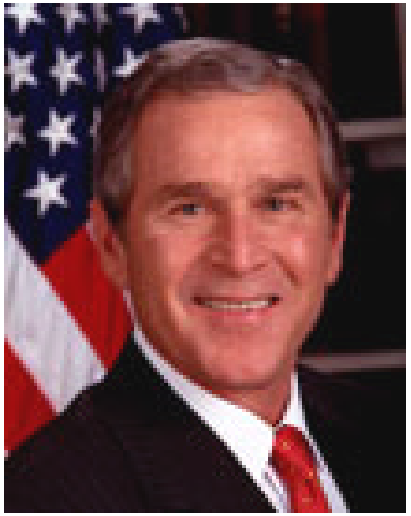
DoD Chemical/Biological Defense Program Overview

Presentation to the National Academy of Sciences Board on Chemical Sciences and Technology, 7 April 2002

Workshop on National Security and Homeland Defense

Dr. Anna Johnson-Winegar
Deputy Assistant to the Secretary of Defense for Chemical and Biological Defense



"The grave threat from nuclear, biological and chemical weapons has not gone away with the Cold War. It has evolved into many separate threats, some of them harder to see and harder to answer. And *the adversaries seeking these tools of terror are less predictable, more diverse*."

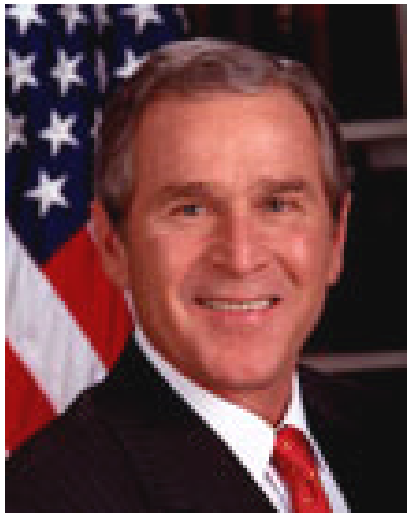
President George W. Bush
Norfolk Naval Air Station, Norfolk, Virginia
February 13, 2001

"We need to prepare, as an Alliance, for the full range of asymmetric threats: new forms of terrorism, … and nuclear, chemical and biological weapons of mass destruction. All of these are emerging dangers. None can be ignored.

It should be of particular concern to all of us that the list of countries which today support global terrorism overlaps significantly with the list of countries that have weaponized chemical and biological agents, and which are seeking nuclear, chemical and biological weapons—and the means to deliver them."

Secretary of Defense Donald Rumsfeld,
NATO North Atlantic Council,
December 18, 2001

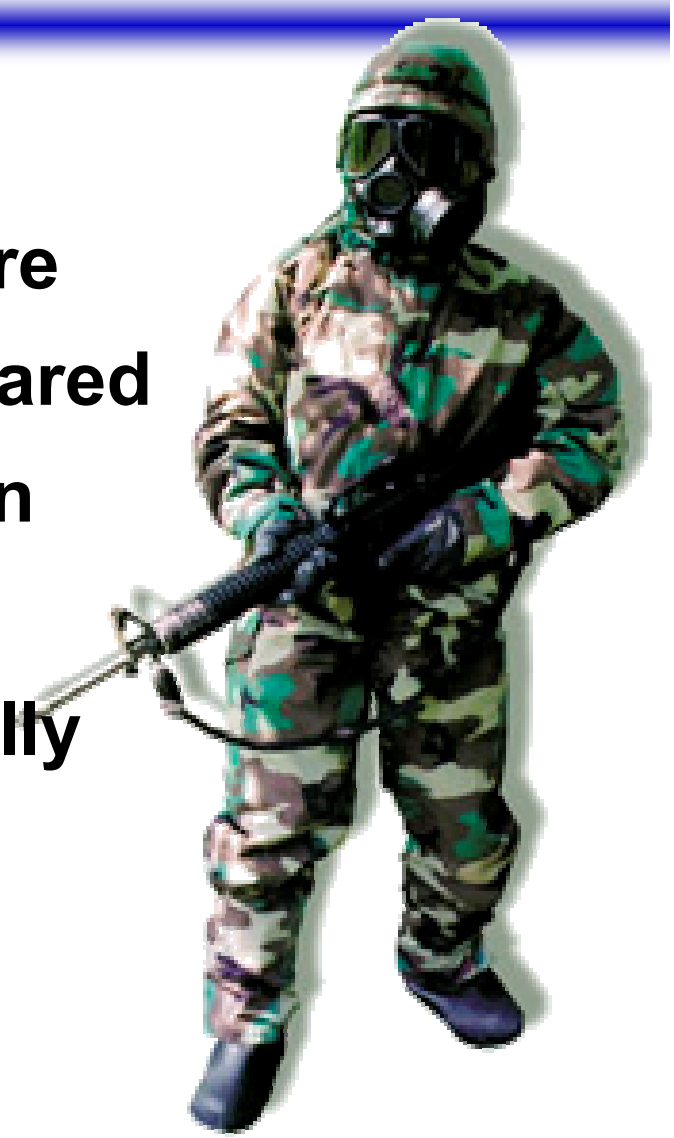
"The United States of America will not permit the world's most dangerous regimes to threaten us with the world's most destructive weapons…. My budget nearly doubles funding for a sustained strategy of homeland security, focused on four key areas: bioterrorism, emergency response, airport and border security, and improved intelligence. We will develop vaccines to fight anthrax and other deadly diseases. We'll increase funding to help states and communities train and equip our heroic police and firefighters. "



President George W. Bush
State of the Union Address
29 January 2002

CBDP Vision

- Ensure U.S. <u>military personnel</u> are the best equipped and best prepared force in the world for operating in <u>future battle spaces</u> that may feature chemically and biologically contaminated environments.



