2006 Chemical Biological Individual Protection (CBIP)
Conference & Exhibition

Charleston, SC

7-9 March 2006

Agenda

Wednesday, 8 March 2006

Keynote Address -- After Milestone Decision - What next?, Mr. Richard Decker, Director, Engineering Directorate, Edgewood Chemical Biological Center

Individual Protection for Expanding Warfighter Missions, Brigadier General Stephen V. Reeves, Joint Program Executive Officer for Chemical Biological Defense

Chemical and Biological Defense Future Initiatives, Dr. Joseph Palma, Deputy Special Assistant and Medical Director, Chemical and Biological Defense and Chemical Demilitarization Programs

Joint Requirements Office (JRO), MAJ W. Scott Smedley, Joint Requirements Office for Chemical, Biological, Radiological, and Nuclear Defense

JPEO & Technology Integration, Mr. Curt Wilhide, Chief for Advanced Technology and Transition, Joint Program Executive Office for Chemical Biological Defense

Individual Protection Science and Technology Program, Mr. Tony Ramey, Capability Area Program Officer (CAPO)

Realistic Testing and Evaluation of IPE, Mr. Sam Pitts, Science Advisor, CBIRF

Canadian Guidance for Selectionf of PPE by First Responders to a CBRN Terrorism Event, Dr. Eva Dickson, Defense Scientist, Department of Chemistry and Chemical Engineering Royal Military College of Canada

NBC Protection - A Swedish Version for the Future, Dr. Ola Claesson, Project Manager, Division of NBC Defense Swedish Defense Research Agency

Functional Materials for CB Protection Against the Asymmetric Threat, Dr. Scott Duncan, Head, Soldier and Systems Protection Group

Thursday, 9 March 2006

OPTION A: Ground Ensemble

Joint Service Lightweight Integrated Suit Technology (JSLIST) Ensemble, Mr. Scott Paris, Deputy Project Manager-Individual Protection for Ground Ensembles

Joint Service General Purpose Mask (JSGPM) and Joint Service Chemical Survivability Mask (JSCESM), Mr. Bill Fritch, Program Manager, Respirator Engineering and Acquisition Team

Next Generation General Purpose Mask, Mr. Corey Grove, Chemical Engineer, US Army Edgewood Chemical Biological Center

Future Force Warrior Project, Ms. Stephanie Castellani, Materials and System Integration

Advanced Seams & Closures, Ms. Scena Proodian, Clothing Designer, Navy Clothing and Textile Research Facility

Joint Chemical Ensemble (JCE), Mr. Scott Paris, Deputy Project Manager-Individual Protection for Ground Ensembles

OPTION B: Aviation Ensemble

The Joint Service Mask Leakage Tester: Helping to Ensure Protective Mask Readiness, Mr. Jeremy Scott, Program Manager, JSMLT

Joint Protective Aircrew Ensemble (JPACE,), Mr. John Aulson, Program Manager, JPACE

Joint Service Aviation Mask (JSAM), Captain Doug Hanks, Program Manager, JSAM Type I and IA

M41 Protective Assessment Test System (PATS), Mr. Jason Adamek, Mechanical Engineer

Cooling, Mr. Walter Teal, Jr., Physical Scientist

Filtration Technology Overview, Mr. Chris Karwacki, Chemical Biological Radiological Filtration Team Leader

OPTION A: Test and Evaluation

Test and Evaluation Overview, Mr. Fred Schmalkuche, Test Engineer

Capabilities Being Developed for the Future, Mr. Gene Stark, Protection Group Leader

Aerosol Testing, Dr. Jon Kaufman, Senior Research Physiologist/Lab Manager

PD TESS, Ms. Nicole Trudel, Product Director, Test Equipment, Strategy and Support

OPTION B: Science and Technology

Computational Chemistry Science and Technology Thrust Area Overview, Dr. Paul Murdock, Computational Chemistry Thrust Area Manager DTRA/CB--Joint Service Technical Office for CBD

Membrane Development for the Next Generation of Chemical Biological Clothing, Mr. Gene Wilusz, Chemical Technology Team Lead

Reactive Materials Research for Self-Detoxifying Chemical and Biological Protective Clothing, Dr. Heidi Schreuder-Gibson, Research Polymer Chemist, US Army RDECOM Natick Soldier Center

Overarching Model, Mr. Sal Clementi, Senior Engineer

Chemical Biological Individual Protection Conference 2006

March 7-9, 2006
Charleston Area Convention Center,
Charleston, SC

JOINT PROGRAM EXECUTIVE OFFICE
JPEO-CBD
CHEMICAL AND BIOLOGICAL DEFENSE

INDIVIDUAL PROTECTION
JPM – IP

Updated Agenda & Exhibitor Guide

Equipping those who protect us

NDIA
NATIONAL DEFENSE INDUSTRIAL ASSOCIATION
STRENGTH THROUGH INDUSTRY & TECHNOLOGY

Tuesday, March 7, 2006

4:30 PM- 6:60 PM	Pre-Registration and Light Reception in Exhibit Hall

Wednesday, March 8, 2006

7:00 AM	Late Registration
7:55 AM	Administrative Remarks Ms. Danielle Fleming Acquisition Director for the Joint Project Manager for Individual Protection
8:00 AM	Opening Remarks Brigadier General Dean Ertwine, USA (Ret) Co-Chairman, Chemical Biological Defense Division, NDIA
8:10 AM	Welcome/Introduction of Speaker Mr. Jim Nelson Joint Project Manager - Individual Protection
8:20 AM	Keynote Address--After Milestone Decision - What next? Mr. Rick Decker Director, Engineering Directorate Edgewood Chemical Biological Center
8:50 AM	Individual Protection for Expanding Warfighter Missions Brigadier General Stephen V. Reeves Joint Program Executive Officer for Chemical Biological Defense
9:20 AM	Chemical and Biological Defense Future Initiatives Dr. Joseph Palma Deputy Special Assistant and Medical Director Chemical and Biological Defense and Chemical Demilitarization Programs
9:50 AM	New York City Task Force Supervisory Special Agent Neil Donovan
10:20 AM	BREAK in Exhibit Hall
10:50 AM	Joint Requirements Office (JRO) Representative Joint Requirements Office for Chemical, Biological, Radiological, and Nuclear Defense

11:20 AM	US Special Operations Command (USSOCOM) Lieutenant Colonel John S. Campbell USSOCOM-Chemical Biological Radiological Nuclear
11:50 AM	JPEO & Technology Integration Mr. Curt Wilhide Chief for Advanced Technology and Transition Joint Program Executive Office for Chemical Biological Defense
12:20 PM	LUNCH in Exhibit Hall
1:50 PM	Individual Protection Science and Technology Mr. Tony Ramey Capability Area Program Officer (CAPO)
2:20 PM	Realistic Testing and Evaluation of IPE Mr. Sam Pitts Science Advisor, CBIRF
2:50 PM	Canadian Guidance for Selection of PPE by First Responders to a CBRN Terrorism Event Dr. Eva Dickson Defense Scientist, Department of Chemistry and Chemical Engineering Royal Military College of Canada
3:20 PM	BREAK in Exhibit Hall
3:50 PM	NBC Protection - A Swedish Version for the Future Dr. Ola Claesson Project Manager, Division of NBC Defense Swedish Defense Research Agency
4:20 PM	Functional Materials for CB Protection Against the Asymmetric Threat Dr. Scott Duncan Head, Soldier and Systems Protection Group Chemical and Biological Defence Section DRDC Suffield, Defence R&D Canada
4:50 PM	Operation Iraqi Freedom--Lessons Learned Mr. Darren Wheeler Senior CBRN Defense Analyst
5:25 PM	Closing Remarks for the day Ms. Danielle Fleming Acquisition Director for the Joint Project Manager for Individual Protection
5:30 PM- 7:00 PM	View Exhibits/Poster Session and Chemical Biological Individual Protection Reception in Exhibit Hall

Thursday, March 9, 2006

Break Out Session

OPTION A: Ground Ensemble

8:30 AM	Introduction to Session
8:35 AM	Joint Service Lightweight Integrated Suit Technology (JSLIST) Ensemble Mr. Scott Paris Deputy Project Manager-Individual Protection for Ground Ensembles
9:05 AM	Joint Service General Purpose Mask (JSGPM) and Joint Service Chemical Survivability Mask (JSCESM) Mr. Bill Fritch Program Manager, Respirator Engineering and Acquisition Team
9:35 AM	Next Generation General Purpose Mask Mr. Corey Grove Chemical Engineer, US Army Edgewood Chemical Biological Center
10:05 AM	BREAK
10:35 AM	Future Force Warrior Project Ms. Stephanie Castellani Materials and System Integration
11:05 AM	Advanced Seams & Closures Ms. Scena Proodian Clothing Designer, Navy Clothing and Textile Research Facility
11:35 AM	Joint Chemical Ensemble (JCE) Mr. Scott Paris Deputy Project Manager-Individual Protection for Ground Ensembles
12:05 PM	LUNCH in Exhibit Hall– LAST CHANCE TO VIEW EXHIBITS!

Thursday, March 9, 2006

Break Out Session

OPTION B: Aviation Ensemble

8:30 AM	Introduction to Session
8:35 AM	The Joint Service Mask Leakage Tester: Helping to Ensure Protective Mask Readiness Mr. Jeremy Scott Program Manager, JSMLT
9:05 AM	Joint Protective Aircrew Ensemble (JPACE) Mr. John Aulson Program Manager, JPACE
9:35 AM	Joint Service Aviation Mask (JSAM) Captain Doug Hanks Program Manager, JSAM Type I and IA
10:05 AM	BREAK
10:35 AM	M41 Protective Assessment Test System (PATS) Mr. Jason Adamek Mechanical Engineer
11:05 AM	Cooling Mr. Walter Teal, Jr. Physical Scientist
11:35 AM	Filtration Technology Overview Mr. Chris Karwacki Chemical Biological Radiological Filtration Team Leader
12:05 PM	LUNCH in Exhibit Hall – LAST CHANCE TO VIEW EXHIBITS!

Break Out Session

OPTION A: Test and Evaluation

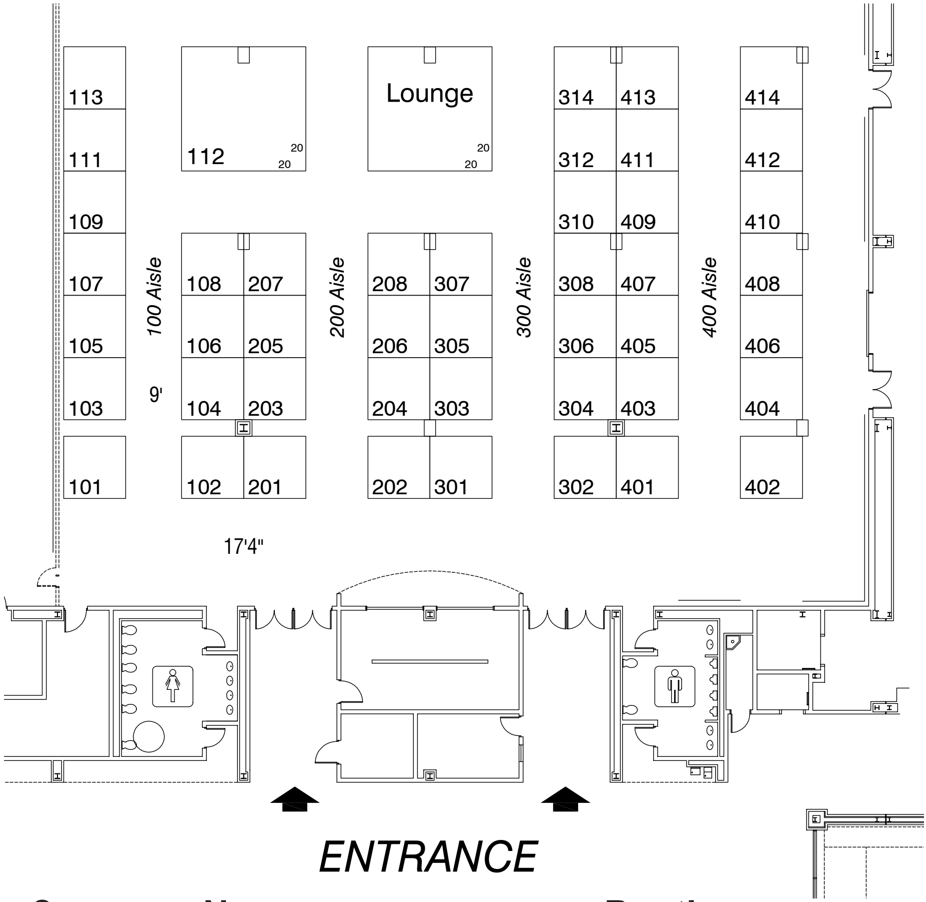
1:35 PM	Introduction to Session
1:40 PM	Test and Evaluation Overview Mr. Fred Schmalkuche Test Engineer
2:10 PM	Test Infrastructure Upgrades Dr. Eugene Stark Protection Group Leader
2:40 PM	Aerosol Testing Dr. Jon Kaufman Senior Research Physiologist/Lab Manager
3:10 PM	PD TESS Ms. Nicole Trudel Product Director, Test Equipment, Strategy and Support
3:45 PM	Closing Remarks & Adjournment Mr. Jim Nelson Joint Project Manager for Individual Protection

Break Out Session

OPTION B: Science and Technology

1:35 PM	Introduction to Session
1:40 PM	Computational Chemistry Science and Technology Thrust Area Overview Dr. Paul Murdock Computational Chemistry Thrust Area Manager DTRA/CB--Joint Service Technical Office for CBD
2:10 PM	Membrane Development for the Next Generation of Chemical Biological Clothing Dr. Eugene Wilusz Chemical Technology Team Lead
2:40 PM	Self-Detoxifying Materials for Protective Clothing Dr. Heidi Schreuder-Gibson Research Polymer Chemist, US Army RDECOM Natick Soldier Center
3:10 PM	Overarching Model Mr. Sal Clementi Senior Engineer
3:45 PM	Closing Remarks & Adjournment Mr. Jim Nelson Joint Project Manager for Individual Protection

Exhibit Hall



Company Name	Booth
Quick Protective Systems, Inc.	101
Avon Protection Systems, Inc.	102
3M	103
TBD	104
Scott Health & Safety	105
GSA/FSS/Services Acquisition Center	106
Proengin Inc	107
Kalman & Company, Inc.	108
Tex-Shield, Inc.	109
JPEO for Chem Bio Defense	112
Gentex Corporation	113
Air Techniques International	201

Company Name	Booth
SafetyTech International, Inc.	202
Kappler, Inc.	203
Battelle	204
Premier Micronutrient Corporation	205
BACOU-DALLOZ	206
New Breed Logistics	207
AirBoss Defense	208
CamelBak	301
LANX Fabric Systems	302
Draeger Safety, Inc.	303
Military Medical Technology	304
JEAP	305
Morphix Technologies	306
Audiopack	307
W. L. Gore & Associates, Inc.	308
The Sigmon Group	312
Nor E First Response, Inc	314
Milliken & Company	401
TSI Incorporated	402
CDO Technologies, Inc.	403
Ahura Corp.	404
Essex PB&R Corporation	405
MKI, Systems.	406
RDECOM-ECBC	407
Wel-Fab, Inc.	408
First Line Technology	409
Joint Research & Development Inc.	410
E-Z-EM, Inc.	411
Safety Equipment America Inc	412
Remploy Ltd.	414

Notes

Notes

Notes

Mask Fitting - M41 PATS

Protective Assessment Test System

Presented by: Jason Adamek
RDECOM, Test Technology Engineering Team
DSN: 584-2839
Comm: 410 436-2839
jason.adamek@us.army.mil

EDGEWOOD CHEMICAL BIOLOGICAL CENTER
Since 1917 · A Tradition of Solutions

M41 PATS

- Commercial Off-the-Shelf Device That Measures How Well a Protective Mask Fits a Soldier's Face.

- Tests the Seal Between the Mask and the Soldier's Face.

- Provides a Quantitative Indication of Mask Fit in Minutes.

- Rugged, Portable,
Durable for Field Use.

ECBC

M41 PATS - What Does It Do?

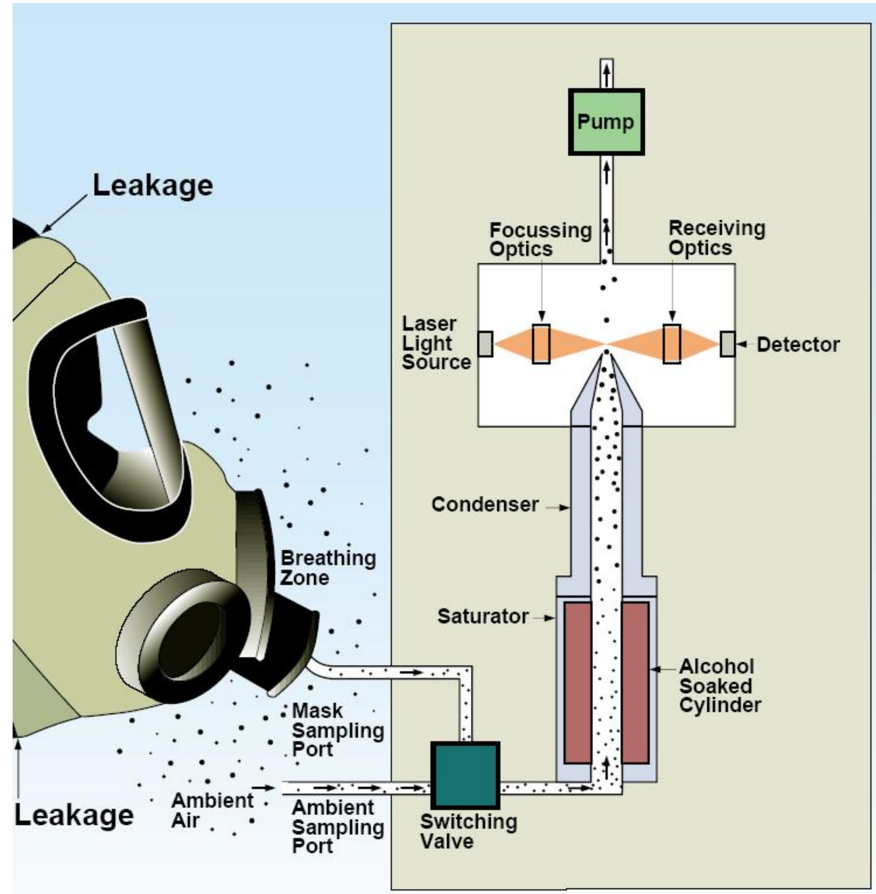
- Samples Air Inside the Mask and Outside the Mask.
- Counts Particles in the Air (0.02 – 0.2 micron range).
- Calculates Fit Factor as Follows:

$$\textbf{Fit Factor} = \frac{\textbf{Concentration Outside Mask}}{\textbf{Concentration Inside Mask}}$$

ECBC

M41 PATS - How Does It Work?

- Condensation Nucleus Counter (CNC).
- Condenses Evaporated Alcohol on Airborne Particles.
- Alcohol Droplets Scatter Light from Laser Source.



ECBC

M41 PATS – Benefits to the Military

- Verifies That Soldiers Are Getting The Best Possible Protection From Their Assigned Mask.
- Helps Assign Properly Sized Masks.
- Instills Confidence in Soldiers That Their Mask Protects Them.

