed by a three pound burster charge at a height of 5 meters creates a dosage of 100 mg min/m_3 50 yards from the burst within 25 seconds. (Robinson, 1967).

TRANS-NATIONAL "AUM SHINRIKYO" Chemical Agent Terrorism

- Founded in 1984 by Shoko Asahara.
- Large complex at base of Mount Fuji granted religious corporation-status in 1989.
- Revenues of ~$1B/year generated through computer and pharmaceutical sales.
- Procurement of helicopters from Russia and pilot training in SC.
- Chemical agent production begin 1993 (goal 70 metric tons of Sarin).
- Sarin gas attack in Matsumoto City 1994.
- Sarin attack on Tokyo Subway 1995.

GOAL: Seventy metric tons of SARIN nerve agent ……

Equipment in Aum SARIN Facility



Shoko Asahara

Russian helicopter obtained by the Aum Shinrikyo for line-source release of the chem-bio agents being produced by the cult. Pilots were trained in South Carolina.

COUNTERING CHEMICAL TERRORISM

PROBABILITY

PREVENTION

--Technical controls on materials

--Alternate materials

--Taggants (stable isotopes)

--Special catalysts

DETECTION

--Smart films

--Remote chemical analysis

--Miniature mass spectrometers

--Ultrasonic resonance

CONSEQUENCE

RESPONSE

--Forensics/analysis

--Containment systems

--Dispersal and fate modeling

--Neutralization

PROTECTION

--Antidotes (e.g., atropine)

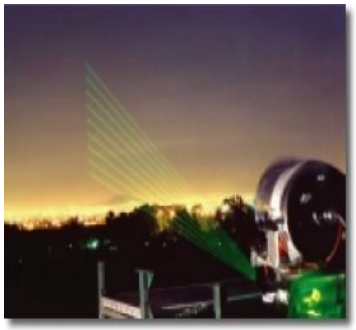
--Monitors for responders

--Decontamination

--Chemical masks/suits

Competencies applied in addressing chemical terrorism

Detection & Characterization

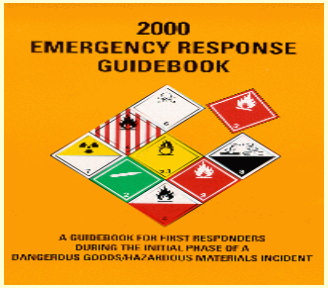


Goal: To provide early warning, identify people to treat, and identify contaminated areas with high sensitivity and low false alarms.

Chemical Foundations

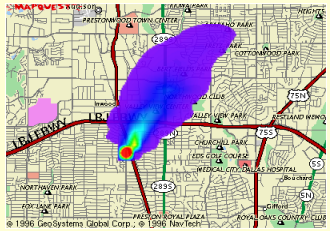
Goal: To provide essential interactive chemical information for protection, detection of agents, medical intervention, and environmental remediation

In Situ Neutralization of Chemical Agents



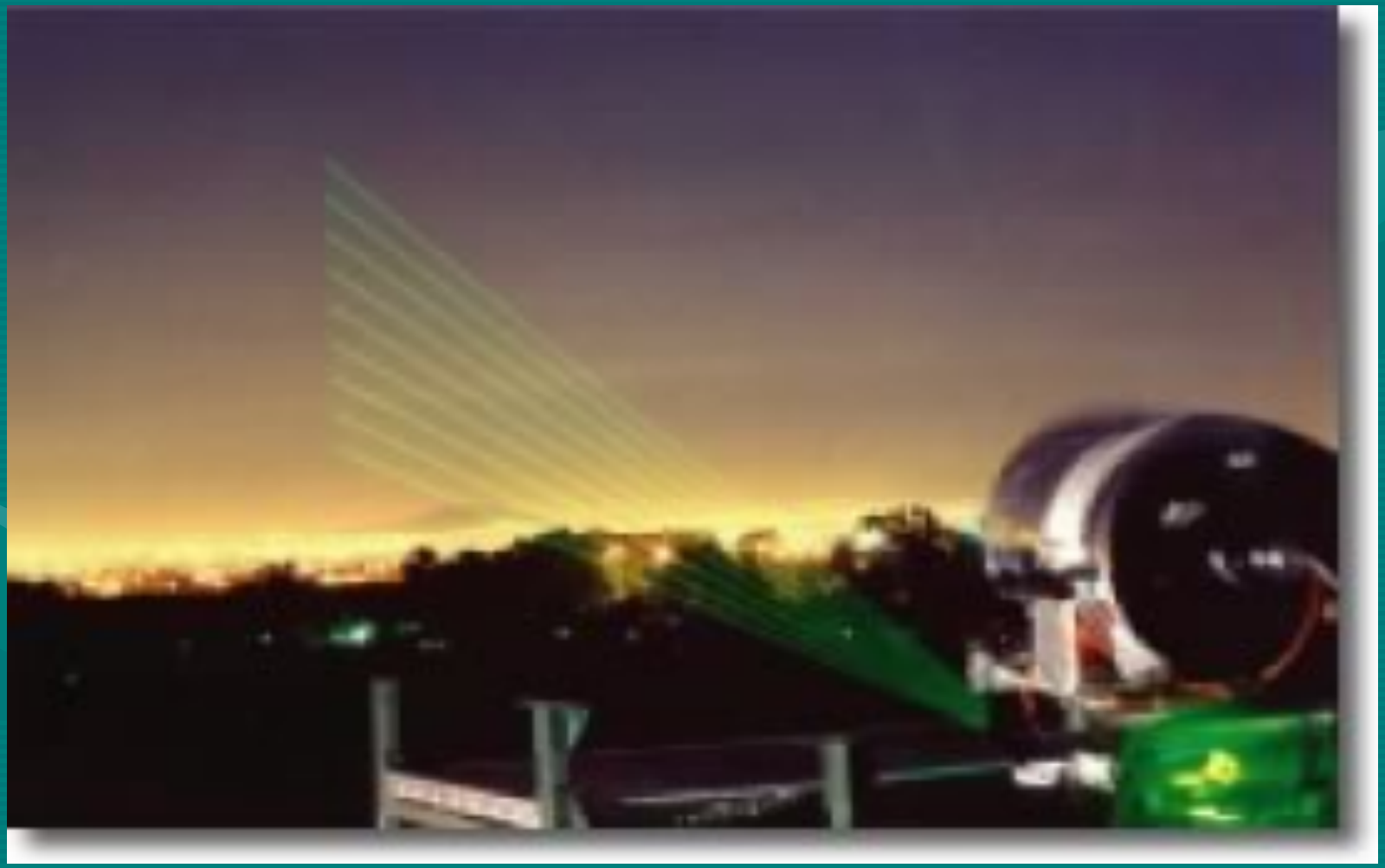
Goal: To neutralize or or render safe chemical agents in situ and quickly restore civilian and defense facilities