Chemical/Biological Defense Program (CBDP)

- **Established by Congress**
  - Fiscal Year 1994 National Defense Authorization Act Public Law 103-160, Sect. 1703 (50 USC 1522)

- **"The Secretary of Defense shall … Assign responsibility for overall coordination and integration of the chemical and biological warfare defense program and the chemical and biological medical defense program to a single office within the Office of the Secretary of Defense."**
  - Provides visibility for many relatively low-cost items
  - Eliminates redundancy

Chemical/Biological Defense Program
Global Proliferation

- **More than 20 countries working toward CW capability**
  - Relatively cheap and readily obtainable
  - Blister - Nerve - Blood - Choking
- **More than 10 countries developing BW capability**
  - Equipment not unique
  - More potent than most deadly chemical agents
  - No need for large stockpiles
  - Easy to hide
- **At least 25 countries have delivery capabilities or are developing them**
- **Legitimate global trade of many precursors & equipment**
  - Difficult to limit production with export controls
- **Toxic Industrial Chemicals (TICs)**
  - Any chemical with LCt50 less than 100,000 mg-min/m3 and produced in quantities exceeding 30 tons annually at one facility (ITF-25 definition)

The Chemical and Biological Agent Threat

- ***First,*** **chemical and biological agents, when properly prepared, are extremely toxic or potent and could be disseminated to incapacitate or kill thousands of individuals.**
- ***Second,*** **chemical and biological agents, in contrast to other destructive means, are suitable to attack large areas.**
- ***Third,*** **because chemical and biological agents may be disseminated over such a large area, they are indiscriminate. Effects can be particularly insidious in that they can be delayed, the onset occurring even after the person believes they are in a safe area. Chemical and biological agents are truly terror weapons.**
- ***Fourth,*** **chemical and biological agents are relatively inexpensive and available. In addition to the classic agents, many toxic industrial chemicals may be acquired either through legitimate means or by theft and used as terror weapon.**

CBW Agent Spectrum

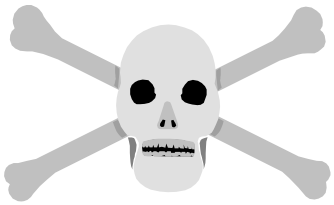
CLEARLY CHEMICAL ⟷ **CLEARLY BIOLOGICAL**

CW

CLASSIC CHEMICAL	EMERGING CHEMICAL
BLOOD	PROTECTION DEFEATING
VESICANT	PHYSICAL INCAPACITANT
NERVE	ENHANCERS
PSYCHOLOGICAL INCAPACITANT	
CHOKING	

BW

BIOREGULATOR	TOXIN	PATHOGEN
PAIN	PLANT	BACTERIA
SLEEP	BACTERIAL	VIRUSES
BLOOD PRESSURE	VENOM	RICKETTSIAE
MOOD	MARINE	GENETIC ENGINEERED MICRO-ORGANISMS
	FUNGAL	
	ALGAL	



MID-SPECTRUM

Chemical Threats

- **Vesicant Agents**:
  - HD-Mustard
  - H-Mustard with Impurities
  - HN-Nitrogen Mustard
  - L-Lewisite
  - CX-Phosgene Oxime
- **Blood Agents**:
  - AC-Hydrogen Cyanide
  - CN- Salts of: Sodium, Potassium, Calcium
  - CK-Cyanogen Chloride
- **Nerve Agents**:
  - GA-Tabun
  - GB-Sarin
  - GD-Soman
  - GF
  - VX
- **Respiratory Agent**:
  - Phosgene

Chemical Agents and Their Effects

Class of Agent	Symbol	Symptoms	Effects	Rate of Action
Nerve	**GA** **GB** **GD** **GF** **VX**	**Difficulty breathing, sweating, drooling, convulsions, dimming of vision.**	**Incapacitates at low concentrations. Kills in sufficient dosage. VX is persistent and a contact hazard. The other agents are non-persistent and present an inhalation hazard.**	**Vapors—seconds to minutes** **Skin—2 to 18 hours**
Blood	**AC** **CK**	**Rapid breathing, convulsions, and coma.**	**Kills in sufficient dosage. Non-persistent and an inhalation hazard.**	**Immediate**
Blister	**HD** **HN** **HL** **L**	**No early symptoms. Searing/stinging of eyes and skin.**	**Blisters delayed hours to days; eyes and lungs affected more rapidly. Immediate pain, delayed blisters. Persistent and a contact hazard.**	**Vapors—4 to 6 hours** **Skin—2-48 hours**
Choking	**CG** **DP**	**Difficulty breathing; tearing of the eyes.**	**Damages and floods lungs. Death can result. Non-persistent and an inhalation hazard.**	**Immediate to 3 hours**

Toxic Industrial Chemicals (TICs): A Potential Hazard in the Battlespace

Refinery in Pancevo,Yugoslavia

Fuel Depot in Smederevo,Yugoslavia

TICs – Any chemical with LCt_{50} less than 100,000 mg-min/m^3 and produced in quantities exceeding 30 tons annually at one facility

Smoke from power stations in Belgrade

Toxic Industrial Chemicals (TICS)