ECBC

M41 PATS - Background

- Manufacturer: TSI Inc., Minneapolis, MN - sole source contractor
- Quantity: 11,135 units across the Services
- Users: Army (9897), Air Force (635), Marines (469), Navy (19), other (115)
- Unit cost: $6374 (FY05)
- Support: Organic - Redstone, AL, and Parmesans, Germany
- History:

  Type classified limited production (urgent) - Dec 1990

  Type classified - Oct 1993

  Production initiated - FY93

  Follow-on contract - FY03

ECBC

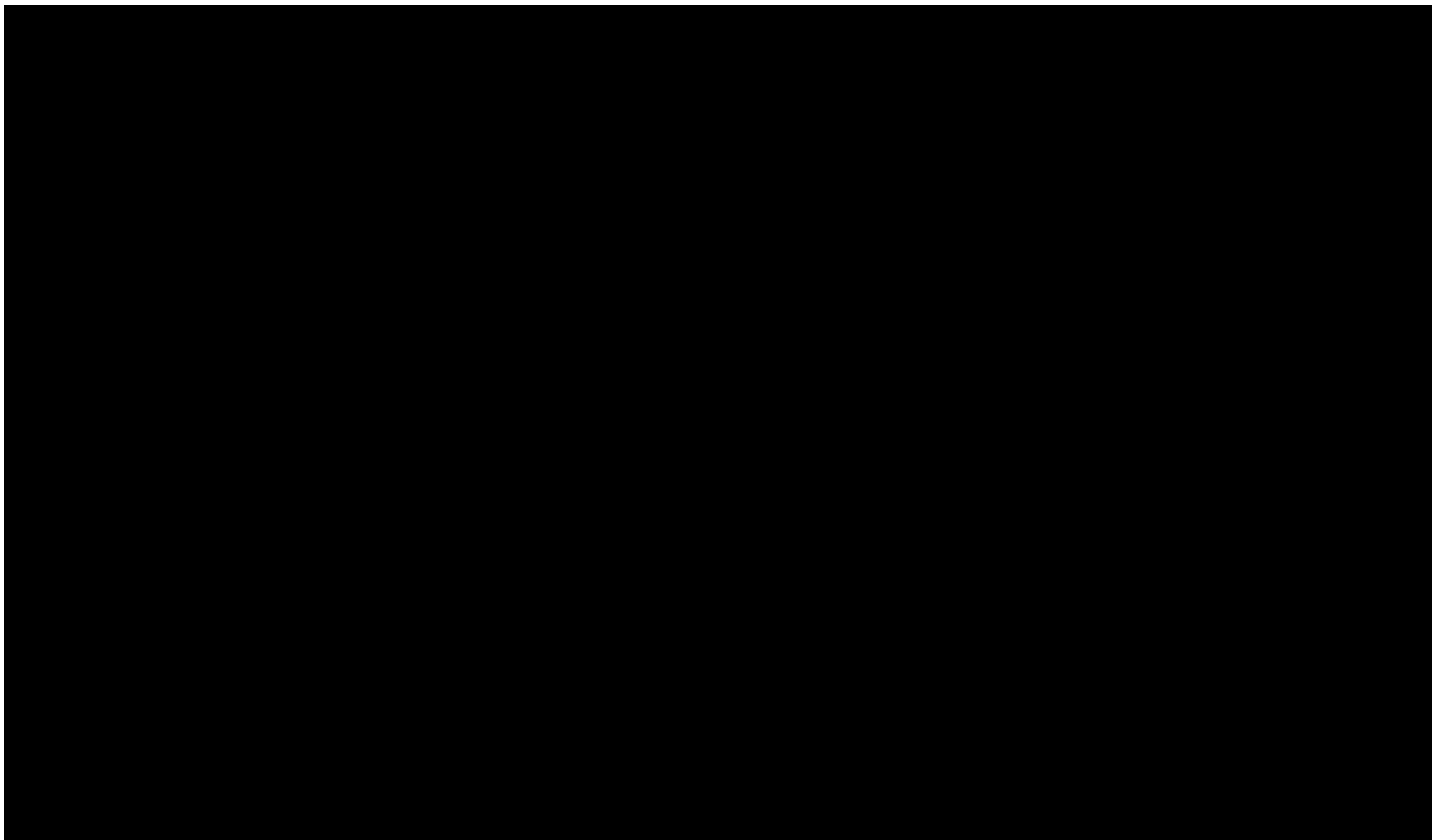
M41 PATS - Specs

Specifications

Size	
Instrument	240 mm × 190 mm × 140 mm
Carrying case	410 mm × 380 mm × 250 mm
Weight	
Instrument	1.9 kg
Carrying case	10 kg
Fit factor range	1 to greater than 50,000
Particle concentration range	0.01 to 500,000 particles/cm^3
Particle size range	0.02 to greater than 1 µm
Test duration (per exercise)	40 seconds
Power requirements	
AC	115 VAC or 230 VAC, 50/60 Hz, dual-voltage AC power supply
Battery	Optional
Temperature range	
Operation	0 to 38°C
Storage	-40 to 70°C
Sample flow rate	0.7 lpm (nominal)
Alcohol	
Hours of operation per charge	8 hours at 21°C
Alcohol type	Reagent grade isopropyl
Pass/fail settings	User-selectable
Factory recalibration interval	One year
Warranty	One year on workmanship and materials

ECBC

M41 PATS - Video



M41 PATS – Recent Developments

- Operations and Support Cost Reduction effort to reduce costs associated with the non-rechargeable lithium manganese dioxide battery.

- Created an alternative alkaline battery pack that uses 8 standard D-cell batteries.

- Potential savings of $2.5 M per year.

ECBC

M41 PATS – Recent Developments

- Operations and Support Cost Reduction effort to reduce costs associated with calibration and maintenance procedures.
- Currently on an 18-month calibration cycle.
- Developing time-of-use meter, total-particles-counted meter, and embedded diagnostics to monitor performance of major components.
- Switch to a more usage-based or as-needed service schedule.
- Estimated cost savings of $5 Million over 10 years.

ECBC

M41 PATS

- Questions?

JPACE – MOPP 4

IN THE

AVIATION ENVIRONMENT

Chemical/Biological

Individual Protection

Conference

March 2006

GLOSSARY

- Joint Protective Air Crew Ensemble (JPACE)
- Mission – Oriented Protective Posture (MOPP)
- Chemical/Biological (CB)
- Key Performance Parameter (KPP)
- Joint Service Lightweight Integrated Suit Technology (JSLIST)
- Aircrew Life Support Equipment (ALSE)
- Individual Protective Equipment (IPE)
- Microclimate Cooling Garment (MCG)
- Microclimate cooling Unit (MCU)
- Naval Aviation = Navy & Marine Aviators
- Air Warrior – US Army

JPACE

- One-Piece Chemical Protective Coverall for all services, all platforms
- Backward and forward compatible with all services Chemical/Biological respirators and foot and hand protection
- Backward and forward compatible with all services Aircrew Life Support Equipment, aircraft, and mission essential equipment

KPP's

- Provide CB protection equal to or better than JSLIST
- Provide CB protection over a 16 hour minimum mission duration
- Not interfere with ejection and continue to meet all CB agent permeation requirements following a survivable ejection and parachute descent
- Resist ignition and if ignited self-extinguish at a rate equal to or faster than the current (non CB) flight garments

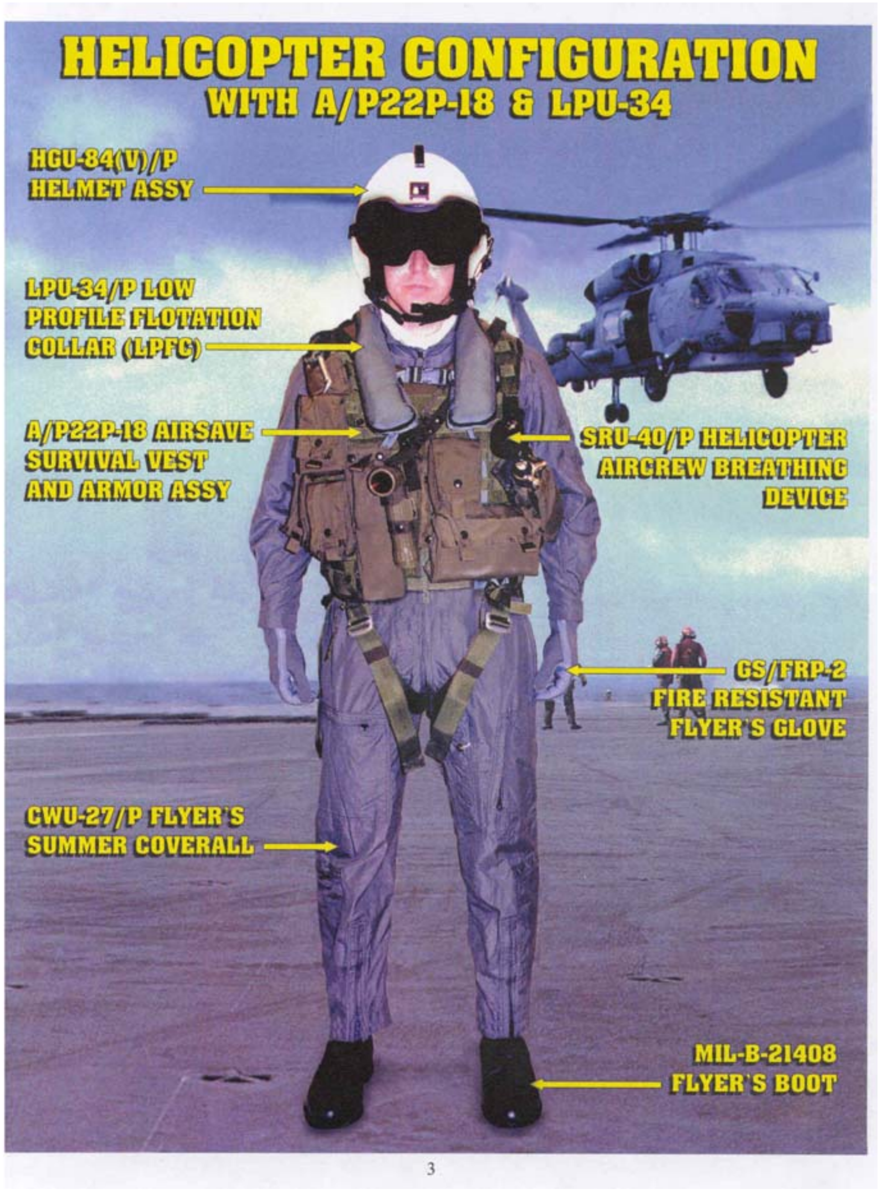
MOPP LEVELS

Afloat*		Ashore**	
MOPP	**Description**	**MOPP**	**Description**
		MOPP Ready[2] (USA/USMC only)	Carry mask and ensure that IPE is nearby[2].
		MOPP0	Carry mask and ensure that IPE is available[3].
MOPP 1	Ensure that IPE is available[3].	MOPP1	Don overgarment.
MOPP 2	Activate installed detectors, Carry mask[1] and post M8/M9 paper.	MOPP2	Don protective boots.
MOPP 3	Don protective suit, and boots; activate intermittent countermeasures washdown.	MOPP3	Don protective mask.
MOPP 4	Don protective gloves and mask	MOPP4	Don protective gloves.
*USN, USCG, and MSC vessels.		**USN, USMC, USA, and USAF personnel.	

[1] The term "mask" includes any form of respiratory protection against NBC hazards as issued by services.

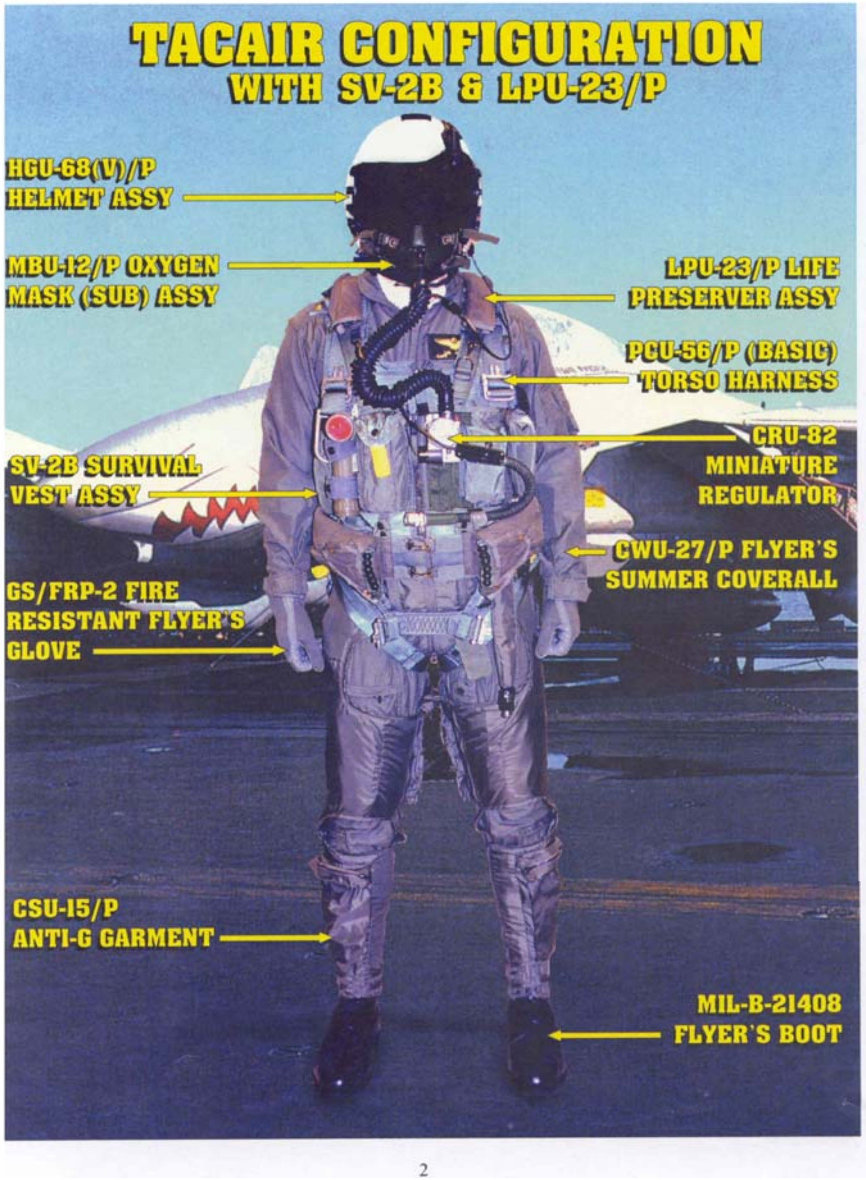
[2] IPE must be available to soldiers and marines within 2 hours. A second set must be available in 6 hours. MOPP ready does not apply to the USAF.

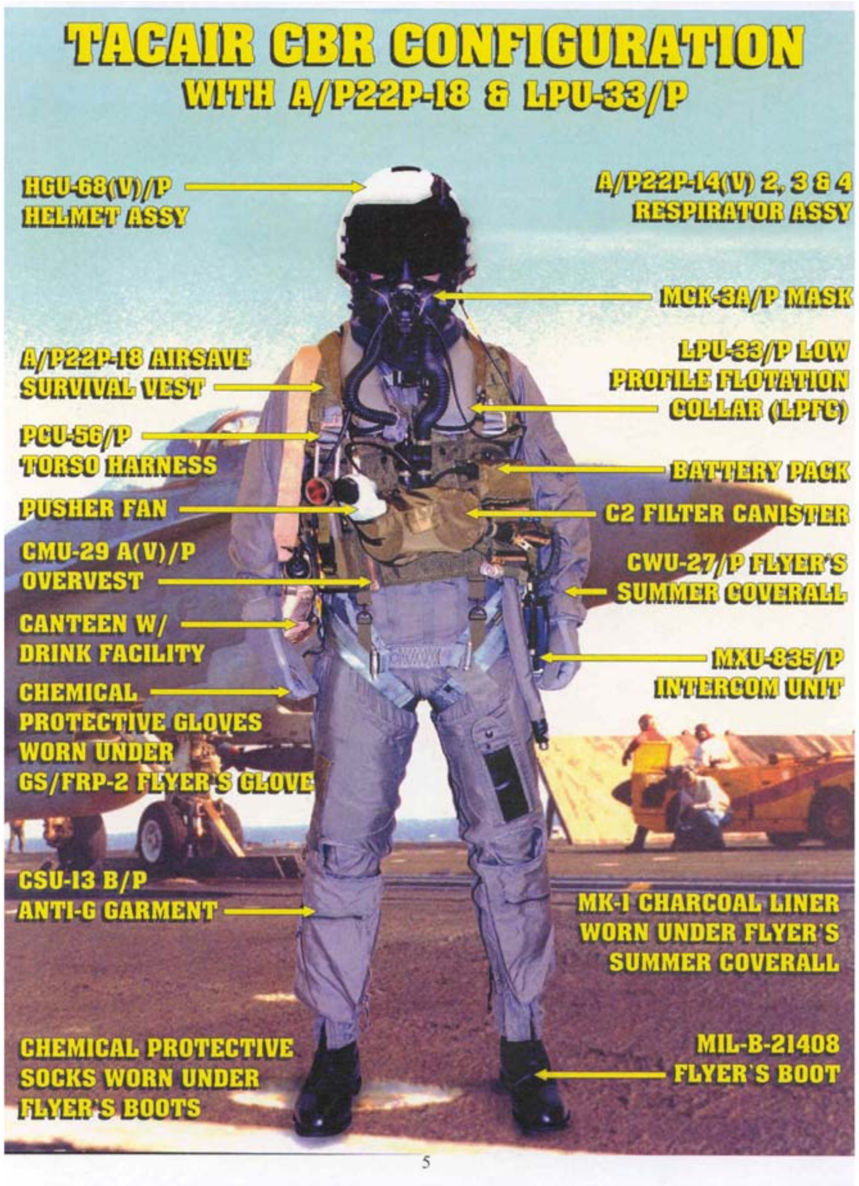
[3] IPE must be within arm's reach of personnel.