Modeling & Prediction of Chemicals in Complex Urban Environments.

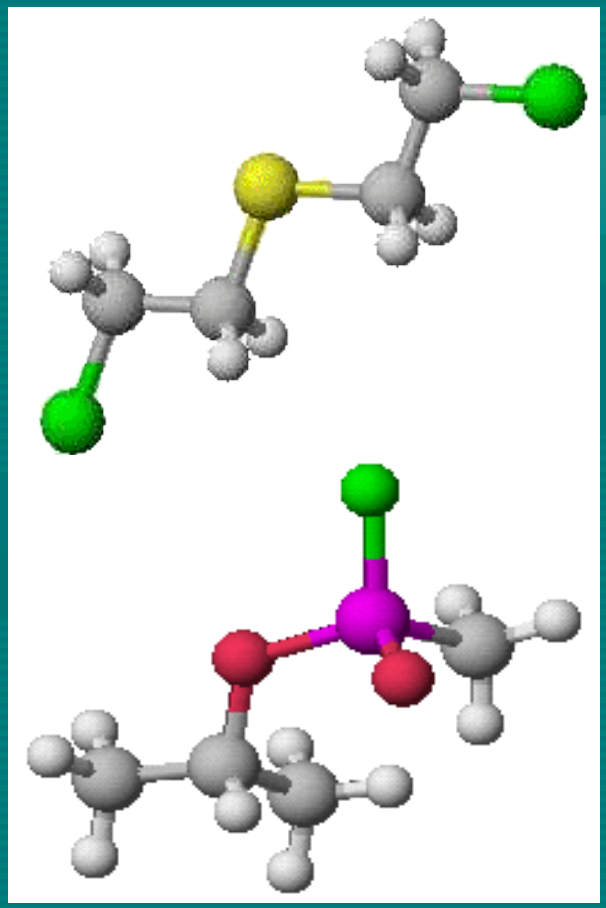


Goal: To develop predictive modeling tools for urban environments (inside & outside of facilities).

Detection & Characterization



Chemical Foundations



In Situ Neutralization of Chemical Agents

LOOKING AT POSSIBLE FUTURES

POSSIBLE FUTURE

- Terrorism, fed by radicalism and hatred, has become a more significant challenge to our society and its values.
- Vehicle bombs and cyber-terrorism have severely damaged or destroyed one or more critical national infrastructures.
- Terrorism, involving chemical and biological agents, has been demonstrated and attacks are increasing in lethality.
- Nuclear terrorism has increased as a threat of concern.
- WMD terrorism has fundamentally changed our way of life and the rationale for sustaining our freedoms and liberties is being questioned.

A MORE DESIRABLE FUTURE

- Science and technology have made acts of terrorism less probable and more costly to the terrorist.
- Science and technology have ameliorated the impact of security on our basis freedoms.
- Science and technology, with global legal initiatives, have denied sanctuary to terrorists.
- Science and technology have reduced the consequence of possible terrorist acts.
- The underlying factors that made terrorism an option for achieving social change have been eliminated.