HIGH RISK	MEDIUM RISK		LOW RISK	
Ammonia	Acrolein	Phosphine	Allyl isothiocyanate	Iron pentacarbonyl
Arsine	Acrylonitrile	Phosphorus oxychloride	Arsenic trichloride	Isobutyl chloroformate
Boron trichloride	Allyl alcohol	Phosphorus pentafluoride	Bromine	Isopropyl chloroformate
Boron trifluoride	Allyl amine	Selenium hexafluoride	Bromine chloride	Isopropyl isocyanate
Carbon disulfide	Allyl chlorocarbonate	Silicon tetrafluoride	Bromine pentafluoride	n-Butyl chloroformate
Chlorine	Boron tribromide	Stibine	Bromine trifluoride	n-Butyl isocyanate
Diborane	Carbon monoxide	Sulfur trioxide	Carbonyl fluoride	Nitric oxide
Ethylene oxide	Carbonyl sulfide	Sulfuryl chloride	Chlorine pentafluoride	n-Propyl chloroformate
Fluorine	Chloroacetone	Sulfuryl fluoride	Chlorine trifluoride	Parathion
Formaldehyde	Chloroacetonitrile	Tellurium hexafluoride	Chloroacetaldehyde	Perchloromethyl mercaptan
Hydrogen bromide	Chlorosulfonic acid	tert-Octyl mercaptan	Chloroacetyl chloride	sec-Butyl chloroformate
Hydrogen chloride	Diketene	Titanium tetrachloride	Crotonaldehyde	tert-Butyl isocyanate
Hydrogen cyanide	1,2-Dimethyl hydrazine	Trichloroacetyl chloride	Cyanogen	Tetraethyl lead
Hydrogen fluoride	Ethylene dibromide	Trifluoroacetyl chloride	Dimethyl sulfate	Tetraethyl pyroposphate
Hydrogen sulfide	Hydrogen selenide		Diphenylmethane-4'-diisocyanate	Tetramethyl lead
Nitric acid, fuming	Methanesulfonyl chloride		Ethyl chloroformate	Toluene 2,4-diisocyanate
Phosgene	Methyl bromide		Ethyl chlorothioformate	Toluene 2,6-diisocyanate
Phosphorus trichloride	Methyl chloroformate		Ethyl phosphonothioicdichloride	
Sulfur dioxide	Methyl chlorosilane		Ethyl phosphorous dichloride	
Sulfuric acid	Methyl hydrazine		Ethylene imine	
Tungsten hexafluoride	Methyl mercaptan		Hexachlorocyclopentadiene	
	Nitrogen dioxide		Hydrogen iodide	

Potential BW Agents

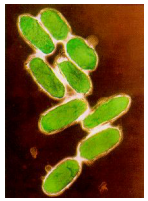
Bacteria/Rickettsia

Anthrax →

Brucellosis

Cholera

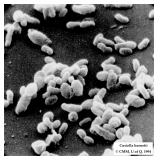
Plague →



Shigella

Tularemia

Q-Fever →



Typhus

Viruses

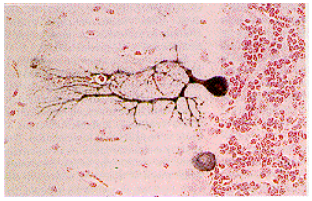
Smallpox

Rift Valley Fever

Crimean-Congo

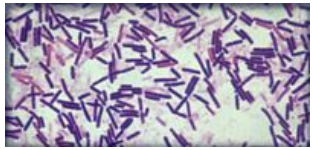
Hemorrhagic Fever

VEE



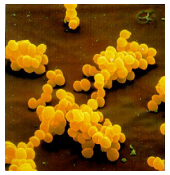
Toxins

Botulinum



Ricin

SEB →



T2 Mycotoxins

Saxitoxin

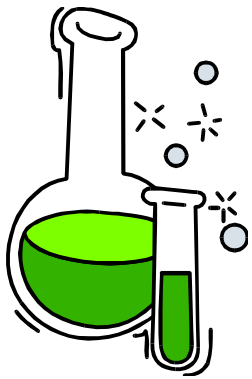
C. perfringens toxins

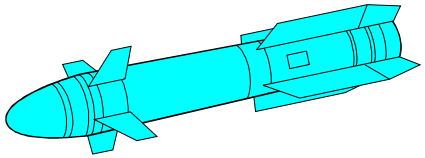
Neurotoxins

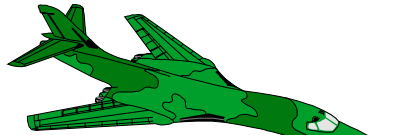
Aflatoxin

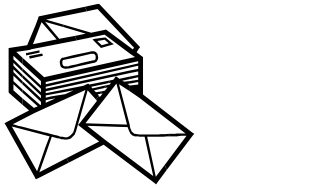
Weaponization Of Biological Agents

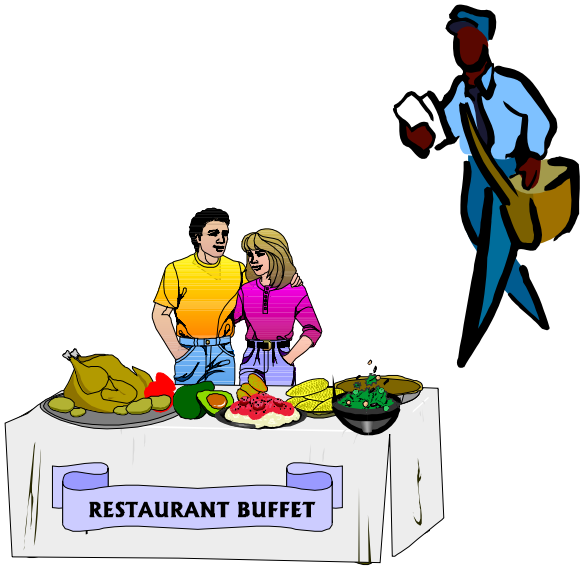
FUNDAMENTAL RELATIONSHIP OF AGENTS, MUNITIONS AND DELIVERY SYSTEMS











AGENT + **DISSEMINATION DEVICE** + **SUITABLE DELIVERY MEANS** = **BIOLOGICAL WEAPON**

(R&D, production, acquisition)

(+ testing)

Characteristics of Selected Pathogens

Pathogen	Routes of Infection*	Dissemination	Untreated Mortality (%)	Incubation Period	Treatment
Anthrax	**S,D,R**	**Aerosol**	**S – less than 25% R – approaches-100%**	**1-4 days**	**Antibiotics (limited effectiveness after symptoms develop)**
Plague	**V,R**	**Aerosol or vectors**	**Bubonic – 50% Pneumonic – 50 – 90%**	**2-3 days**	**Antibiotics**
Tularemia	**V,S,R**	**Aerosols**	**30 – 40%**	**1-10 days**	**Antibiotics**
Q Fever	**V,R**	**Covert or aerosols**	**less than 1%**	**14-26 days**	**Antibiotics**
Brucellosis	**D,R**	**Aerosol**	**<6%**	**5-21 days**	**Antibiotics**
Viral Hemorrhagic: Fevers (e.g., Ebola, Marburg, etc…)	**DC, uncertain**	**Aerosol**	**40-90%**	**4-21 days**	**Supportive care only**

*S – skin, D – digestive, R – respiratory, V – vector, DC – direct contact.