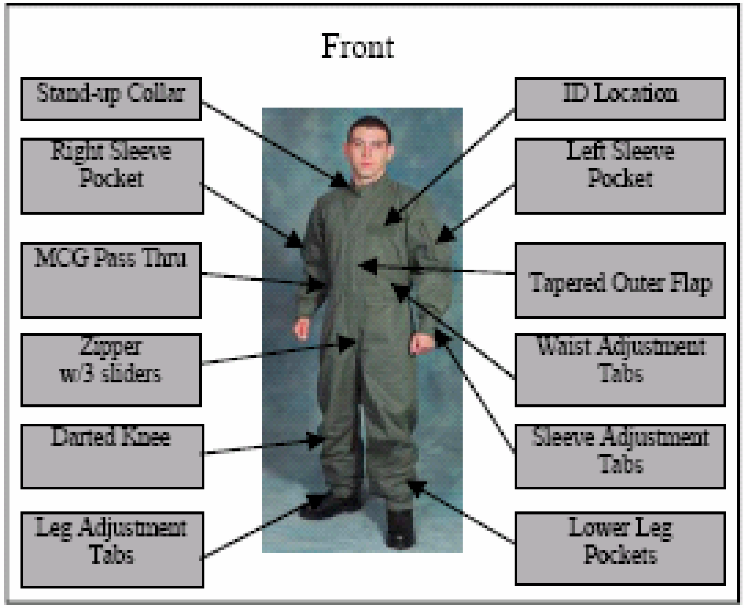

HELICOPTER CONFIGURATION
WITH A/P22P-18 & LPU-34
HGU-84(V)/P HELMET ASSY
LPU-34/P LOW PROFILE FLOTATION COLLAR (LPFC)
A/P22P-18 AIRSAVE SURVIVAL VEST AND ARMOR ASSY
SRU-40/P HELICOPTER AIRCREW BREATHING DEVICE
GS/FRP-2 FIRE RESISTANT FLYER'S GLOVE
CWU-27/P FLYER'S SUMMER COVERALL
MIL-B-21408 FLYER'S BOOT
3

AIR WARRIOR BLOCK 3

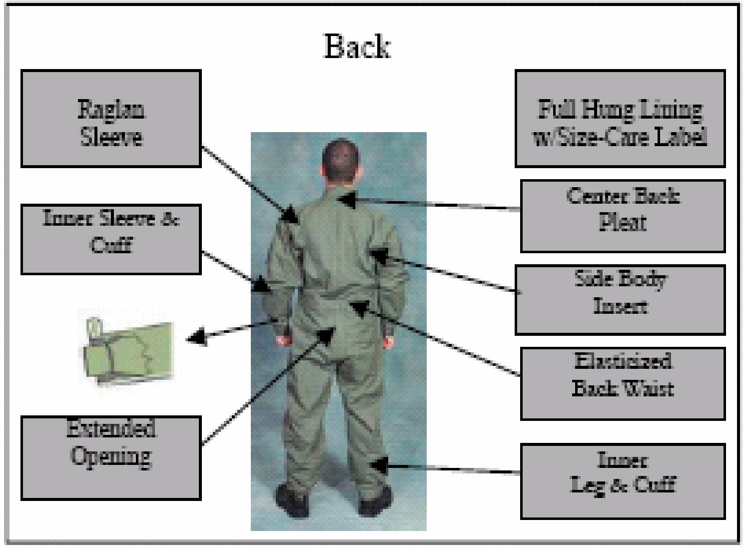
General Dynamics C4 Systems


TACAIR CONFIGURATION
WITH SV-2B & LPU-23/P
HGU-68(V)/P HELMET ASSY
MBU-12/P OXYGEN MASK (SUB) ASSY
LPU-23/P LIFE PRESERVER ASSY
PCU-56/P (BASIC) TORSO HARNESS
CRU-82 MINIATURE REGULATOR
SV-2B SURVIVAL VEST ASSY
CWU-27/P FLYER'S SUMMER COVERALL
GS/FRP-2 FIRE RESISTANT FLYER'S GLOVE
CSU-15/P ANTI-G GARMENT
MIL-B-21408 FLYER'S BOOT
2


TACAIR CBR CONFIGURATION
WITH A/P22P-18 & LPU-33/P
HGU-68(V)/P HELMET ASSY
A/P22P-14(V) 2, 3 & 4 RESPIRATOR ASSY
MCK-3A/P MASK
A/P22P-18 AIRSAVE SURVIVAL VEST
LPU-33/P LOW PROFILE FLOTATION COLLAR (LPFC)
PCU-56/P TORSO HARNESS
BATTERY PACK
PUSHER FAN
C2 FILTER CANISTER
CMU-29 A(V)/P OVERVEST
CWU-27/P FLYER'S SUMMER COVERALL
CANTEEN W/ DRINK FACILITY
MXU-835/P INTERCOM UNIT
CHEMICAL PROTECTIVE GLOVES WORN UNDER GS/FRP-2 FLYER'S GLOVE
CSU-13 B/P ANTI-G GARMENT
MK-1 CHARCOAL LINER WORN UNDER FLYER'S SUMMER COVERALL
CHEMICAL PROTECTIVE SOCKS WORN UNDER FLYER'S BOOTS
MIL-B-21408 FLYER'S BOOT
5

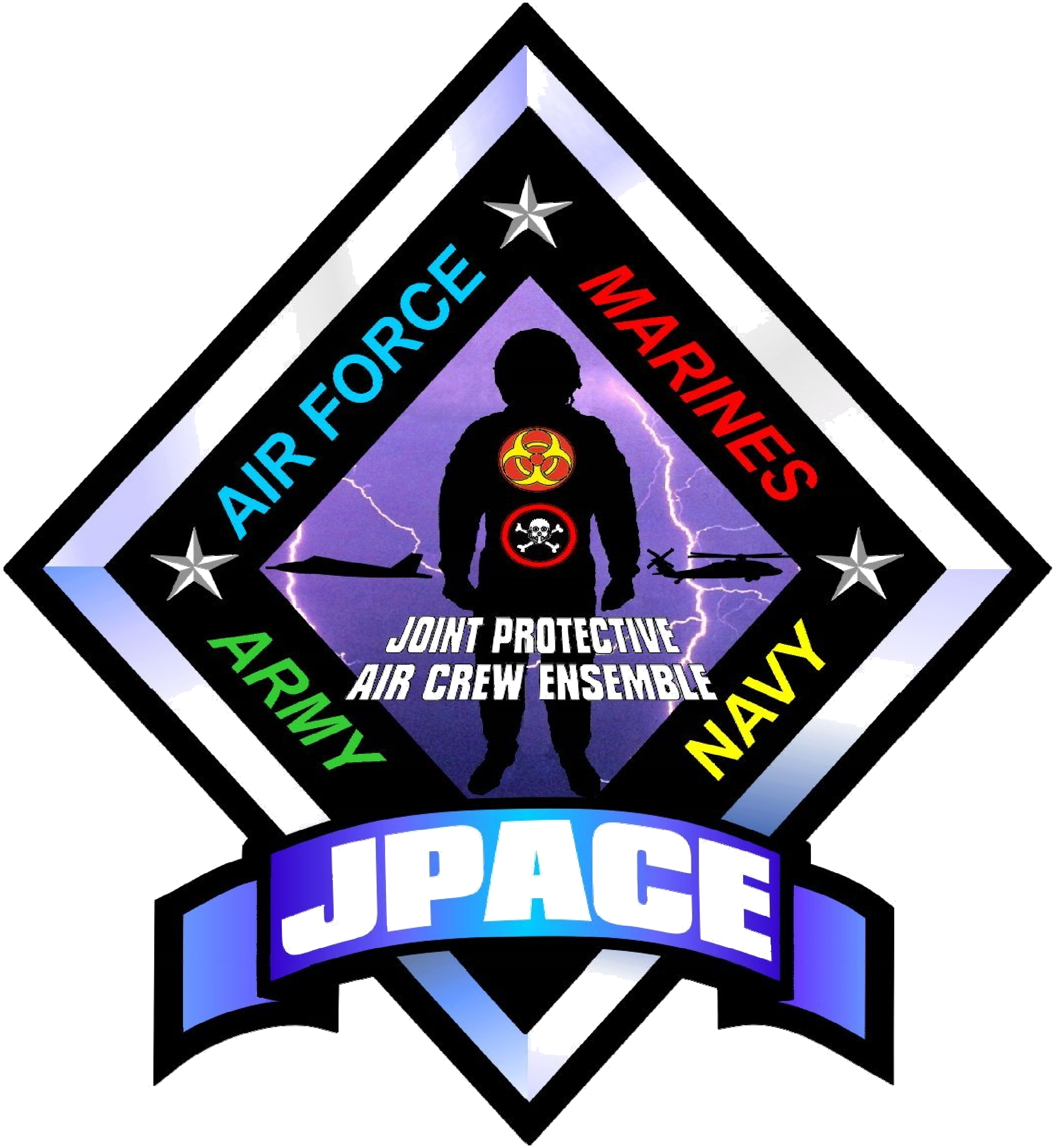

Front
Stand-up Collar
Right Sleeve Pocket
MCG Pass Thru
Zipper w/3 sliders
Darted Knee
Leg Adjustment Tabs
ID Location
Left Sleeve Pocket
Tapered Outer Flap
Waist Adjustment Tabs
Sleeve Adjustment Tabs
Lower Leg Pockets

Neck Dam


Back
Raglan Sleeve
Inner Sleeve & Cuff
Extended Opening
Full Hung Lining w/Size-Care Label
Center Back Pleat
Side Body Insert
Elasticized Back Waist
Inner Leg & Cuff

TESTING

- Flame-Resistance
- Chemical Protection
- Contaminated Doffing
- Survivability
- Human Factors
- Heat Stress
- Durability Field Testing
- Physical Properties


AIR FORCE
MARINES
ARMY
NAVY
JOINT PROTECTIVE
AIR CREW ENSEMBLE
JPACE

BACKUP SLIDES

Air Warrior Configuration

- **Air Warrior Block 1**
- Flexible Body Armor
- Ballistic Upgrade Plates
- Primary Survival Gear Carrier
- First Aid Items
- Universal Holster
- Aircrew Survival and Egress Knife
- M45 Protective Mask Blower
- Microclimate Cooling System (MCS)
  - Microclimate Cooling Garment (MCG)
  - Microclimate Cooling Unit (MCU)
- Over Water Mission Equipment (SELECT UNITS)
  - Over Water Gear Carrier
  - Survival Egress Air (SEA)
  - Flotation Collar

- **Accelerated Block 2**
- Electronic Data Manager (EDM)

Potential Expanded use

- Potential candidate for CVC
- Participating in Side-by-Side tests with JC3 designs and JSLIST Type VII

Future Force Warrior:
Soldier Protection and Individual Equipment System

NDIA Chemical Biological Individual Protection Conference

9 March 2006
Stephanie Castellani – Natick Soldier Center

What is SPIES?

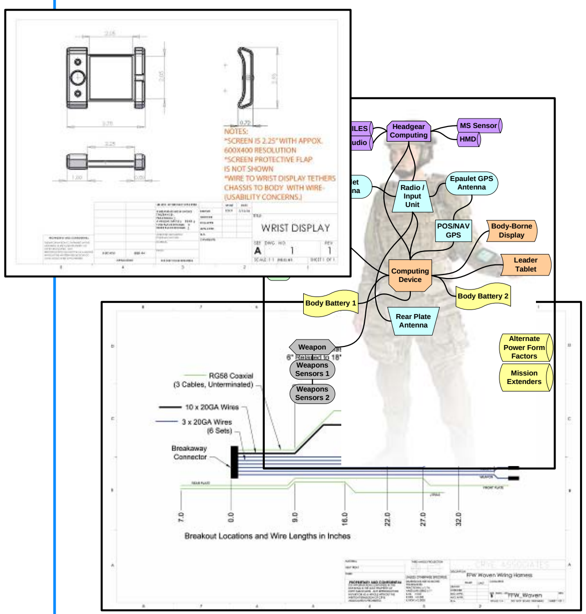
- Soldier Protection and Individual Equipment System

- SPIES is Physical Embodiment
  - Body Armor
  - Load Carriage
  - Physical Integration of Soldier Electronics
  - Uniform designed for Combat
  - Signature Management
  - Hydration
  - CB Protection
  - Fightable form factors

What is SPIES?

- **SPIES is also the <u>Physical Bridge</u> between the electronics and the user.**
- Making technology work and making technology work ***on a Soldier, in the field*** are not always the same thing. SPIES helps make the tech. work for a user in the field.

ELECTRONICS TECHNOLOGY



SPIES

FIGHTABLE, PHYSICALLY INTEGRATED, MODULAR SOLDIER-CENTERED, BODY-BORNE SYSTEM

GENERAL DYNAMICS
C4 Systems

Multi-function Combat Suit (MFCS)

Optimized for Combat

- **Combat Shirt**
  - Moisture/Thermal Management Torso utilizing advanced wool materials
  - High Utility Sleeves utilizing NyCo
  - Integrated/Removable Modular Elbow Protection
  - Multi-Environment Camouflage

Weight:	
Combat Shirt:	0.9 lbs
Elbow Pads:	0.1 lbs
Combat Pants:	2.6 lbs
Knee Pads:	0.2 lbs

- **Combat Pants**
  - Integrated/Removable Modular Knee Protection
  - Lightly Padded Waistband
  - Changes underway to improve passive cooling and reduce weight
    - lighter and stretchable NyCo fabric, reduce length of side zippers, eliminate multiple layers of Cordura at lower leg, lighter knee/elbow pads

GENERAL DYNAMICS
C4 Systems

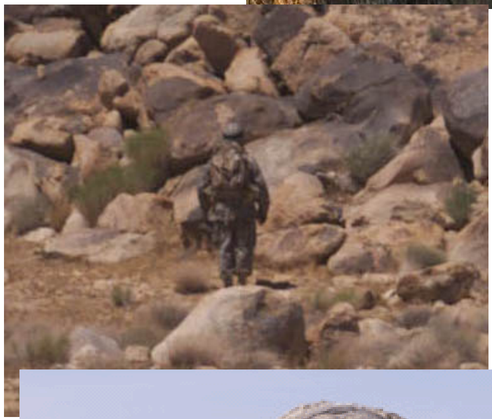
Multi-Environment Camouflage Pattern Evaluation

- **Purpose:** To determine if the FFW MultiCam pattern provides a **significant** improvement in camouflage effectiveness over the Army Universal Camouflage in multiple combat environments.

- **Methodology:** Employ test methodology used by Vehicle community and ATC using digital images.
  - Significantly increases the data set in terms of number of backgrounds, lighting, and number of observers.
  - Measure visual blending of Universal Camouflage and FFW MultiCam in multiple backgrounds.

- **Schedule:**
  Collect calibrated imagery Nov 05 – Jan 06;
  Observer test, Mar- Apr 06; Data Analysis, May – Jun 06

- **Data Goals**:
  - 120 images: woodland, desert, rocky, grassy, urban
  - Scored individually and forced choice
  - 100 Observers from 3 units



SPIES Body Armor/Load Carriage

FORCE
FUTURE
WARRIOR

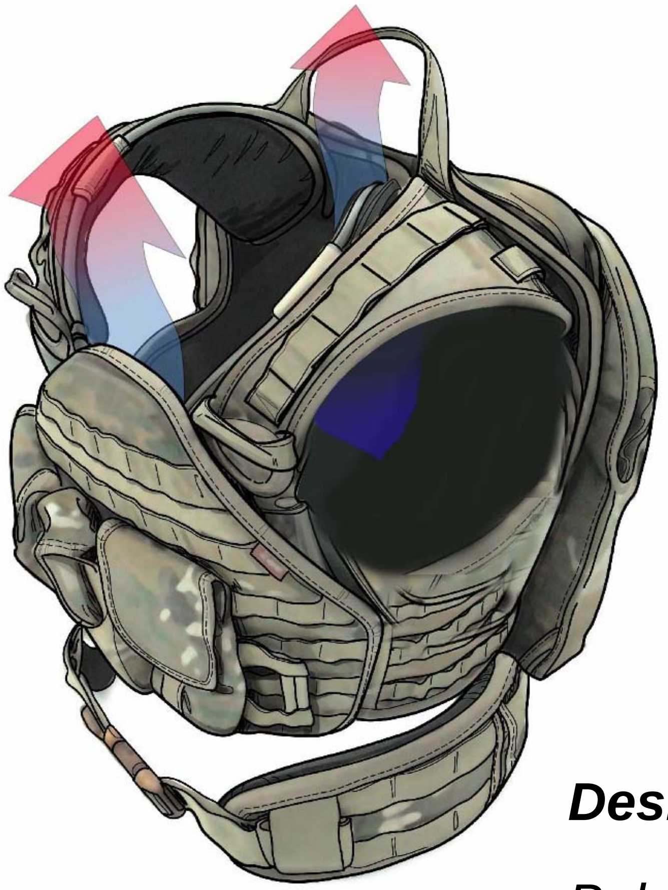
<u>The Armor Chassis and Belt</u>

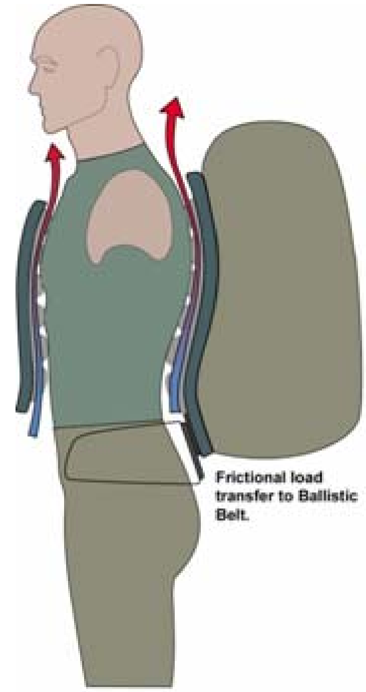
Central Load Carriage, Ballistic Protection, and Thermal Management system.

Provides increased passive cooling, increased mobility, increased ballistic and flame protection, improved comfort, and stabilized load carriage.

Apparel, Load Carriage, and Armor component designs are based on the advantages of this fundamental system architecture.

Weight:
Chassis, sz 2 without plates: 7.0 lbs
Chassis, sz 2 with plates: 18.3
Belt sz 1: 2.2 lbs





Design Challenge:

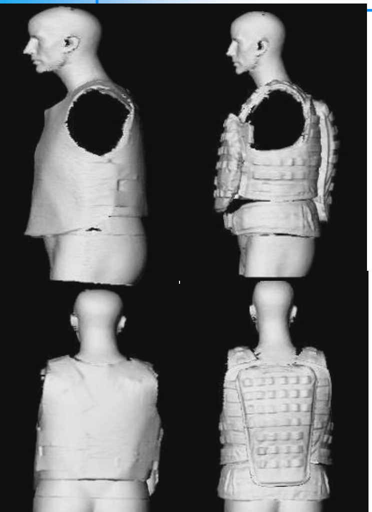
Balance protection with fightability

TEAM SOLDIER

Natick Soldier Center

GENERAL DYNAMICS
C4 Systems

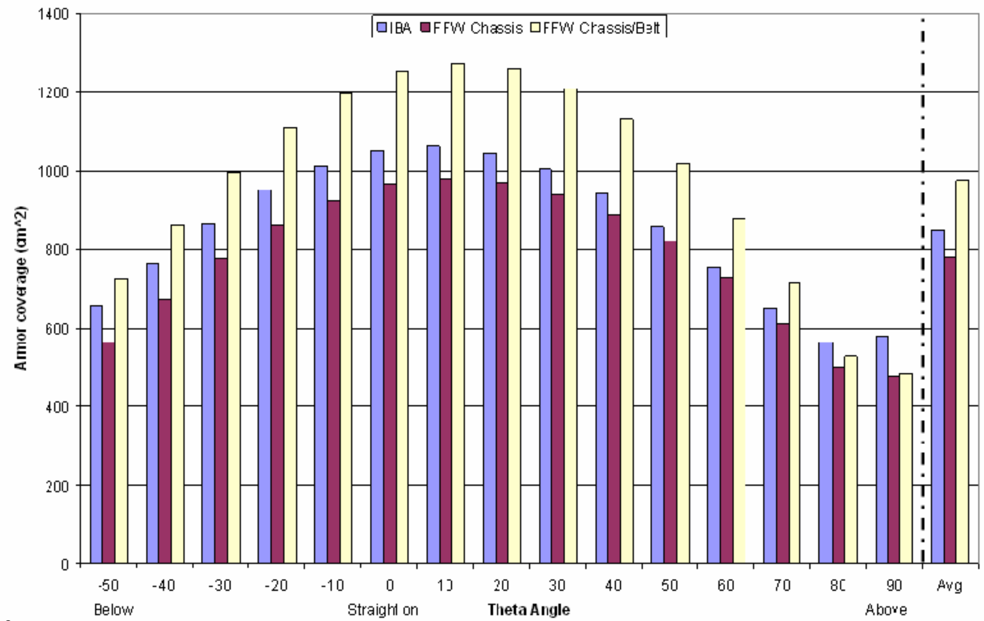
Presented Area of Baseline Ballistic Coverage - Simulated Angles of Attack



Area of Coverage

Using 3-D scan data, for each angle 'theta', plot the average over all angles 'phi'.

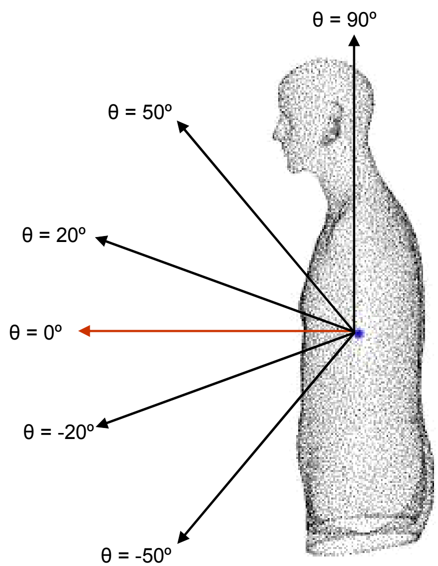
FFW Chassis and Belt provide 15 % more presented coverage on average.