Characteristics of Selected Toxins

Toxin	Natural Source	Rate of Action	LD50 (mg/kg)*	Effect
Botulinum	**Clostridium botulinum bacteria**	**1 to 12 hrs.**	**0.0003 to 0.01**	**Dilated pupils, double vision, dry mouth, paralysis**
Tetanus	**Clostridium tetani bacteria**	**1 to 12 hrs.**	**0.0025 in humans**	**Muscle spasms, frequently in the jaw muscles**
Palytoxin	**Palythoa soft corals**	**5 mins.**	**0.08**	**Muscle contractions, heart irregularities, rigid paralysis**
Batrachotoxin	**South American frog**	**5 mins. to 1 hr.**	**0.1 to 2**	**Loss of coordination, numbness, headache, irregular heart rate, respiratory paralysis**
Ricin	**Castor Bean**	**5 mins. to 1 hr.**	**3.0 (oral)**	**Nausea, vomiting, cramps, bloody nose, diarrhea, difficulty in breathing, twitching**
Saxitoxin	**Shellfish**	**5 mins. to 1 hr.**	**5-12 (oral), 1 (aerosol)**	**Tingling, numbness, weakness, flaccid (limp) paralysis**
Tetrodotoxin	**Puffer fish**	**5 mins. to 1 hr.**	**30 (oral)**	**Vomiting; tingling; numbness; lack of muscle control; loss of voice; paralysis, especially of the arms and legs**
Tricothecene (T2) mycotoxin	**Fusarium mold on infected grain**	**1 to 12 hrs.**	**50 to 240 (aerosol)**	**Itching, tingling, vomiting, hemorrhaging, bloody diarrhea**
Staphylococcus Enterotoxin Type B (SEB)	**Staphylococcus aureus bacteria**	**1 to 12 hrs.**	**200 (aerosol)**	**Vomiting, cramps, nausea, diarrhea, severe weakness**

* Lethal Doses based on mouse model, unless otherwise noted.

Selected Chemical and Biological Defense Technologies

Current and Emerging

Chemical Detection
Current Capability

- **M22 Automatic Chemical Agent Detector Alarm (ACADA)**
  - Automatic point detection and identification of nerve and blister agents
  - Man-portable vapor alarm
  - Provides enhanced capability over M8A1 alarm
  - Based on Ion Mobility Spectrometry (IMS) technology

Chemical Detection
Current Capability

- **Chemical Agent Monitor (CAM) & Improved CAM**
  - **Detects, identifies, and provides relative vapor hazard read-outs for G and V nerve agents and H blister agents within one minute of agent exposure**
  - **<u>IMS</u> technology**
  - **Missions:**
    - Area reconnaissance & surveillance
    - Decontamination operations
    - Medical triage operations

Chemical Detection- Current Capability Advanced Portable Detector (APD) 2000

- Fielded to the National Guard WMD-CSTs
- Portable, hand-held device that can be used as a detector or as a continuously sampling monitor
- Simultaneously detects nerve and blister agents (GA, GB, GD, VX, HD, HN, L, Pepper spray, Mace)
- Powered by six internal alkaline or rechargeable batteries, external ac sources, or 9 to 18 V dc from a vehicle or external power supply
- Tested by SBCCOM Domestic Preparedness Program against live agents and found effective

Chemical Detection – Current Capability - Hapsite

HAPSITE Field-Portable GC/MS

- Fielded to the National Guard WMD-CSTs and the USMC CBIRF
- Field-portable gas chromatograph/mass spectrometer (GC/MS) for analysis of volatile organic compounds (VOCs)
- Weighing about 35 lbs
- Windows-based software allows customized data analysis and methods development
- Battery-powered

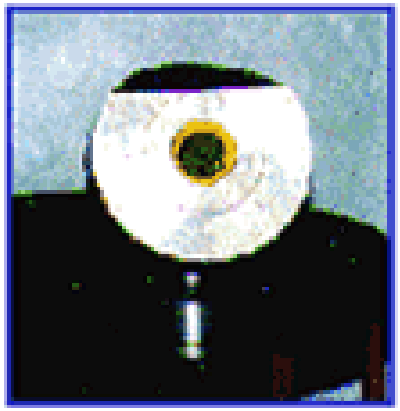
Chemical Detection- Emerging

Joint Chemical Agent Detector (JCAD)

- Real-time detection, identification of nerve blister, and blood agents
- Miosis-Level detection capability
- Calculates accumulated dosage
- Stores up to 72 Hours of detection data
- May be networked and remotely controlled
- May be operated by primary battery, rechargeable battery, DC or AC power.
- Replaces M8A1 Alarm, M22 ACADA and CAM/ICAM
- Requires more R&D

Chemical Detection- Emerging Technology

- **Joint Service Lightweight Standoff Chemical Agent Detector (JSLSCAD)**
  - Detects nerve, blister & blood agent vapor clouds
  - Mounts on land, sea & air platforms
  - Provides 360° x 60° on-the-move coverage
  - Provides 5 km detection range
  - Automatic Warning/Reporting through JWARN
  - No operator required
  - Requires more R&D



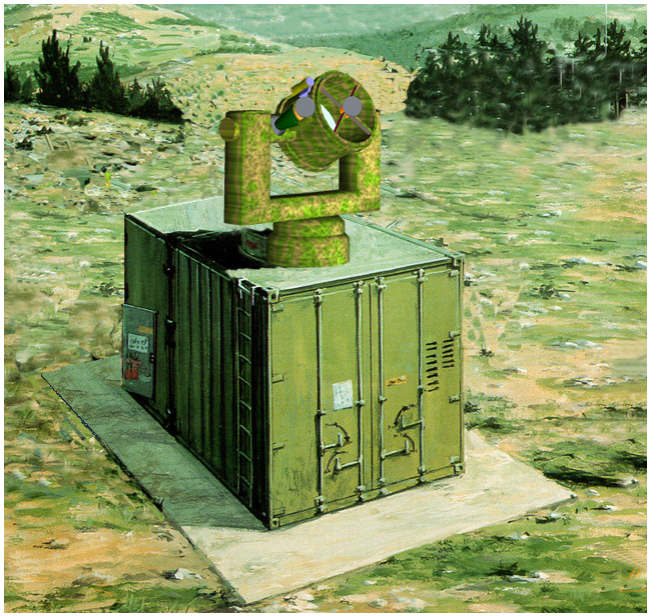
SCANNER

INTERFEROMETER

Defense Technology Objective - Laser Standoff Chemical Detector

Joint Service Warning and Identification LIDAR

- Detection, identification, quantification, and mapping of CW agents in vapor, liquid rain, and aerosol forms
- Frequency Agile Laser (FAL)



- 10-20 km range, 360 x 90 degree hemispherical coverage (less for aerosols/rains)
- Rapidly tuned laser emits 2 or more wavelengths that penetrate cloud
- Light is differentially absorbed/scattered upon transmission as well as reflection
- Light reflects off of topographic/aerosol/rain targets & detected at receiver
- Agents identified since each has a unique absorption/scattering spectrum

Biological Detection
Current Capability

Biological Integrated Detection System (BIDS) (Land System)

- ***"Large Area" Coverage***
- **ID 8 BW Agents**
- **ID Time <45 Min (Multiple Technologies)**

Interim Biological Agent Detection System (IBADS) (Blue Water System)

- ***"Local Alarm"***
- **ID 8 BW Agents**
- **ID Time <25 Min (Single Technology)**
- **Semi-Automatically Detects Background Particulate Change**

Biological Detection
Current Capability

Portal Shield System (Fixed Site Protection)

- ID 8 BW Agents Simultaneously
- ID Time <25 Minutes (Network)
- Chemical Sensor(s) Interface

DoD Biological Sampling Kit (Quick Screen of Suspect Packages/Samples)

- ID 9 BW Agents
- ID Time <15 Minutes
- Low False Positive Rate (.5%)

Biological Detection
Current Capability

Joint Biological Point Detection System (JBPDS) Block I

- Fully automated
- Simultaneous ID of 10 agents
- Operates as individual detector or as network
- <18 minute process time
- < 30 minute setup time
- Sample Isolation
- Block modifications to improve

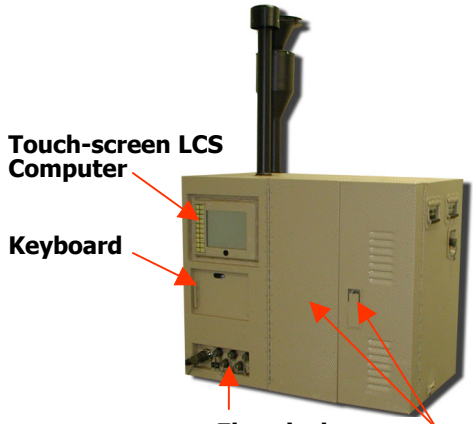
Common Suite For All Services

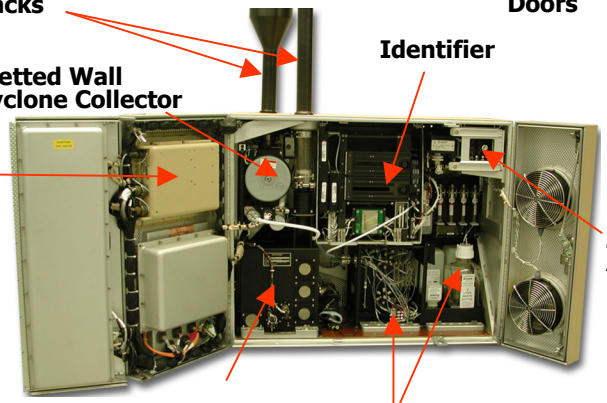
Emerging Technology - JBPDS Block II Development

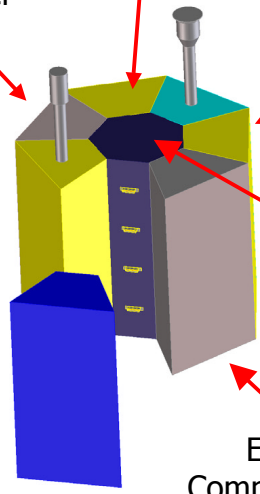
JBPDS LRIP- Block I
Basic Biological Suite Unit (BBSU)

Component Upgrades and Evolving Modularity

Potential JBPDS Block II Configuration







- **Modular/fully automated**
- **Detect/Identify all threat agents**
- **10 min or less time to identify**

Individual Protection
Current & Emerging Technology

Joint Service Lightweight Integrated Suit Technology (JSLIST)

- **Protective Suit**
  - Fielded system
  - Provides improved chemical protection, including overgarments, boots, gloves
  - 45 day protection and launderable
  - Planned improvements include new materials (selectively permeable membranes) to reduce weight and thermal stress and improved closures to prevent leaks
- **Multipurpose Overboot**
  - Wet weather and CB protection
- **JSLIST Glove Upgrades** *(developmental)*
  - Replace butyl rubber gloves
  - Improved dexterity
  - CB aviation glove
  - Liner or all-in-one glove