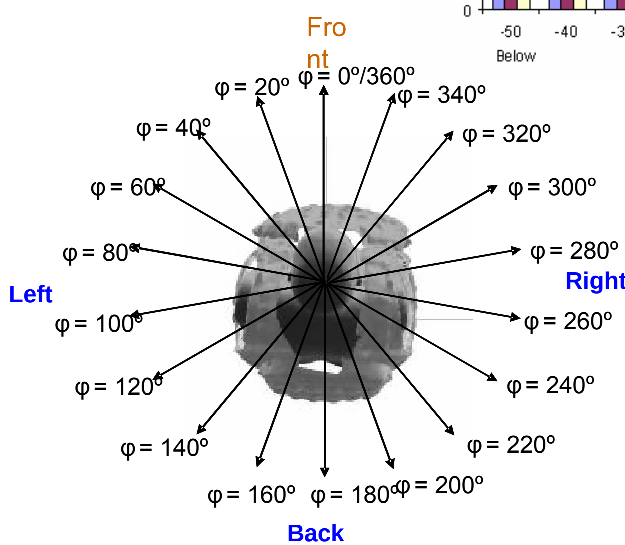
IBA: 850 cm^2 avg.

FFW Chassis: 779 cm^2 avg.

FFW Chassis & Belt: 976 cm^2 avg.



Theta Angles



Phi Angles

SPIES – Up-Armor Options

BALLISTIC COLLAR-
ACCEPTS PLATE IN REAR

RIFLE
SHOULDER
PLATE

RIFLE
SIDE
PLATE

BALLISTIC BELT
CAN ACCEPT
SIDE PLATES

GROIN PANEL
CAN ACCEPT
SIDE PLATE

BALLISTIC
LEG PANEL
CAN ACCEPT
SIDE PLATE

Up-Armor options are being designed to significantly increase area of coverage for both fragmentation and rifle protection.

GENERAL DYNAMICS
C4 Systems

On-the-Move Hydration

- **Chem / Bio Resistant bladder assembly**
  - CB testing scheduled at Dugway Apr 06
- **Blow molded bladder, 70 oz. capacity**
  - Holds its shape, yet collapses as water is removed
  - Easy to insert and remove from carrier
  - EVA material, 30 mil minimum thickness
- **Hang to dry with no creases for water residue and bacterial growth**
  - Meets FDA and NSF standards
- **Low projected production cost: $21.50 bladder assembly**

GENERAL DYNAMICS
C4 Systems

CB Protection

- **Leverage SOF's Personal Protection Ensemble (PPE) materials and design, with modifications to enhance compatibility with SPIES**
  - Components
    - Selectively Permeable Membrane (SPM) suit
    - High Strength Fluoropolymer (HSF) gloves
    - HSF over-boots
    - HSF integral hood
  - Design Features/Modifications
    - Sleek design for use under chassis
    - Leg and arm gussets
    - Personal Air Ventilation System (PAVS) and Personal Air Purifying Respirator (PAPR)

GENERAL DYNAMICS
C4 Systems

Personal Air Ventilation System (PAVS)

- **PAVS: modified GOTS**
  - Evaluated with PAPR modified to increase air flow from 2 cfm to 10 cfm
  - Belt mounted with hip inlet
  - Internal removable manifold distributes air throughout the suit
  - Dual path for developing PAVS (no funding currently available)
    - Modified GOTS item – increase airflow at contractors expense
    - Cooperative Research and Development Agreement (CRADA) – convert developmental PAVS to a CB PAVS

"Performance of the PAVS and PAPR was worth the weight "

"Less performance for less weight was not acceptable"

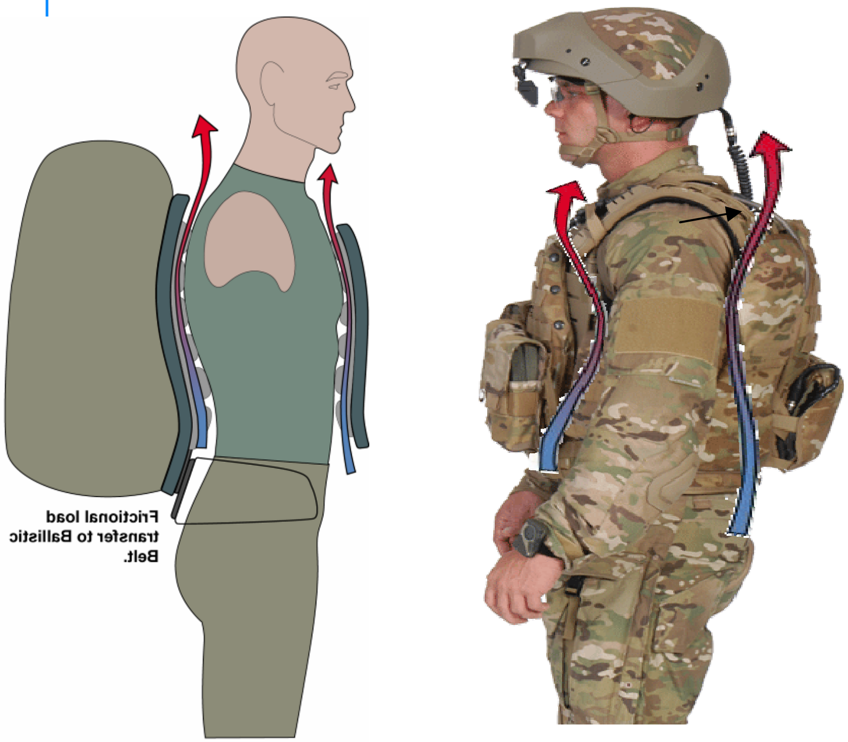
GENERAL DYNAMICS
C4 Systems

CB Testing Strategy

- **Component level testing is being leveraged from SOF testing**
  - CWA Swatch testing
  - Physical Properties Testing
- **System level testing**
  - Thermal Manikin Testing
    - Completed February 2006
  - Aerosol Testing
    - Fluorescent Aerosol Screening Tests (FAST)
  - Chemical Vapor Resistance Testing
    - TBD based on PAVS availability

Thermal Management
Passive Cooling

Air flow through chassis off-set



Configuration	Insulation CLO	Moisture Vapor Permeability (I_m)	Perm-Insul Ratio (I_m/CLO)
Land Warrior, 2002 **BDU+BA+LBE**	**1.51**	**0.38**	**0.25**
Land Warrior, 2002 **BDU+CBR+BA+LBE**	**2.07**	**0.27**	**0.13**
SPIES Rev 7+ MFCS, Chassis, Belt, LSDS	1.23	0.40	0.33
ACU, T-shirt, SPIES Chassis and Belt	1.23	0.38	0.31
SPIES Rev 7+ MFCS, Chassis, Belt, LSDS, CB (no PAVS) = CB worst case	1.76	0.21	0.12
SPIES Rev 7+ MFCS, Chassis, Belt, LSDS, CB w/ PAVS = CB mid case	TBD	TBD	TBD
SPIES Rev 7+ Chassis, Belt, LSDS, CB w/ PAVS = CB best case	TBD	TBD	TBD

GENERAL DYNAMICS
C4 Systems

System Level Flammability

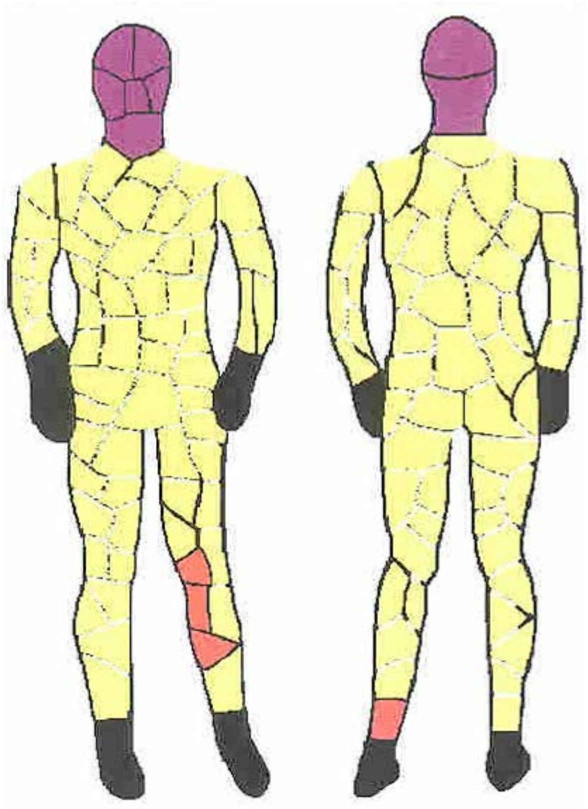
- Test conducted by N.C. State University, 20 July 2005
- ASTM F 1930, Standard Test Method for Evaluation of Flame Resistant Clothing for Protection Against Flash Fire Simulations Using and Instrumented Manikin.
- 8 gas burners produce flash fire conditions, average heat flux of 2 cal/cm^{2}sec, 3 and 4 second exposure durations
- Nomex undergarments used to protect manikin sensors; data comparable within this data set only
- Preliminary testing, n=1

GENERAL DYNAMICS
C4 Systems

System Level Flammability:
FFW, 4 second exposure

After-burn and melt drip on nylon at lower leg, around knee and elbow pads

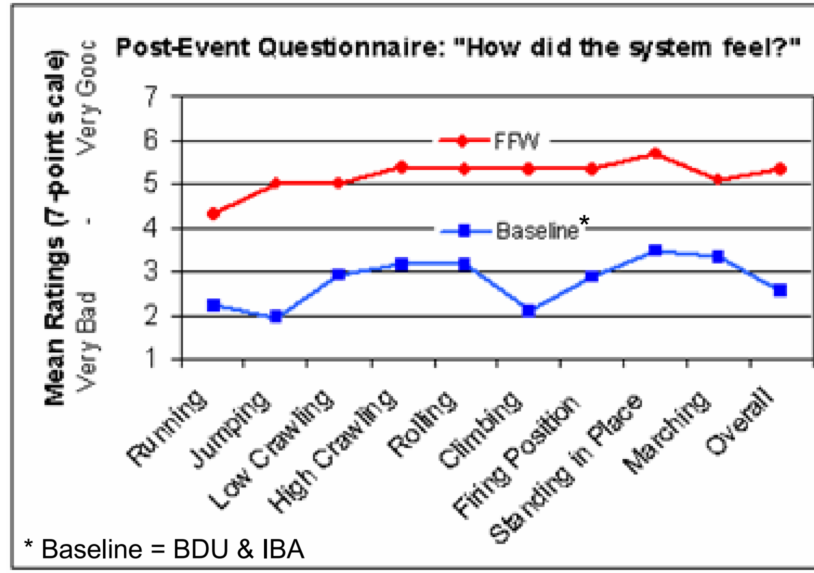
Interior of chassis was unaffected. Slight singeing lower edge of inner pads. 1,000 denier nylon on outside of chassis stayed mostly intact.



Burn Injury Prediction:
RED 2nd degree burn: 3.28%
PURPLE 3rd degree burn: 6.56%

Improvements attributed to Design features: Form-fitting uniform, shirt tucked into pants, internal chassis sizing adjustments, 1000 denier nylon armor covering

Integration / Fightability / Mobility



Summary

- SPIES is the physical embodiment of the FFW physical protective systems from the neck down.
- CB protection is one piece of the overall SPIES system and is designed to integrate with the entire FFW system.
- Development efforts in CB are on-going and will be proven out through additional laboratory experiments in FY07.

GENERAL DYNAMICS
C4 Systems

NBC-protection - a Swedish version for the future

Ola Claesson

Present status – NBC capability

- NBC defence capability built on “heritage” - a low technology level, high demand in manpower
- Unit NBC defence is limited, primarily because of low training levels.
- New materiel has been supplied to a limited extent.
- NBC defence still has a low priority in the armed forces and is often regarded as a logistical question.
- There is, at all levels, a lack of knowledge of the effects on units of NBC threats and incidents.
- The warning and reporting capability is considered inadequate due to insufficient competence and lack of methods at battalion level.
- The armed forces do not meet the capability requirements laid down in STANAG 2150, primarily with regard to organisation and competence.

FOI

YESTERDAY

THREAT

- Enemy identified
- Means and methods “known”
- Time and place of CW-attack could be predicted

MISSION

- To defend Sweden at home

FOI

TODAY

ACTIVE THREATS

- Enemy: From states to terrorism
- Means: From advanced WMD to dirty bombs
- Methods: Difficult to predict
- Target of attack: From military units to schools
- Time: When least expected

PASSIVE THREAT

- ROTA

MISSION

- To do anything - anywhere

FOI

SCENARIOS WITH BROADER SCALES

From peace over crisis to war

From few and known agents to a broader spectrum (complexity)

From a ”classical” slow course of events to surprise and speed (time)

FOI

NEED

- **Capability to support military operations during an NBC-threat or in an hazardous environment**

HOWEVER

- **NBC-threat one among many other threats that have to be considered in the protection of the unit**
- **NBC defence to focus on operational needs**

FOI

NBC-defence concept

The ”tactical” principle is to implement balanced NBC defensive measures on the basis of risk assessments.

The aim is to make defensive measures an optimized balance of mission objectives, risk assessment and protective measures so that risks to personnel and the need to reinstate contaminated materiel are minimized.

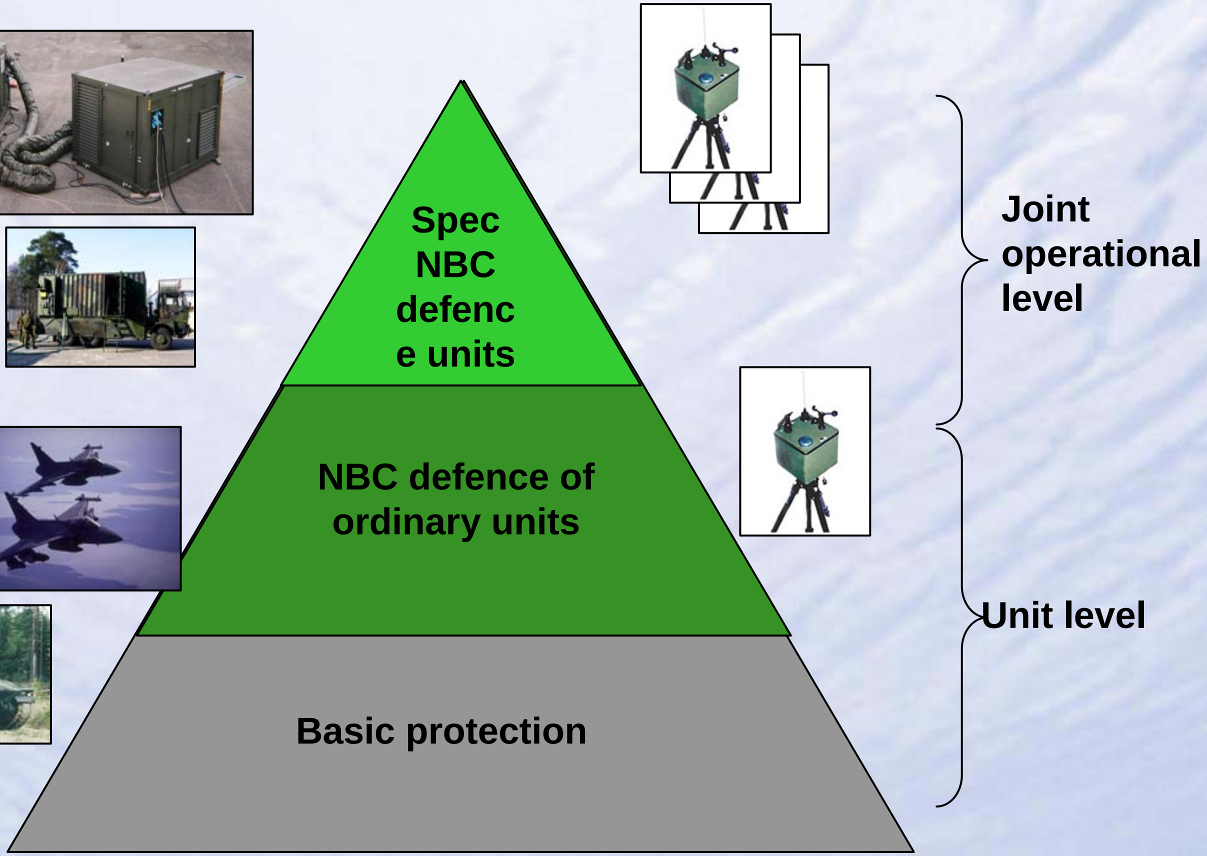
FOI

Principles of NBC-defence

- Crucial capabilities:
  - Information
  - Risk management
  - Command and Control
- ”Cost effective” methods (resources)
- Integrated with systems/equipment
- Included in the units tactics
- Passive and active NBC-defence
- A concept based on a combination of the NBC defence capability of ordinary units and the capability provided by special NBC units

FOI

Principle design of NBC-defence concept



NBC has to be embedded not added

REQUIREMENTS

- Meet/manage unpredictable NBC-hazards/attacs
- Operational for long time (weeks to months)
- Minimal reduction of operational capability
- Flexible concept, adaptable to different threat levels (both short and long term)
- Adapted to both national and international operations

DEVELOPMENT PLAN

LONG TERM GOALS:

- **Develop co-operation both with national and international partners (operational and equip/syst)**
- **Continue to develop towards NATO PfP**
- **Develop the NBC Defence Concept to be an integrated part of the Net Centric Warfare Concept**

SHORT TERM GOALS:

- **Develop NBC- concept of the (EU) Nordic Battle Group**
- **Continue the development of the NBC Company**
- **Continue the process to procure a new combat suit and an early warning system**

FOI

NBC-protection for the future soldier

PRE-STUDY

NBC general

Present/future threats

Present/future missions

International operations

Toxicology – challenge levels

Measurement methods

Standards

Working environment laws - consequences

Conditions/specifications

Heat stress - comfort

Interoperability (international)

Integration (MARKUS)

Equipment - existing

Developments - trends

NBC-protection for the future soldier

IMPORTANT FACTORS

- More agents + B
- Lower permissible limits + zero tolerance
- Integrated + modular + flexible + improveable

CONSEQUENCES

- Protection to be worn at all times (time + protectionfactor)
- Individual dosemeters (N,C,,,B), ”healthmeters”
- Higher protection factors, on individual level (?)
- Better knowledge of limitations -> realistic tests
- Internationally coordinated specifications of requirements
- Internationally coordinated test metods
- Lower physiological burden
- Local (swedish) requirements (wInter) integrated internationally

FOI

NBC-protection for the future soldier

MOST IMPORTANT

- **N + B + C**
- **Testmethodes and tests**
- **Higher protectionfactors**
- **Lower physiological burden**
- **Realistic tests**
- **Integration**
- **Internationalisation**

FOI

NBC-protection for the future soldier

A BALANCED PROTECTION

BUT WHAT BALANCE?

Interoperability – swedish requirements

High protection factor – low physiological burden

Swedish need of competence – international ”market”

NBC-protection for the future soldier

AREAS OF WORK

- **Continous survey of the market (to follow the progress of the technological limits)**
- **International co-operation (risk spreading, aquire competence, include swedish requirements, standardisation)**
- **Develop measurement methods (real-time measurements, full/better characterisation, TEST SUBSTANCES, B, different conditions)**
- **Get relevant numbers for heat stress when carrying out military type activities in different climatic zones. Include effect of NBC-protection.**
- **Membranes (novel material)**
- **Integration (lots of talk, less action => not much experiences)**
- **Relevant protection factors (effects of sweat, talk, movements, work)**
- **Fogging, correcitve lenses, sweat in the respirator**
- **Better filters**
- **Sealing edge / over pressure ?**

FOI

CA/NL/S trilateral co-operation

GOAL:

To develop a functional field-uniform (demonstrator) that gives the soldier a relevant body-protection against toxic chemicals and B-agents under operational conditions.

AIMS:

- **To identify new materials with potential for the protection of the future.**
- **To develop efficient closures and joints.**
- **To study the effects of balancing protection factors against regional body toxicological sensitivity, function and structured considerations of risks.**
- **To validate the whole-body function of the protection for relevant exposures and environments.**

ADVANTAGES for Sweden

- **Co-ordinated specifications S/CA/NL (testsubstanses, -metods, suit performance)**
- **Efficient splitt of measurements**
- **Possibility to use CA test chamber (mannekin)**
- **Possibility to test new suit concepts in Sweden**
- **Gain experience in suit design (closures, fit, etc)**
- **Possibility to co-ordinate design of test methods for B**
- **Exchange of experiences (challenge levels, limits, operational concepts)**

Novel Materials and Concepts for Low Burden NBC Protective Clothing Systems

UK, Belgien, Finland, Frankrike, Grekland, Italien, Holland, Norge, Spanien, Sverige, Turkiet

GOAL:

To enhance the capability of the Individual Protective Equipment

FACTORS TO BE STUDIED:

- **Changed threat picture**
- **Physiological and psycological strains**
- **New missions**
- **Quantification of the risk**
- **TICs + TIMs**
- **Large span in climatic conditions**

FOI

NEW!!!!!