Joint Service Sensitive Equipment Decontamination – Emerging Technology

- **Block I Requirement**
  Decon **sensitive equipment** without adverse effects to the decontaminated items
- Sensitive equipment includes electronics, avionics, environmental control systems, and life-support systems
- Objective: **Transportable system** able to process electronic and night vision equipment rapidly for immediate re-use

- **Block II Requirement**
  Decon **aircraft / vehicle interiors and cargo** without affecting aircraft / vehicle / cargo operation or service life
- C/B agents may penetrate porous materials, presenting residual agent off-gassing problems requiring periodic decon
- Objective: System which can be **equipped on or with all existing airframes / vehicles** for on-demand Decon operations

- **Block III Requirement**
  Decon **aircraft / vehicle interiors** and associated cargo "On-the-Move"
- On-demand decon operations without adverse effects on crew, mission, or platform performance
- Objective: Block II upgrade which is capable of **safe operation in-flight**

Emerging Chemical and Biological Defense Technologies: Modeling & Simulation

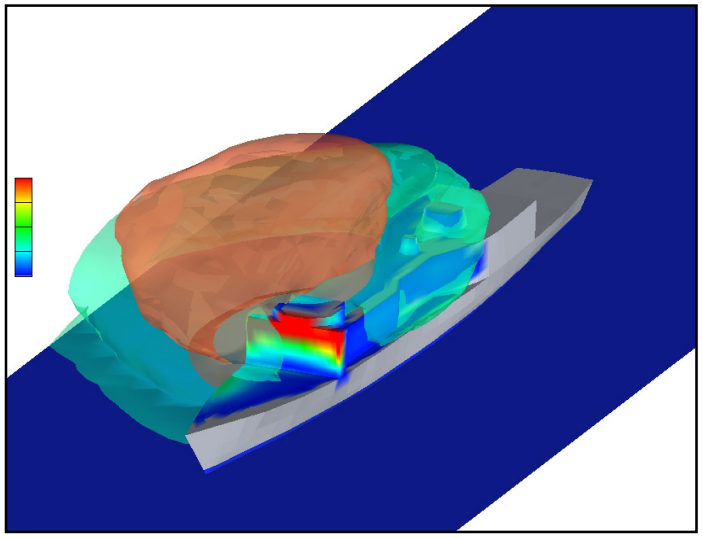
CBW Computational Fluid Effects Model General Description

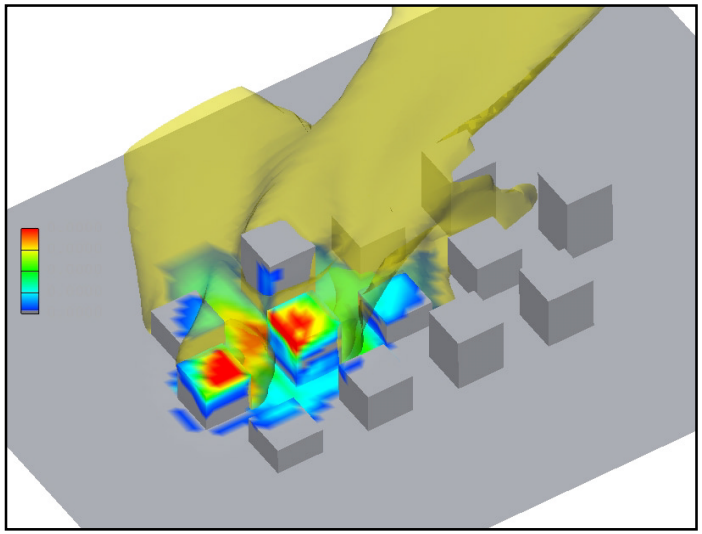
Capabilities

- Full 3D Navier-Stokes equations (coupled flow field and transport)
- Multi-phase flow with full diffusion equations
- Droplet evaporation, surface deposition and weathering effects

Uses

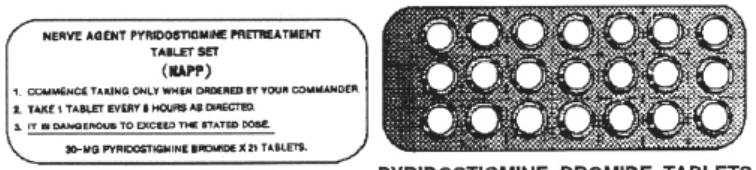
- CB threat studies and analyses (shipboard, urban environments)
- Detector placement
- Contamination of external structure surfaces
- Validation tool for less complex methodologies