Project : Physical protection

- **Field trials of of the shelf protective clothing.**
- **Complemented by materials testing**
- **Physiological burden**
- **Comfort**

FOI

SUMMING UP

- Internationalisation (NATO PfP, EU)
- NBC-defence as integrated part of operations
- Early warning
- Methods/standards
- Procurement of the shelf

FOI

JPEO-CBD

Joint Program Manager Individual Protection Nuclear, Biological, Chemical Defense Overarching Model

Charleston, SC

9 Mar 2006

Salvatore Clementi
JPM-IP Senior Engineer
(703) 432-3201
salvatore.clementi@usmc.mil

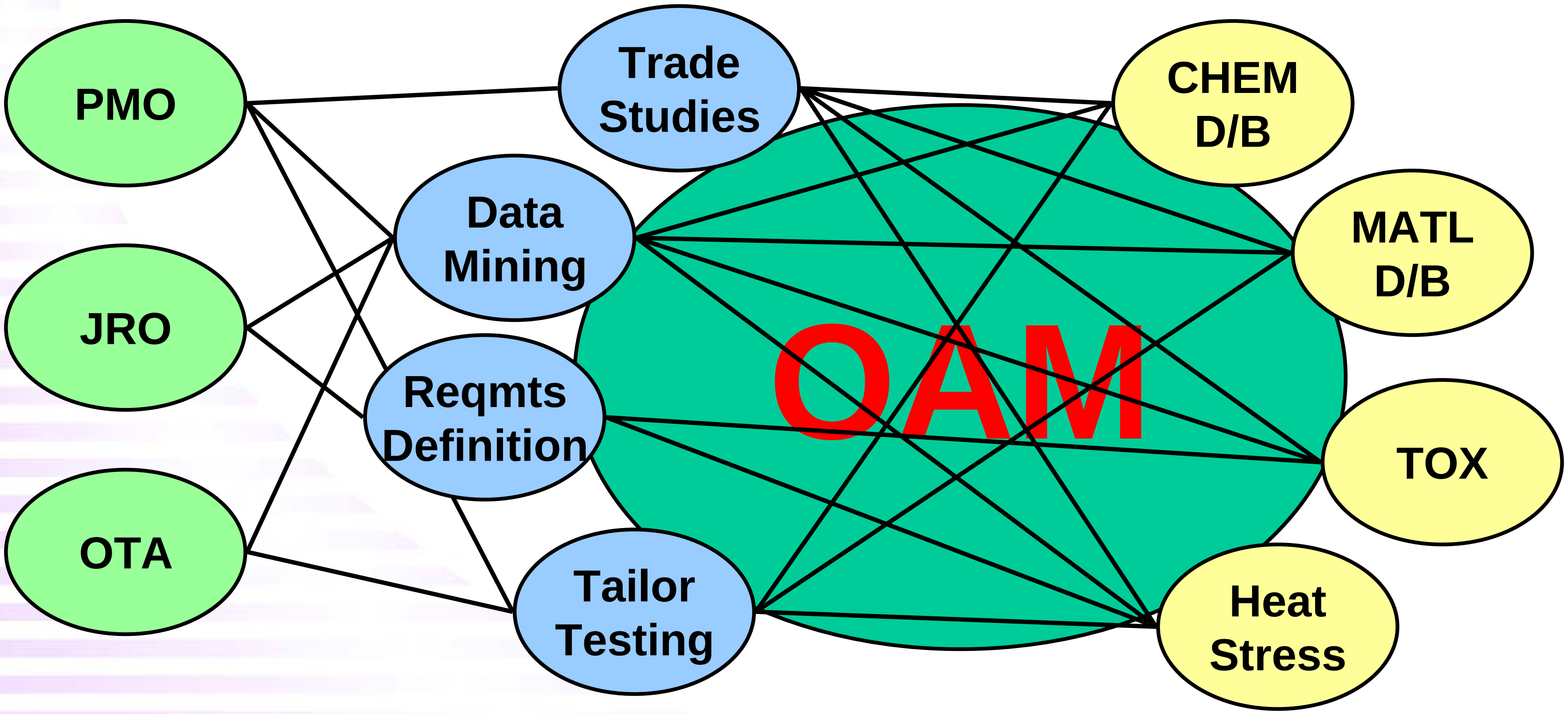
JPEO-CBD

PURPOSE

- **Mission**
  - To Develop A Functional And Useful Overarching Model (OAM) And Toolkit To Support Requirements Development, Testing, And Fielding Of Chemical, Biological, Radiological, Nuclear (CBRN) Individual Protective Equipment (IPE)
- **Stakeholders**
  - Joint Requirements Office (JRO)
  - Program Office
  - Testing Agency (OTA)
  - Test Location (DPG, ECBC, NATICK, Commercial)

WHAT CAPABILITIES ARE IN AN OAM?

- Different Needs For Different Stakeholders
- Common Data Sets Support Different And Multiple Needs



JPEO-CBD

REQUIREMENTS DETERMINATION

JRO

- Identification Of Areas Of Over/Under Protection
- Realistic Requirements Determination And Validation
- Evolve Requirements As Absolute Toxicological Effects Are Integrated
- Evaluate Performance As Additional Threat Protection is Introduced   TIC/TIM, etc.
- Fielding Dates, Quantities, Distribution Alternatives

REQUIREMENTS DETERMINATION

Program Office

- Are Requirements Attainable?
- Are Requirements Affordable?
- What Are Cost/Schedule/Performance Attributes To Requirements?
- Are There Life Cycle Implications To Design Elements?
- Are There Life Cycle Impacts Due To ECPs or Changes?
- What Is The Most Cost Effective Change Implementation Sequence?
- What Materials Have Been Previously Proven?
  - Against What Threats?

REQUIREMENTS DETERMINATION

- **Testing Agency (OTA)**
  - **What Tests Must Be Done To Demonstrate Effectiveness?**
  - **What Procedures Are Documented?**
  - **Are All Planned Tests Fully Defined?**
  - **Does The Infrastructure Support The Test Needs?**

REQUIREMENTS DETERMINATION

- **Test Location (DPG, ECBC, NSC, Commercial)**
  - What Assets Are Needed?
  - Are All Assets Needed Available?
  - Are Equipments Within Calibration?
  - Are Equipments Operational?
  - Are Procedures Fully Defined?
  - Scheduling
  - Manpower
  - Automated Data Collection
  - Meteorological Conditions

IPE DEVELOPMENT

Program Office

- Ability To Conduct Trade Studies (Performance vs. Cost)
- Risk Management
- Cost Benefit Analysis
- Early Material Evaluation
- Comparison Of Data To Absolute Toxicological Effects
- Balance CBRN Protection With Heat Stress And Other Physiological Issues

JPEO-CBD

IPE DEVELOPMENT

Program Office

- Manufacturing Processes Consistent With Requirements And Production Rates
- Prototyping
  - Ability To Model Garment In Three Dimensions
  - Sizing/Fitting Against Standard Human Forms
- Material And Design Selection
  - Evaluate Impact Of Material Characteristics On Garment Comfort, Durability, Protection
- Evaluate Impact Of Ancillary Equipment

IPE DEVELOPMENT

Test Agency

- Expand IPE Testing Scope Without Incurring Excessive Costs Or Logistical Burden
- Integrate Data Across All Testing Phases
- Provide A Basis For Assessment Of Operational Effectiveness
- Interact With Testing Process To Identify Data Gaps And Required Re-Testing or Additional Tests
- Testing Regimen Tailored To Extent Of Unknowns And Divergence From Normal

JPEO-CBD

DATA MINING

- Correlation Of Data To Real World Results
- Intelligent Prediction And Selection Criteria
  - Materials Selection Consistent With Threat
- Basic Data Repository
  - Data Repository For All Data Associated With CBRN IPE
  - Intelligent Search Engine For Data Mining (Knowledge Management)

DATA MINING

Chemical And Material Databases

- Data Repository For All Existing Chemical and Material Test Data Sets
- Chemical D/B
  - Physical Properties
  - Toxicological Effects On Humans
  - Interaction With Atmospheric Conditions
- Material D/B
  - Historical Test Results For Various Materials Used In IPE Systems
  - Physical Properties
  - Hazard Analysis

JPEO-CBD

DATA MINING (cont.)

- **Test Traceability Matrix**
  - Data Repository For Existing Test Data Sets Mapped To Standard Operating Procedures (SOPs), Test Plans, Test Methodologies, Industry Standards
- **Lot Variability And Shelf Life Analysis**
  - Data Repository For All Production Lot Testing (PLT) For Variability Analysis And Prediction
  - Shelf Life Analysis And Confidence Based On Surveillance Testing Data Sets
- **Simulant Vs. Agent Comparative Data**
  - Data Repository And Analysis Of Simulant Versus Agent Comparisons
  - Intelligent Selection Of Simulant For Specific Test Purposes

TECHNICAL APPROACH

Technical Approach

- Modular Structural Approach
- Use An Open Architecture To The Maximum Extent Possible
- Detailed Examination Of Data Requirements And Data Throughput
- Reuse Or Revise Existing Databases

STRATEGY

FY 06 Effort

- Survey Current Models/Databases (e.g., Body Region Hazard Analysis (BRHA), Agent Simulant Knowledgebase)
- Survey DPG/ECBC/NSC Historical Results
- Determine Gaps In Data And Models And Upgrade
- Certify Model (With Limitations)
- Determine Preliminary Architecture

FY 07 And Beyond

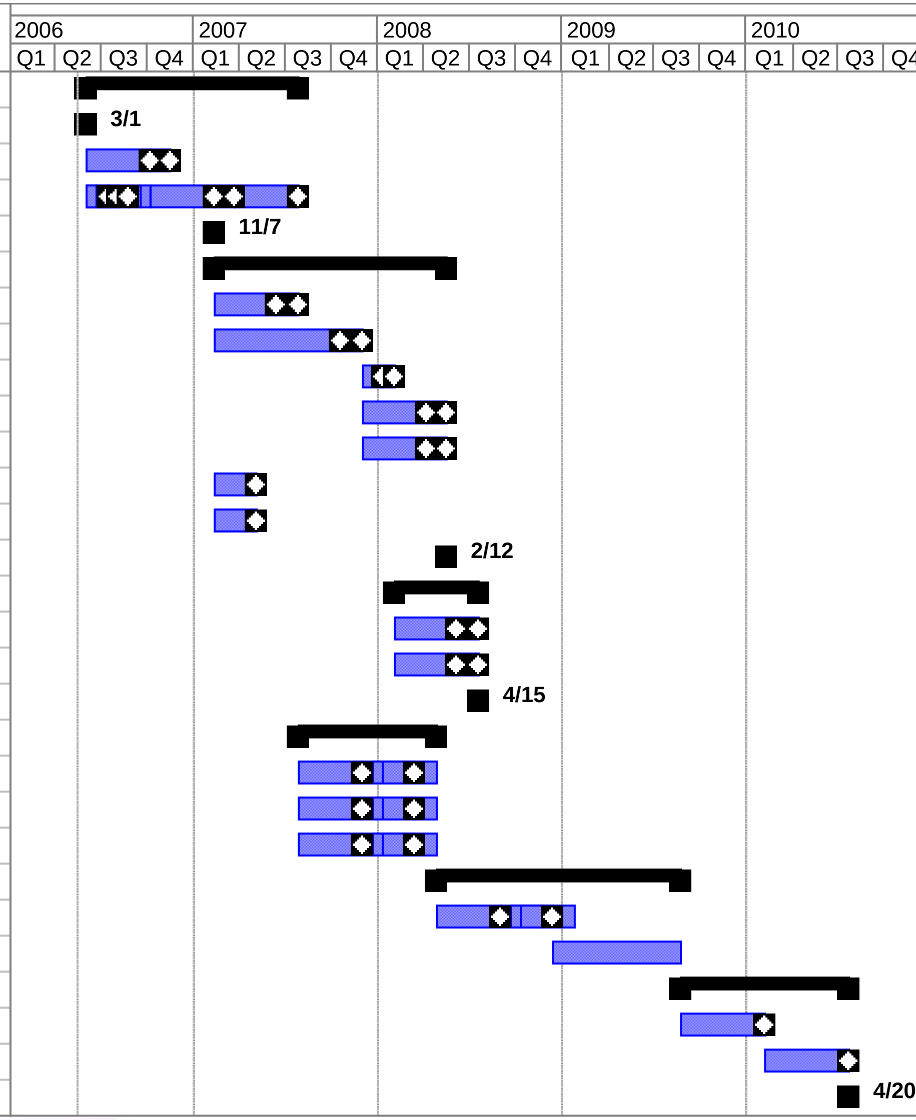
- Finalize Architecture
- Determine Implementation Sequence And Dependencies
- Implement Strategy

Verification, Validation & Accreditation (VV&A)

- The OAM/Toolkit Will Adhere To Established VV&A Procedures
- Some Models And Simulations Will Be Accredited
- Data Certification Will Be Conducted

Notional Schedule

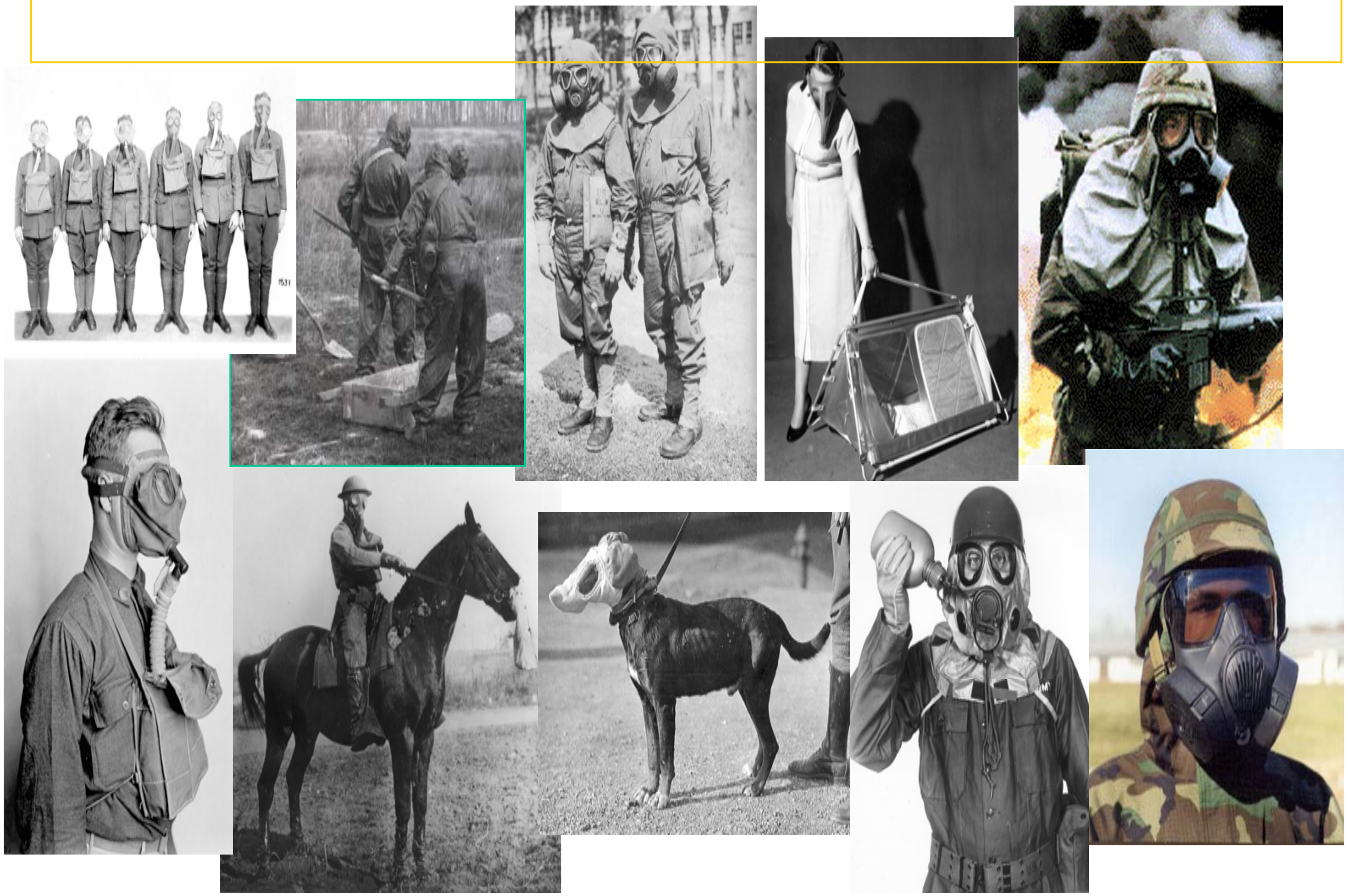
ID		WBS	Task Name
1		1	**Program Management I**
2		1.1	**Form IPT**
3		1.2	**Charter IPT**
9		1.3	**Business Plan**
27		2	**MS A**
28		3	**Program Management II**
29		3.1	**Schedule**
34		3.2	**Modeling and Simulation Strategy**
39		3.3	**Test Strategy**
44		3.4	**Risk Management**
49		3.5	**Safety**
54		3.6	**LCCE**
57		3.7	**Logistics**
62		4	**MS B**
63		5	**Program Management III**
64		5.1	**Test Plan**
69		5.2	**VV&A Plan**
74		6	**MS C**
75		7	**Model Compontent Development**
76		7.1	**Transport Module**
84		7.2	**Toxicological Module**
92		7.3	**Threat Module**
100		8	**Systems Integration**
101		8.1	**Module Integration**
109		8.2	**Integration Testing**
111		9	**VV&A**
112		9.1	**VV&A**
115		9.2	**Accreditation**
118		10	**IPR**



THE IP OAM

THE END!

AFTER MILESTONE C DECISION- WHAT'S NEXT?



by Rick Decker
Director, Engineering - 8 March 2006

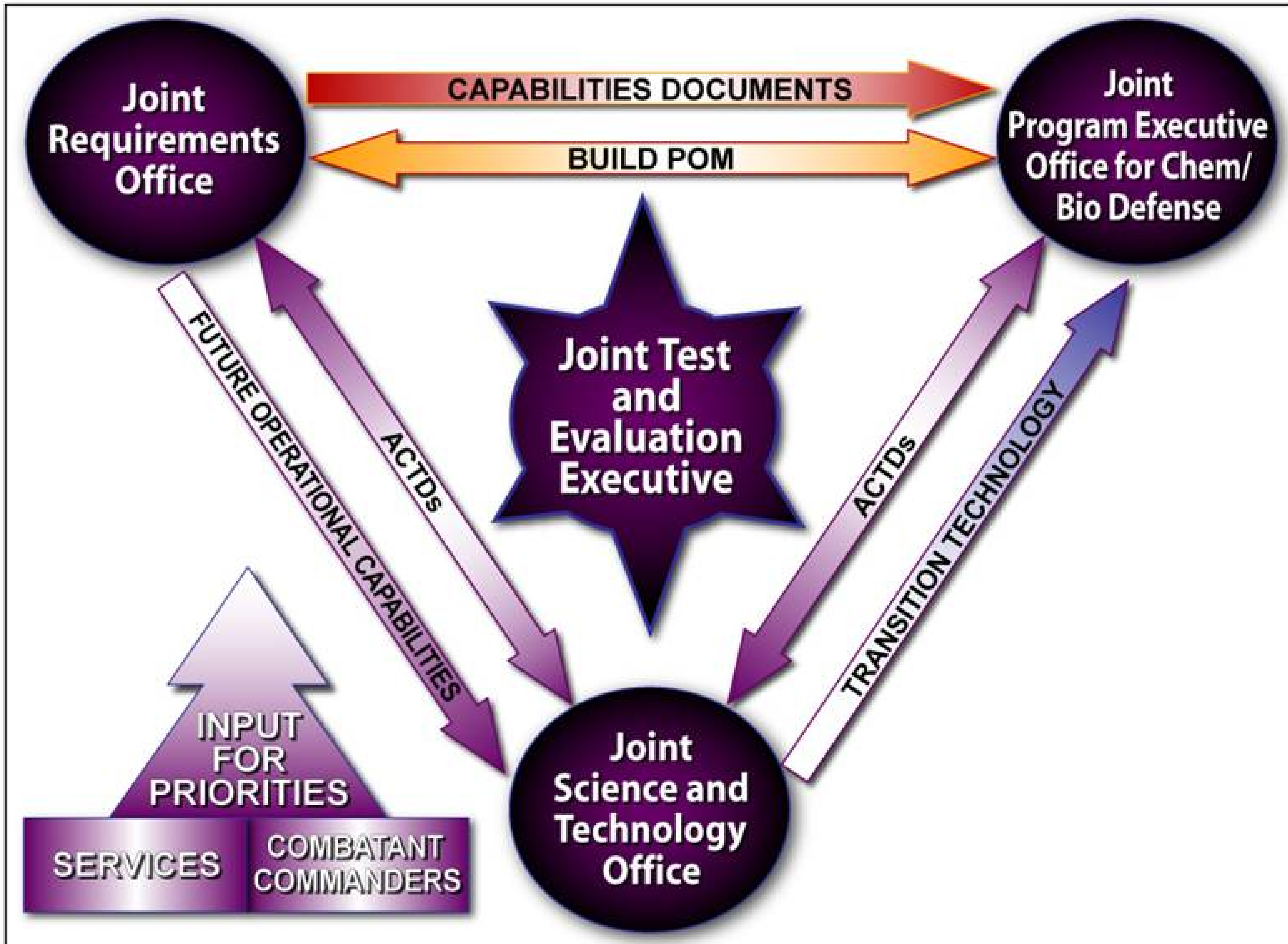
ECBC

OUTLINE

- **Chemical Biological Defense Program Environment**
- **Big “A” Acquisition**
- **DoD OSD Acquisition, Technology and Logistics Goals**
- **Joint Service Sustainment**
- **DoD Operating Environment**
- **JPEO/JPM Responsibilities/Initiatives:**
  - **Total Life Cycle Systems Management (TLCSM) Responsibilities**
  - **Logistics Information Technology Initiative**
  - **Joint Logistics Advisory Council for CBD (JLAC-CBD) Initiatives**
- **The End State**
- **TACOM LCMC/ECBC Partnership**
- **Conclusions**

ECBC

Required Capabilities, Science & Technology, and Acquisition



ECBC

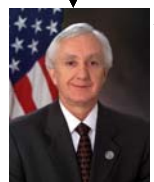
CBDP Major Players

General Peter Pace
Chairman, Joint Chiefs of Staff

Dr. Kenneth J. Krieg
Under Secretary of Defense
(Acq, Tech, and Logistics)

GEN James Cartwright
CMD, USSTRATCOM

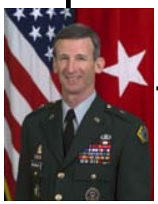
ADM Evan M. Chanik
Director, J-8



Dr. Dale Klein
ATSD(NCB)

Dr. James Tegnelia
Director, Defense Threat Reduction Agency

Dr Pete Nanos



MG Howard Bromberg
JRO-CBRND

BG Stan Lillie
Joint Combat Developer

Jean Reed
Special Assistant for CB Defense & Chem Demil

Dr. Charles Galloway
Director, JSTO

Secretary of the Army (Executive Agent)		
Dep. Under Sec. Army	Army Chief of Staff	Army Acquisition Executive

Mr. Walter Hollis
Joint T&E Executive Agent

Mr. Andy Blankenbiller
Program Analysis & Integration Office

MG Jeffrey Sorenson
Deputy, Acq & Sys Mgt
Assistant Secretary of the Army for Acq, Log & Tech

BG Stephen V. Reeves
JPEO-CBD

Dr. Tom Killian

Deputy Asst Secretary for R&T Chief Scientist

Army Chief of Staff

GEN Richard A. Cody
Vice CoS, US Army

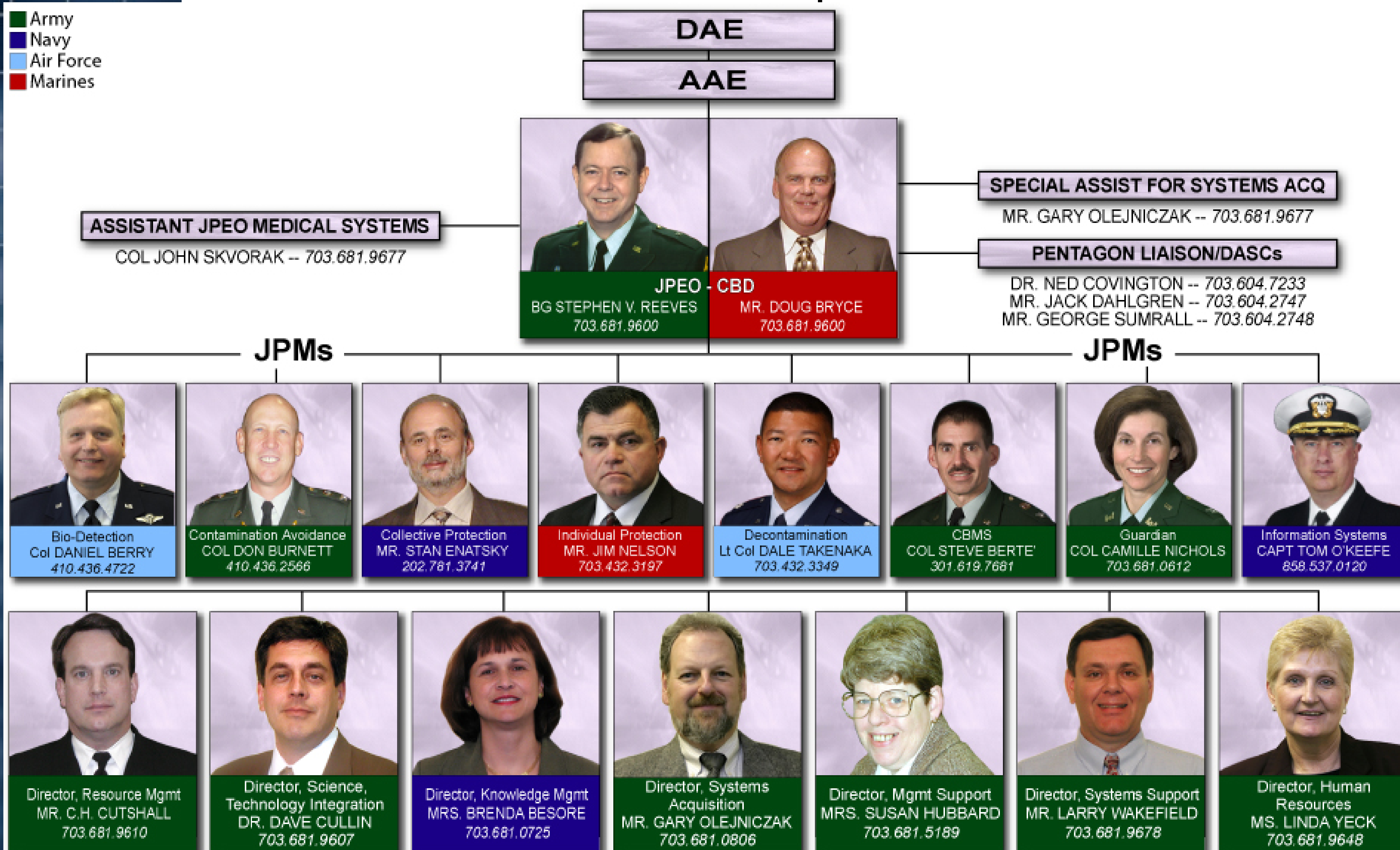
GEN Benjamin Griffin
Army Materiel Command

MG Roger Nadeau
Research Development and Engineering Command

Jim Zarzycki
Director, Edgewood Chemical Biological Center

ECBC

Joint Program Executive Office for Chemical and Biological Defense Leadership Team




Biological Defense
Edgewood, MD
Col DANIEL BERRY (USAF)
NBC Contamination Avoidance
Edgewood, MD
COL DON BURNETT (ARMY)
Chemical Biological Medical Systems
Frederick, MD
COL STEPHEN BERTÉ (ARMY)
Information Systems
San Diego, CA
CAPT TOM O'KEEFE (NAVY)
JOINT PROGRAM EXECUTIVE OFFICER
BG Stephen V. Reeves
Chemical and Biological Defense
Collective Protection
Washington, DC
MR STAN ENATSKY (NAVY)
Individual Protection
Quantico, VA
MR JIM NELSON (USMC)
JPMs Leverage Service/Installation Matrix Support
Guardian
Falls Church, VA
COL CAMILLE NICHOLS (ARMY)
Decon
Quantico, VA
Lt Col DALE TAKENAKA (USAF)
JPEO-CBD JOINT PROJECT MANAGERS

The Process

CAPABILITY NEED

RESOURCES

ACQUIRE
DEVELOP
CONTRACT
TEST
PRODUCE
FIELD

OPERATE/
SUSTAIN
UPGRADE/
MODERNIZE
FMS

RETIRE
DEMIL

acquisition

ACQUISITION

D O T L M P F ?

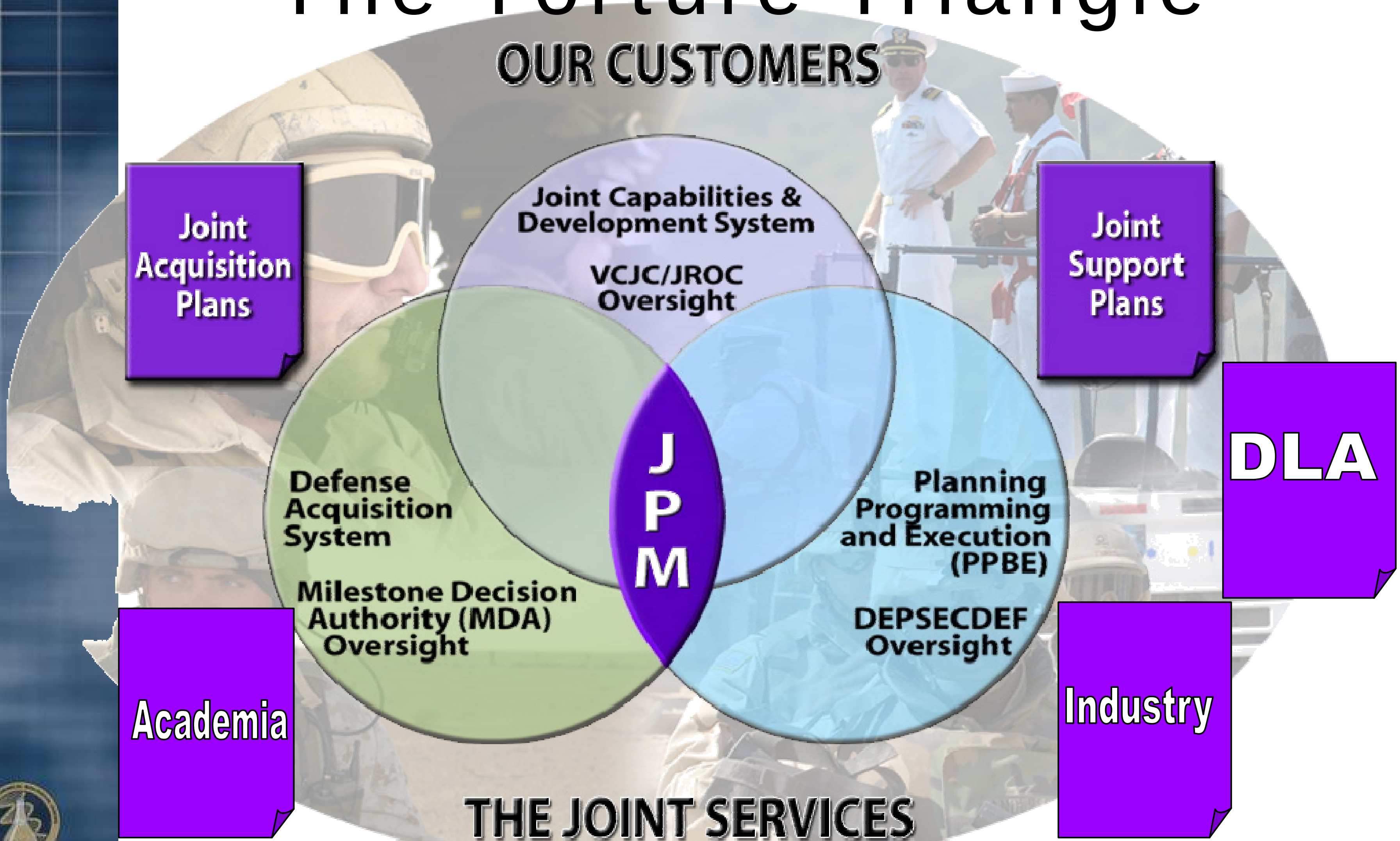
Doctrine, Organizations, Training, Leader Development, Materiel, Personnel, Facilities

GOALS AND OUTCOMES

- High Performing, Agile and Ethical Workforce
- Strategic and Tactical Acquisition Excellence
- Focused Technology to Meet Warfighting Needs
- Cost-Effective Joint Logistics Support for the Warfighter
- Reliable & Cost Effective Industrial Capabilities Sufficient to Meet Strategic Objectives
- Improved Governance and Decision Processes

ECBC

Joint Sustainment – "The Torture Triangle"



Joint Systems Acquisition Total Life Cycle Systems Management

OPERATING ENVIRONMENT

- **Service Title X Responsibilities**
- **O&M Funding Owned by Services**
- **Established Responsibilities, Policies, and Processes**
- **DoD “5000” Acquisition System Responsibilities**

Public Law No. 103-160, Section 1701 (50 USC 1522)

- Coordinate and Integrate all DoD Chem Bio Defense Programs

- Annual Reports to Congress on readiness and plans to improve

ECBC

Total Life Cycle Systems Manager (TLCSM) Responsibilities

- **Total Package Fielding – AR 700-142**

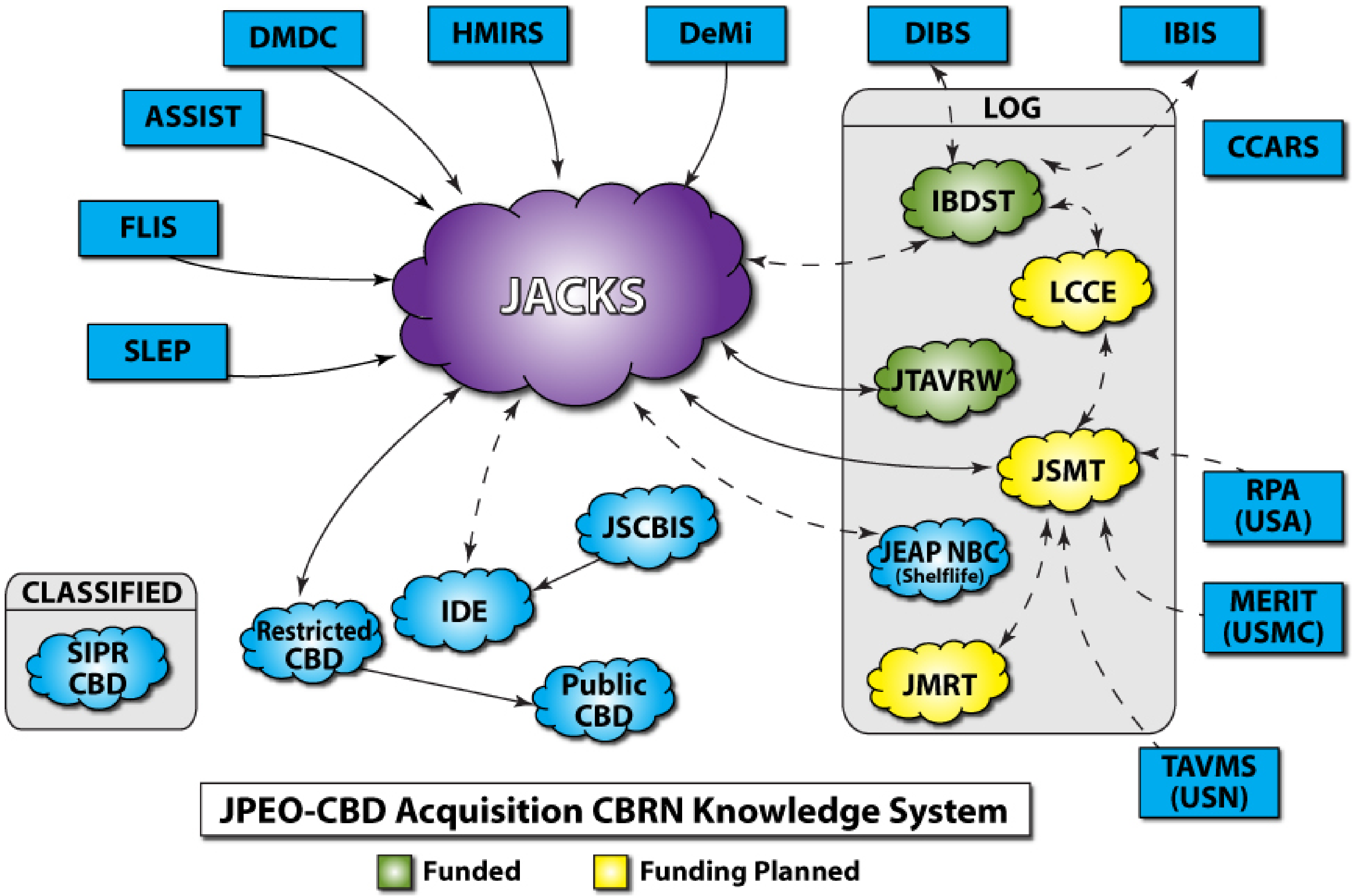
  "*The TLCSM is responsible for programming and budgeting for the necessary funding*."
  - **Initial Support Packages/Spares**
  - **New Equipment Training**
  - **Second Destination Transportation to Hand off Site**

- **Readiness Reviews – Emphasize Roles and Importance of the JPM's as the TLCSM**
  - **Monthly Readiness Review**
    - **Internal – Continuing Issue Items Briefed at the Joint Review**
  - **Joint Quarterly Readiness Review**
    - **External – Brings our Customers into the Process**

JPEO/JPM Must Work With DLA, Service Sustainment and Industry Partners

ECBC

Logistics Information Technology TLCSM Support



JPEO/JPM Establishing IT System

File Edit View Favorites Tools Help

Back Search Favorites

Address https://jacks.jpeocbd.osd.mil/ Go

J.A.C.K.S.
Joint Acquisition CBRN Knowledge System

Login

JACKS

- Home / Login
- Requirements
- PKI/CAC/Login Help
- Contact

J.A.C.K.S.

Joint Aquisition
Chemical **B**iological **R**adiological **N**uclear
Knowledge System

Directed By: **JPEO-CBD**
Joint Program Executive Office
Chemical and Biological Defense

Joint Program Executive Office for Chemical Biological Defense
Joint Acquisition Chemical Biological Radiological Nuclear (CBRN) Knowledge System

This is a Department of Defense computer system. This system, including all related equipment, networks, and network devices (including Internet access) are provided onl authorized U.S. Government use. DoD computer systems may be monitored for all lawful purposes, including ensuring that their use is authorized for management of the sy to facilitate protection against unauthorized access, and to verify security procedures, survivability and operational security. Monitoring includes active attacks by authoriz entities to test or verify the security of the system. During monitoring, information may be examined, recorded, copied and used for authorized purposes. All information, including personal information, placed on or sent over this system may be monitored.