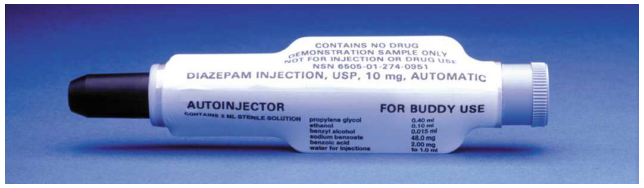




Medical Chemical Defense: Current Capabilities

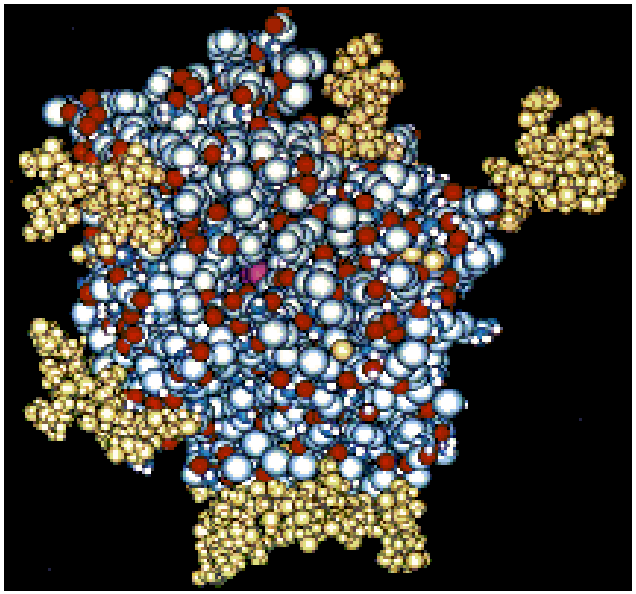
- **Pre-treatment**
  - Pyridostigmine Bromide (NAPP)
    - Inhibits “aging” of GD
    - Not licensed
- **Treatment**
  - Atropine (Mk I)
    - Blocks nerve agent
  - Pralidoxime Chloride (2-PAM Cl) (Mk I)
    - Regenerates Cholinesterase
  - Diazepam (CANA)
    - Anti-convulsant
  - Skin Exposure Reduction Paste Against Chemical Warfare Agents (SERPACWA)
- **Diagnosis**
  - Field Cholinesterase Kit





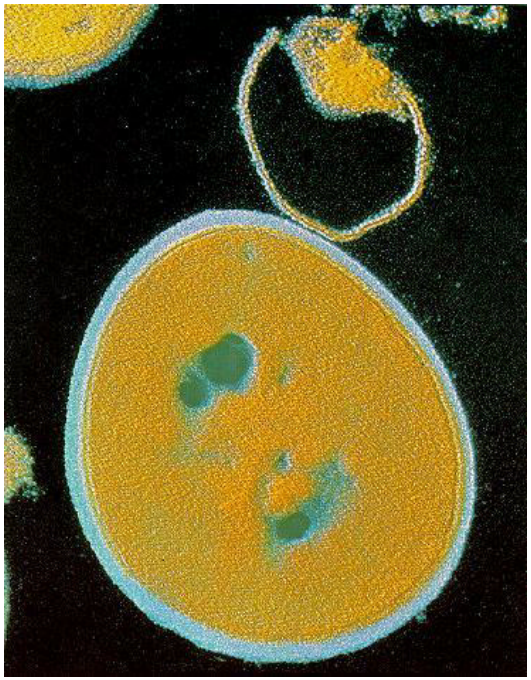
Chemical Agent Prophylaxes
Emerging Technology

- A genetically engineered human cholinesterase for use as a pretreatment for nerve agent exposure.
- Protein-based bioscavengers were identified that protect against five LD_{50s} of nerve agent in animal models without additional therapy or operationally significant physiological or psychological side effects.
- Currently a technology base effort



Medical Biological Defense: Current Capabilities – Therapeutics

- **Various antibiotics for treatment of exposure to bacterial agents**
  - Ciprofloxacin
  - Doxycycline
  - Tetracycline



Cell wall destroyed by antibiotic

The Civilian vs. Military "Threat"

- **The very nature of a civilian population—especially in a free and open democratic society—makes chemical or biological agents both very effective and very deadly**

- **Civilian populations, in contrast to the military:**
  - Are unorganized and have no chain of command,
  - Have no special equipment for detection, protection, or warning,
  - Have no specific training, and hence may be unaware of the threat or symptoms indicating an attack has occurred (especially for biological agents),
  - Are highly diverse, representing all ages, social and ethnic groups, sick and healthy,
  - May be susceptible to agent delivery through a variety of means, including through building ventilation, food or water, or dispersal in enclosed areas

Cross-cutting CB Technology Needs

- **Chemical agent detectors that provide "real-time" quantitative vapor concentrations in the Lowest Observable Effects Level (LOEL) to Immediately Dangerous to Life and Health (IDLH) range**
- **A "close-standoff" / "non-contact" technology for identifying liquid chemical agent surface contamination (*e.g.*, M8 / M9 paper replacement)**
- **Actual (*vs*. extrapolated) *in vivo* "low-level" chemical agent toxicity studies**
- **"Real-time" or "near-real-time" biological detection that is not dependent upon wet—chemistry consumables (*e.g.*, "solid-state detection)**
- **<u>Validated</u> biological markers of chemical or biological agent exposures (*e.g.*, animal surrogate markers and clinical human specimens)**
- **<u>Validated</u> chemical and biological agent dispersion and effects models for post-attack hazard prediction**

DoD Chemical Biological Defense Program Summary

Coordinated and integrated joint requirements respond to validated chemical and biological threats resulting in research, development, and acquisition of defensive equipment fielded to all Services

- Point detectors
- Remote and Standoff detectors
- Warning and reporting system
- Reconnaissance vehicles
- Masks and protective clothing
- Filters and shelters
- Vaccines/Drugs and Other Medical Countermeasures
- Decontamination equipment

Evolving Challenges

- **Supporting homeland security roles and missions**
  - Executing programs as strategy evolves
- **Enhancing CB installation force protection**
- **Acceleration of CB defense technologies**
  - Spinning off appropriate technologies for civilian applications
- **Maintaining current programs to respond to warfighter requirements**
  - Balance of competing priorities within current budget authority
- **Cooperation/strategy with HHS on Vaccine Development and Deployment**

Questions?

“Today’s problems cannot be solved with the same thinking that created them.”