Use of this DoD computer system, authorized or unauthorized, constitutes consent to monitoring of this system. It is a violation of United States Code, Title 18, to access a U. S. Government computer resources without specific authorization. Unauthorized use may subject you to criminal prosecution. Evidence of unauthorized use collected dur monitoring may be used for administrative, criminal or other adverse action. Use of this system constitutes consent to monitoring for these purposes.

Login >>

Click here to add JACKS to your Favorites. If you would like to bypass the Login page every time you access JACKS, please use this link to add the JACKS Main Page to you Favorites (You will still be prompted for your PKI Client Certificate).

Internet

KS
in / News
CKS Overview
quisition Support
visory Messages
N Equipment
uip Overview
uip Search
t Sheets
ality Control
ning
ks
w Equip Trn (NET)
lf Life
Overview
elf Life Search
tact
EO-CBD
RN Equip Hotline
RN Links
pdesk
ggest a Change

JACKS Main / News

Latest News

1 Feb 06 - **JTAV-RW URL**

Effective February 1, 2006, the Joint Total Asset Visibility - Reporting Warehouse (JTAV-RW) will now be accessible through the following interim URL: https://jtavrw.ria.army.mil.

1 Aug 05 - **CE/CBRN Equipment Hotline**

Effective August 1, 2005, the Chemical Equipment (CE) Hotline has had a name change to the CBRN Equipment Hotline. Information on the CBRN Equipment Hotline can be found using the *CBRN Equipment Hotline* link under the *Contact* header on the main menu or click here.

Latest JACKS Updates

23 Nov 05 - JACKS Version 2.2.0 Released

18 Aug 05 - JACKS Version 2.1.0 Released

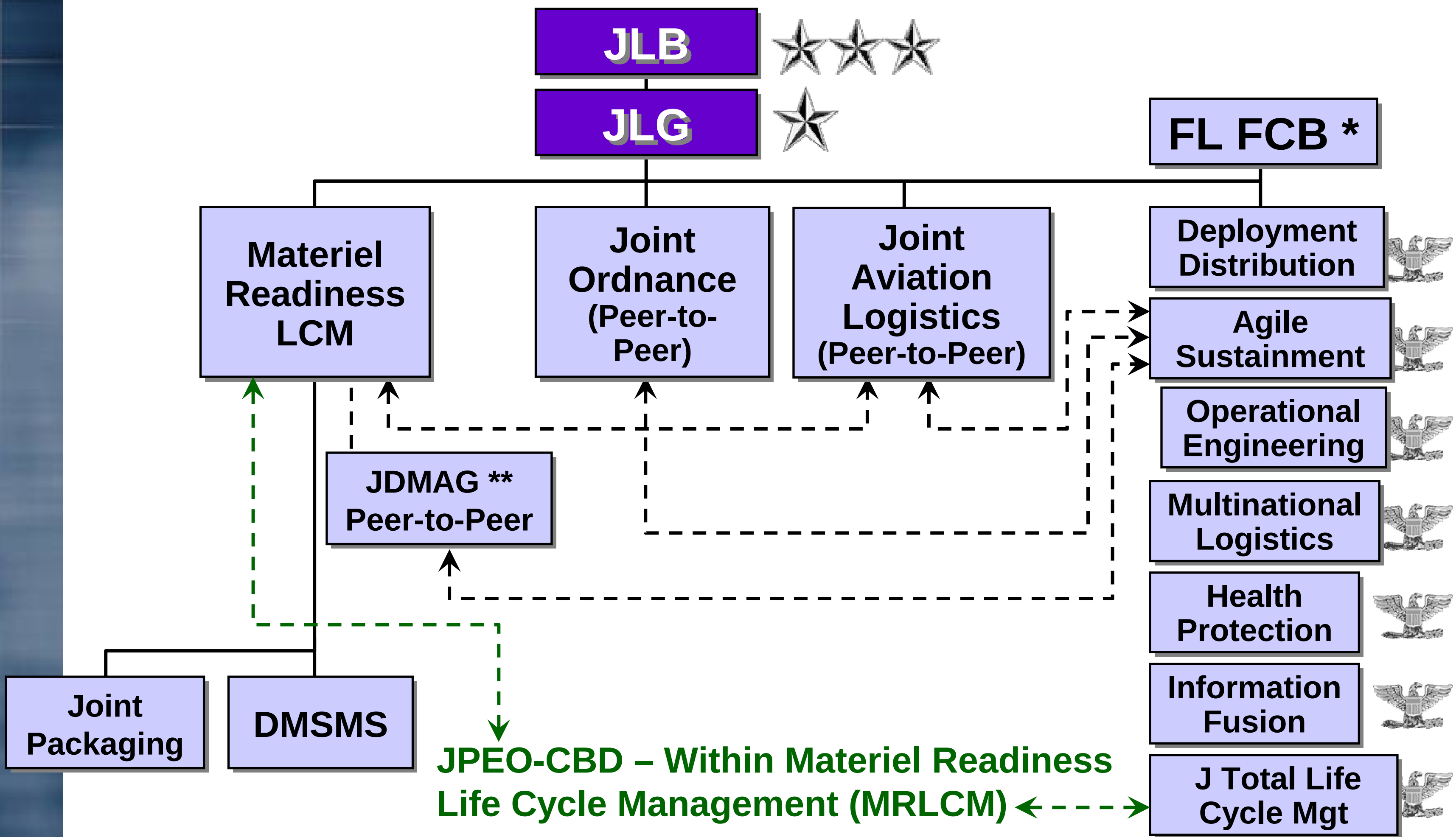
Joint Logistics Advisor Council (JLAC) – Initiatives

- **Joint Maintenance**
  - **Implement Joint Maintenance Concepts on Fielded Systems Where Maintenance is Not Joint**
- **Joint Equipment Assessment Program (JEAP)**
  - **Formal Process for Equipment Surveillance and Assessment**
- **Joint Materiel Fielding**
  - **Integrate, Streamline and Standardize Four (4) Existing Processes into One (1) Executable Joint Process**
- **Joint Individual Protective Equipment Strategic Asset Management**
  - **Joint Individual Protective Equipment Strategic Asset Manager**
  - **Reduce War Reserve Requirements, Redundancies and Mitigate Industrial Base Risks**
- **Joint Training Working Group**
  - **Training Plans and Requirements**
  - **New Equipment Training**
- **Joint Service Maintenance Tool**

JPEO/JPM Working to Develop New Initiatives

ECBC

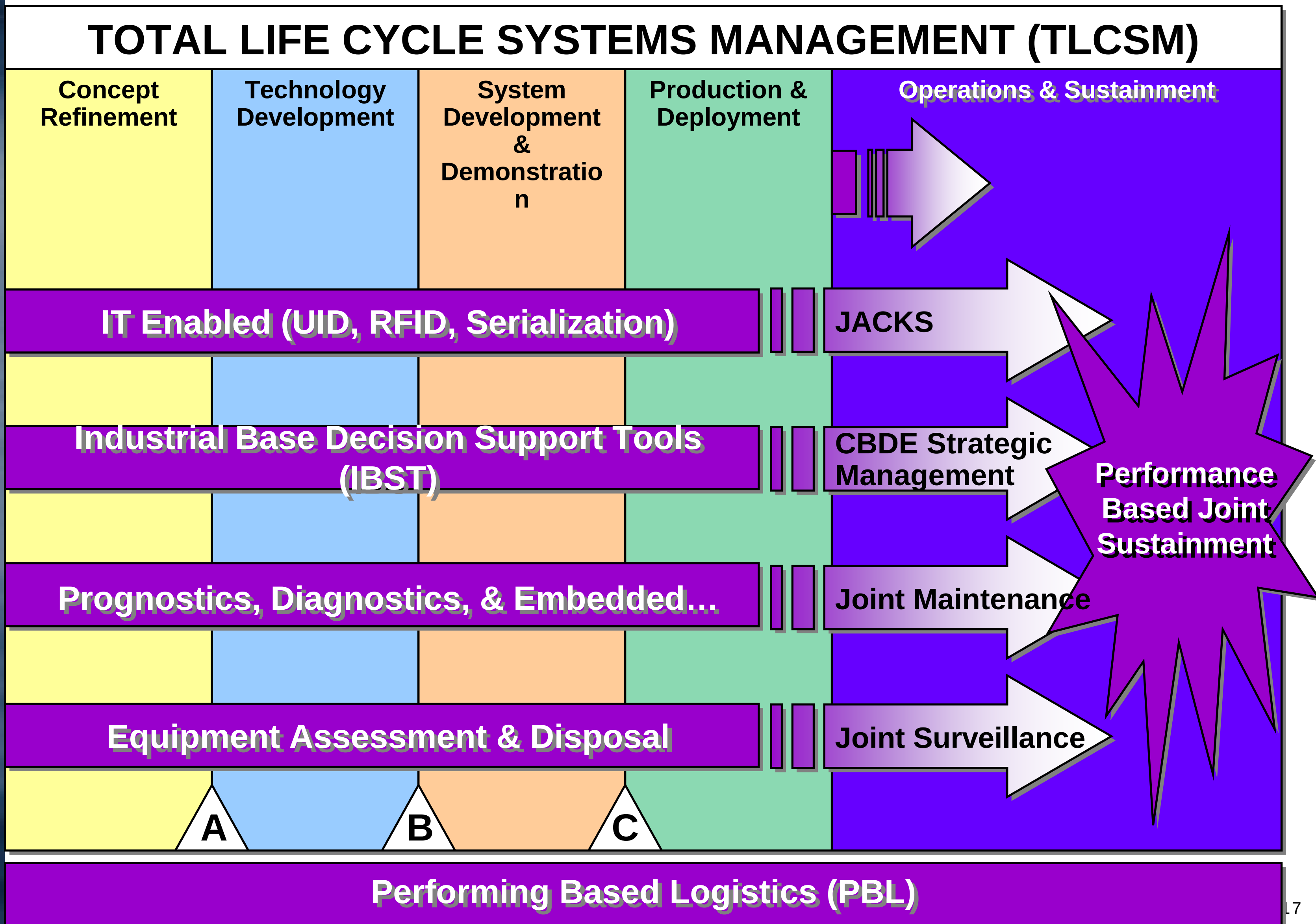
Joint Logistics Board (JLB) – Joint Sustainment Initiatives



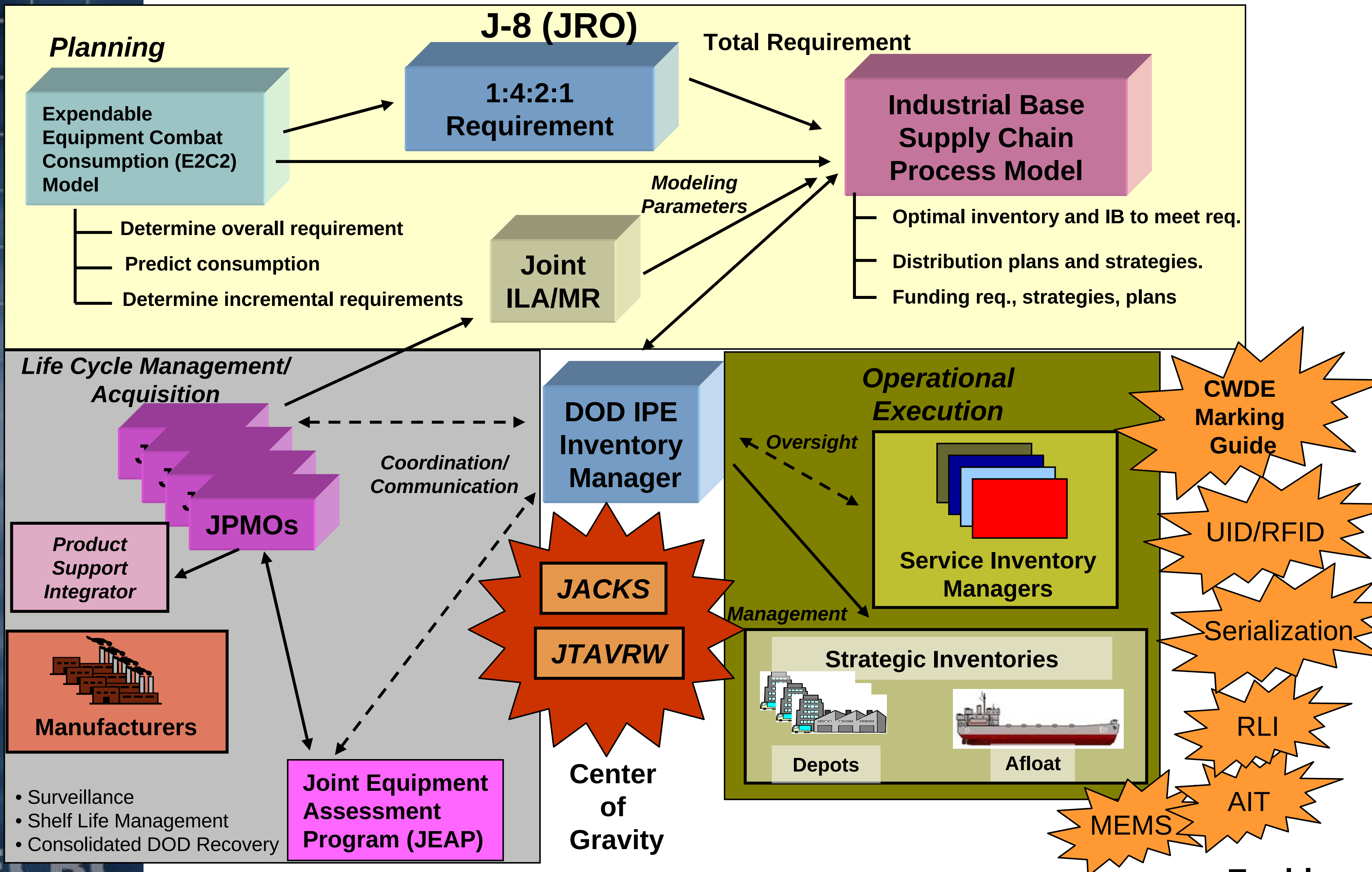
DoD is Currently Reorganizing the JLB. The Chart Depicts the JLB's Proposed Structure.

- **** = Focused Logistics Functional Capabilities Board***
- ***** = Joint Depot Maintenance Activity Group***

Joint Sustainment:
The END-STATE

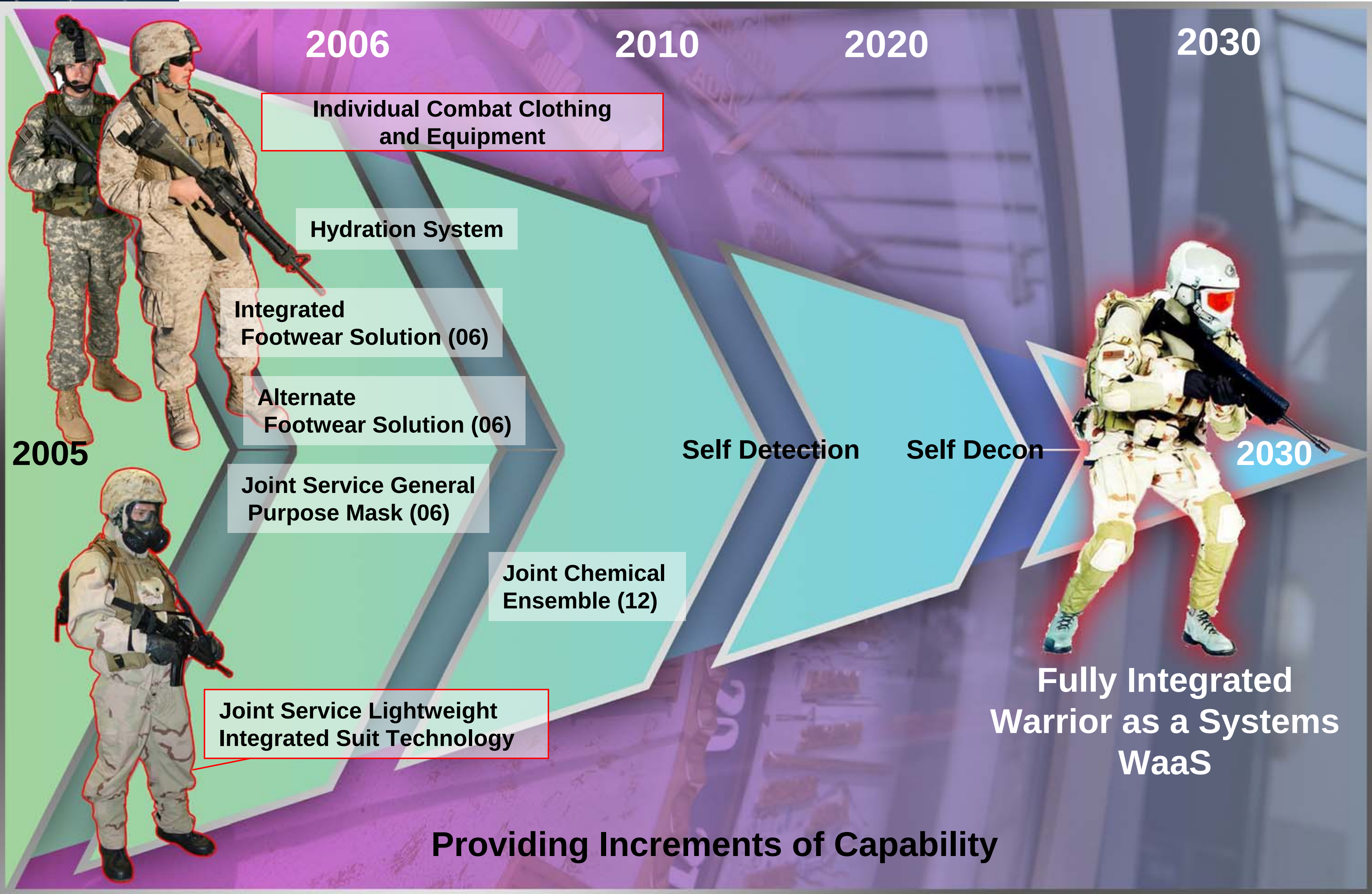


A concept for Integrating the Pieces for Joint TLCM

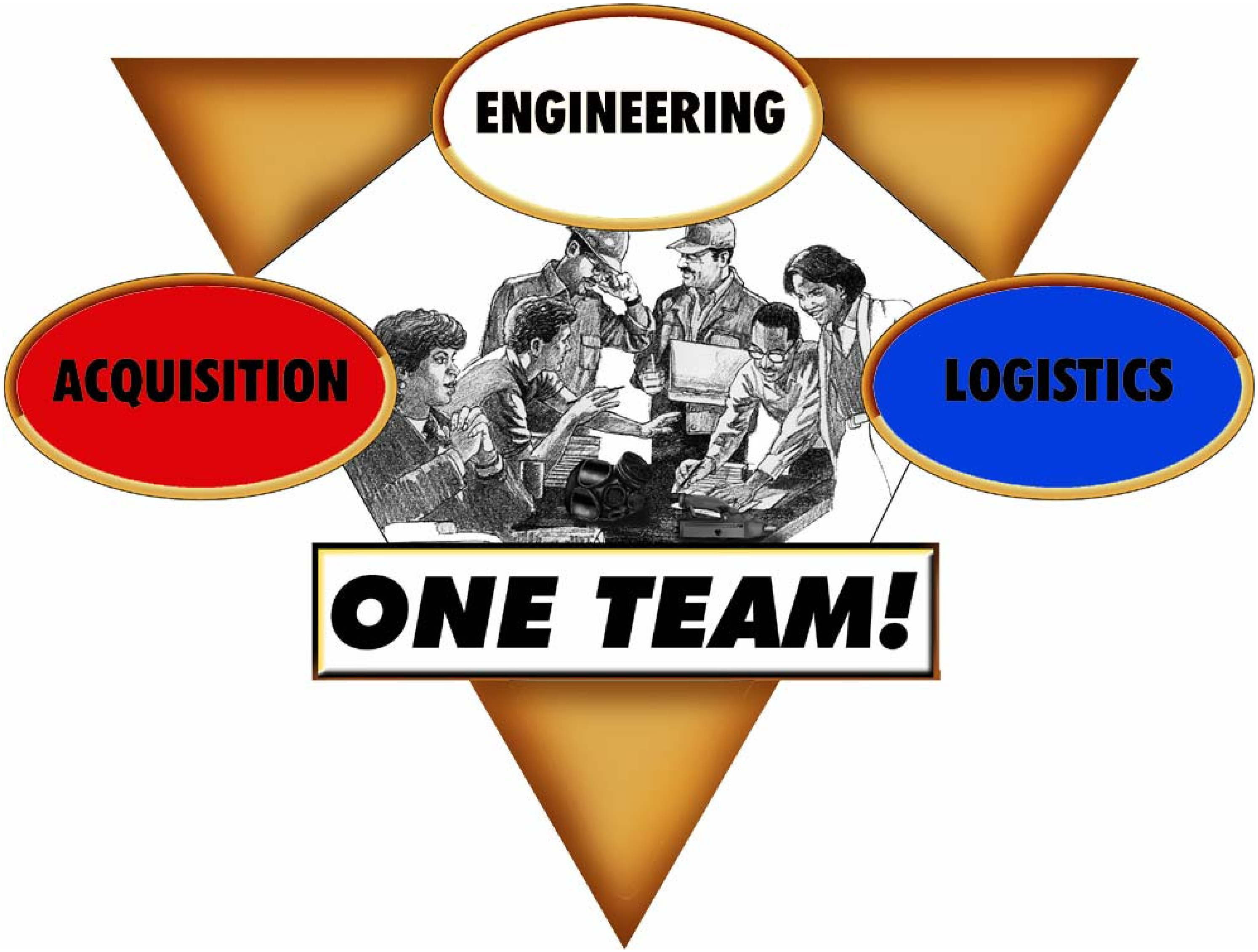


RLI – Residual Life Indication; **MEMS** – Micro-electronic mechanical systems; **AIT** – Automatic Information Technology; **UID** – Unique Identification
JACKS – Joint Acquisition Knowledge System; **JTAVRW** – Joint Total Asset Visibility Reporting Warehouse; **RFID** – Radio Frequency Identification