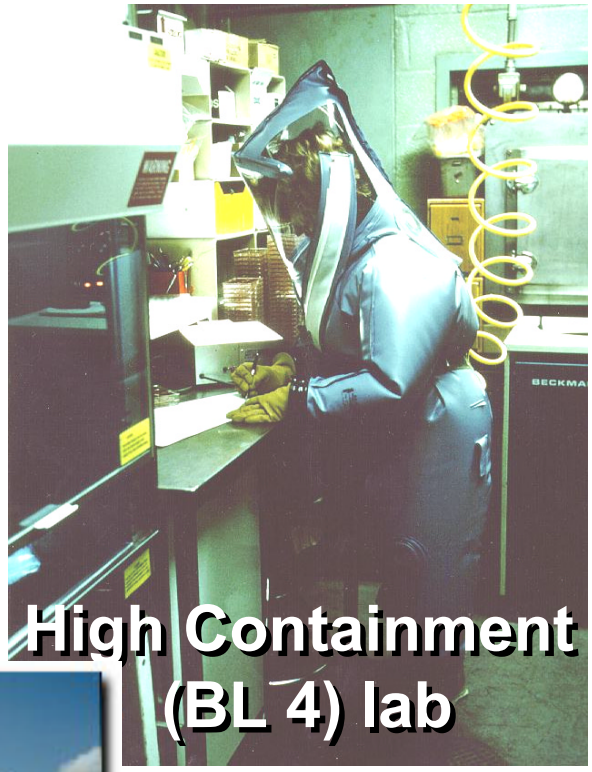
Albert Einstein

BACK-UPS

Key DoD Chemical and Biological Defense Laboratories

- **Army**
  - Soldier, Biological & Chemical Command (SBCCOM)
    - Edgewood Chemical and Biological Center (ECBC)
    - Natick Soldier Systems Command
  - Medical Research and Material Command
    - US Army Medical Research Institute of Infectious Diseases (USAMRIID)
    - US Army Medical Research Institute for Chemical Defense (USAMRICD)
    - Walter Reed Army Institute of Research (WRAIR)
    - US Army Research Institute of Environmental Medicine (USARIEM)
  - Dugway Proving Ground
- **Navy**
  - Naval Surface Warfare Center – Dahlgren Division
  - Naval Research Laboratory
  - Naval Medical Research Center
- **Air Force**
  - Brooks AFB (Human Systems Center)
  - Air Force Research Laboratory

DoD Chemical and Biological Defense Laboratories: Unique Capabilities



DoD Combating Terrorism Technology Task Force

- **Purpose:**
  - Provide DoD a coordinated technology plan for combating terrorism
- **Scope:**
  - Technologies to address potential terrorist threats from
    - Chemical,biological, nuclear, radiological and high explosives
  - Technologies to improve situational awareness and options for DoD action
  - Looking at near, mid, and long-term options
- **Organization – 4 Working Groups**
  - Deterrence and Indications and Warning (Protection)
  - Survivability and Denial (Prevention)
  - Consequence Management and Recovery (Response)
  - Attribution and Retaliation (Response)
- **Initial Approach**
  - Early emphasis on very near-term technologies available
  - Longer-term tech evaluations will include coordination with outside experts (industry, advisory boards,)

Submitting Unsolicited Proposals: Broad Agency Announcements (BAAs)

- U.S. Army Soldier Biological and Chemical Command – http://www.sbccom.apgea.army.mil/RDA/baa01.htm
- U.S. Army Medical Research and Materiel Command – http://mrmc-www.army.mil/
- Air Force Research Laboratories – http://extra.afrl.af.mil/bus-opps.htm
- Naval Surface Warfare Center – http://www.nswc.navy.mil/dahl.htm
- Marine Corps Systems Command – http://www.marcorsyscom.usmc.mil/BusOpps.htm
- Defense Advanced Research Projects Agency – http://www.darpa.mil (Especially SPO and DSO)
- Technical Support Working Group – http://www.tswg.gov

Acronyms

ASBREM – Armed Services Biomedical Research Evaluation and Management
BW – Biological Warfare
BES – Budget Estimate Submission
CAM – Commodity Area Manager
CBD – Chemical Biological Defense
CBDP – Chemical Biological Defense Program
CBTAP – Chemical Biological Threat Agent Program
CINC – Commander in Chief
CW – Chemical Warfare
DARPA – Defense Advanced Research Projects Agency
DATSD(CBD) – Deputy Assistant to the Secretary of Defense (Chemical Biological Defense)
DPG – Dugway Proving Ground
DTO – Defense Technology Objective
GOCO- Government Owned Contractor Operated
IPT – Integrated Product Team
JB1GU – JSLIST Blk I Glove Upgrade
JBPDS – Joint Biological Point Detection System
JBSDS – Joint Biological Standoff Detection System
JCAD – Joint Chemical Agent Detector
JCBAWM – Joint Chemical Biological Agent Water Monitor
JEM – Joint Effects Model
JOEF – Joint Operational Effects Model
JPL – Joint Priority List
JSAM – Joint Service Aircrew Mask
JSCESM – Joint Service Chemical Environment Survivability Mask
JSFXD – Joint Service Fixed Site Decontamination
JSGPM – Joint Service General Purpose Mask
JSIG – Joint Service Integration Group
JSLIST – Joint Service Lightweight Integrated Suit Technology
JSLSCAD – Joint Service Lightweight Standoff Chemical Agent Detector
JSMG – Joint Service Materiel Group
JSMLT – Joint Service Mask Leakage Tester
JSSED – Joint Service Sensitive Equipment Decontamination
JSTPCBD- Joint Science and Technology Panel for Chemical/Biological Defense
JTCG – Joint Technical Coordination Group
JTCOPS – Joint Transportable Collective Protection System
JWARN – Joint Warning and Reporting Network
MCBDR – Medical Chemical/Biological Defense Research Panel
MTW – Major Theater War

Acronyms

MILCON – Military Construction
MPSP – Medical Program Sub-Panel
NBC – Nuclear, Biological and Chemical
NBCRS – Nuclear, Biological and Chemical Reconnaissance System
OPTEMPO – Operational Tempo
PATS – Protection Assessment Test System
PB – President's Budget
POM – Program Objective Memorandum
QDR – Quadrennial Defense Review
RDA – Research, Development and Acquisition
RDT&E – Research, Development, Test and Evaluation
RSTA – Reconnaissance, Surveillance, and Target Acquisition
SDS – Sorbent Decontamination System
SOF – Special Operations Forces
TSWG – Technical Support Working Group
O&M – Operation and Maintenance
OSD – Office of the Secretary of Defense
TOA – Total Obligation Authority