“Spiral” Development 2005 - 2030



TACOM LCMC/ECBC Partnership



Defense Logistics Agency Support to Contractors

- Authorized by Public Law 107-314, Section 365
- Implemented November 18, 2005
  - USD Acquisition, Logistics and Technology Memorandum
- Defense Logistics Agency (DLA) May
  - Directly Contract with Weapons Systems Contractors
    - Distribution, Disposal, and Cataloging of Materiel
    - Must not Degrade Core Mission or Directed Workload
  - Authority Expires September 30, 2007
- Conditions
  - Weapons Systems Contract Must Have Been Competitive
  - Support No More than Five (5) Weapon Systems Contracts
  - DLA Accepts No More than $100,000,000 for All Contracts
  - Contract Period No More than a Five (5) Years

ECBC

Bottom Line: Contractor Impacts Public Law 107-314, Section 365

- Contractors can Subcontract with DLA for Certain Work
  - Subject to Conditions/ Limitations
- DLA Can Support Contractors on a Reimbursable Basis
  - Cataloging
  - Distribution
  - Disposal

PERFORMANCE BASED LOGISTICS (PBL)

- PBL Business Case Analysis Policy – August 18, 2005
  - All Army ACAT Programs or Joint Programs Where the Army is Lead Service and/ or Will Transition to Army

- PBL Tool Kit
  - Defense Acquisition University – https://acc.dau.mil/log
    - Acquisition Community Connection Under “Logistics”

ECBC

CONCLUSION

- CBD is a Low-Density Critical Warfighting Commodity
  - Increasingly Technical and Complex
- Requires Joint Multi-Agency Strategic Management Approach
  - Supported by Current Service Consolidation Efforts
- Incremental Implementation Approach
  - Developmental Items
  - Fielded Systems
  - Partnership between DLA, Service Sustainment, Industry, Academia and JPMs Hold the Key to Joint CBD Sustainment

ECBC

Preparing the warfighter to meet the chemical biological threat

An important part of fighting and winning the Global War on Terrorism

Gabe Patricio, JPEO
703 681-0808

Robert Wattenbarger, JPMOIP
703 432-3198

Rick Decker
Director of Engineering
410-436-5600
www.ecbc.army.mil

AN RDECOM LABORATORY

Canadian CBRN PPE Standards and Guidance

March 2006

Eva Dickson

Royal Military College of Canada

Project Manager, Project CRTI 01-0029RD

The project objectives

- **To provide guidance to first responders in the use and selection of protective equipment in order to enhance preparation for response to a CB incident**
  - To drive the development of equipment guidelines and standards in this area for Canada

CPG
CHEMICAL PROTECTION GROUP
ROYAL MILITARY COLLEGE

CRTI-IRTC

The approach

- **R&D and guidance development in concert**
  - Specialists and responders participate in program
- **Determining what's needed**
  - Model scenarios
  - Understand responder roles, requirements and response procedures
  - Research toxicology of C,B,R agents

The approach

- **Determining what's possible**
  - Model protective performance of clothing and respirators
  - Measure protection under realistic (workplace) conditions
  - Examine a variety of styles of protective equipment
  - Measure performance using a wide variety of appropriate agent simulants, toxic industrial chemicals

CPG CHEMICAL PROTECTION GROUP ROYAL MILITARY COLLEGE

CRTI-IRTC

The approach

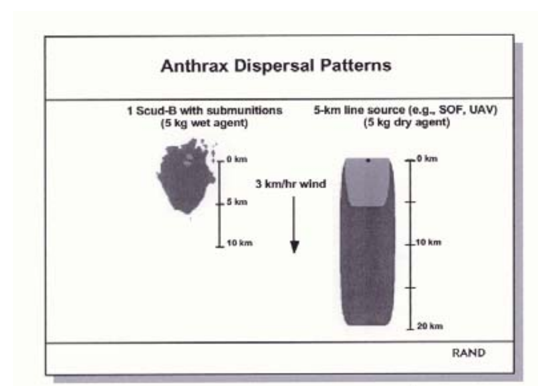
- **Setting and meeting new requirements**
  - Develop standard assessment methods
  - Set requirements
  - Drive PPE standard development
  - Assist industry in understanding, assessing and meeting new performance requirements

CPG
CHEMICAL
PROTECTION
GROUP
ROYAL
MILITARY
COLLEGE

CRTI-IRTC

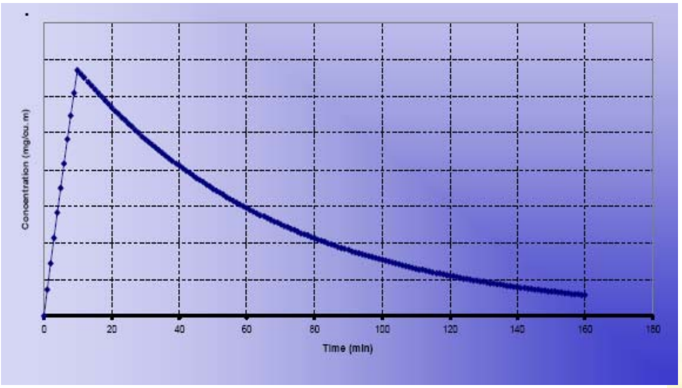
Standards development and guidance

- **Systematic approach to advice based on all-hazards approach, operational requirements and reasonable maximum exposures**
- **Initial emphasis is on practical advice for managing the situation in combination with PPE selection**



Scenario development and release modeling

- **A variety of C, B, R scenarios have been developed and evaluated consistent with the Canadian environment**
  - Include indoor, outdoor release and contagious events
  - Modeling of release events has been performed



Scenario development and release modeling

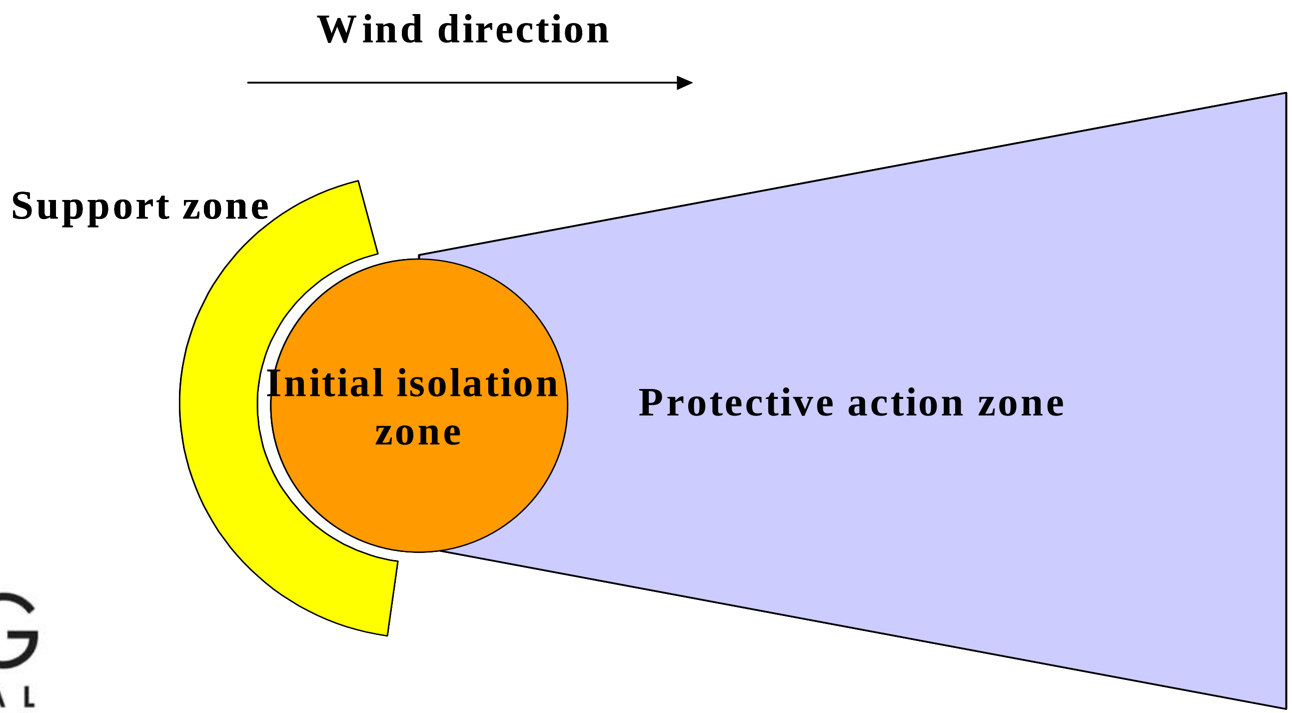
- **Some basic initial assumptions:**
  - Scenarios can be divided into those where a limited release volume is likely, and those where large volume release is possible
    - Use ERG 2004 small vs large release guidelines for chemicals to assist in defining perimeters
  - Vast overkill is unlikely
  - Agents are most likely to be chosen for lethality potential

CPG CHEMICAL PROTECTION GROUP ROYAL MILITARY COLLEGE

CRTI-IRTC

FR working zones

- **Based on ERG 2004 with some modifications**



Roles and responsibilities in a CBRN event

Developed with assistance of FR working groups

Service	Type of event	Duties: Rad	Duties: Chem	Duties: Bio	Location of ops	Work rate[1]
Hospital first receivers - Decon Team	R, B, C indoor release or outdoor release	decon	decon	decon	outside hospital; hospital located in cold zone; exposure to contaminated casualties	Moderate
Hospital first receivers	R, B, C, indoor release or outdoor release	treatment	treatment	treatment	inside hospital: hospital located in cold zone	Moderate
Hospital first receivers	R, B, C, indoor release or outdoor release	treatment	treatment	treatment	inside hospital: hospital located in protective action zone	Moderate
Hospital first receivers	Bio, contagious			high volume normal duties	protective action zone	Moderate
EMS, general duty	R, B, C, indoor release	T, T & T[2]	T, T & T	T, T & T	cold zone perimeter of event	Moderate
EMS, specialists	R, B, C, indoor release	Rescue and T, T & T	Rescue and T, T & T	Rescue and T, T & T	isolation, support	Heavy
EMS, general duty	R, B, C, outdoor release	T, T & T	T, T & T	T, T & T	protective action zone	Moderate
EMS, specialists	R, B, C, outdoor release	treatment & rescue	treatment & rescue	treatment & rescue	isolation, support, protective action zone	Heavy
EMS, general duty	Bio, contagious			high volume normal	protective action zone	Moderate

- also performed for police, fire

Guidance on PPE use during release event

Major issues identified

- **Recognize differences between Hazmat and CBRN terrorism events**

Hazmat release event	CBRN terrorism event
Known substances, known amounts	Unknown substances, unknown amounts (all hazards approach)
Toxicity variable, usually low to moderate Primarily chemical, may include radiological	Toxicity likely to be high Biological agents, including infectious materials, included
Often outdoor release with relatively small area of effect	More likely to be either indoor release or covering very large outdoor area
Specific emergency plan in place	Planning must be generic
Not targeted	Targeted location and timing, may be weaponized for efficient delivery
Usually not criminal event	Criminal event
Event may last hours to days	Event may last hours to months

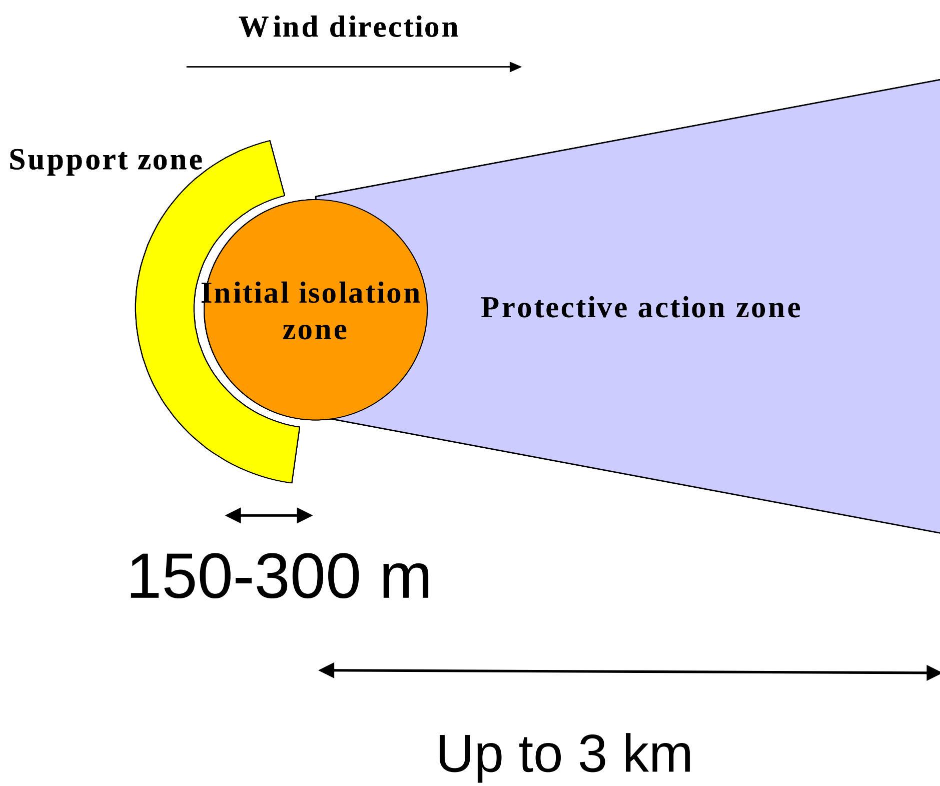
- **Initial approach to event must be all-hazards**

CPG CHEMICAL PROTECTION GROUP ROYAL MILITARY COLLEGE

CRTI-IRTC

Major issues identified: approach to scene

- **Approach to suspected unknown event from up to 3 km distance must include good respiratory protection for <u>all</u> responders**
  - Protective action zone and support zone may contain concentrations well above IDLH
  - Support zone at sufficient distance



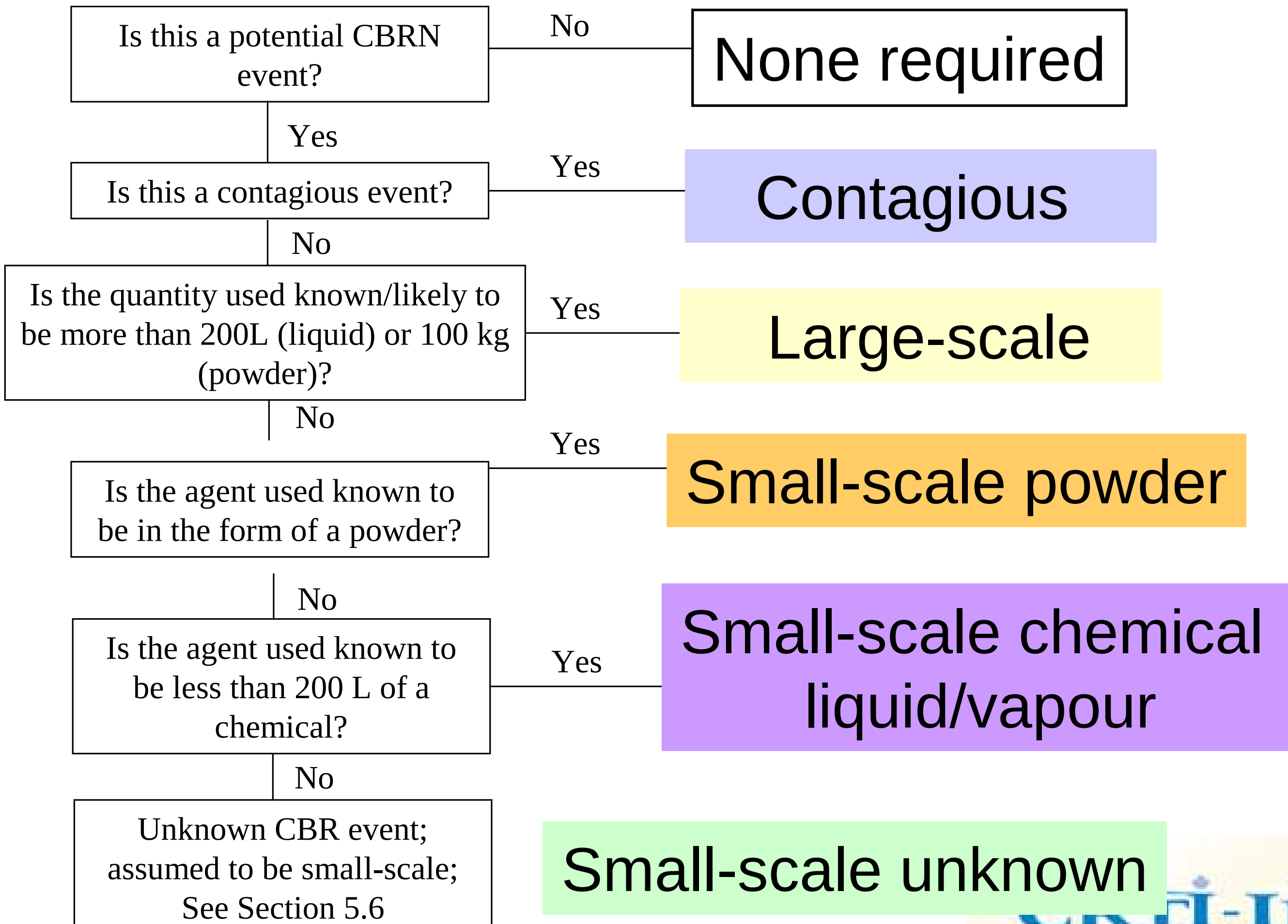
Major issues identified: characterization of event

- **Important to recognize scale/nature of event as soon as possible in order to choose appropriate protective levels**
  - Use appropriate indicators
  - Look for vehicles, reservoirs, ground-level air intakes which might indicate release of amounts larger than man-portable (200 kg)
  - Number of serious casualties relative to number exposed
  - Bio or rad dissemination devices

CPG CHEMICAL PROTECTION GROUP ROYAL MILITARY COLLEGE

CRTI-IRTC

Decision tree for selection of PPE for CBRN events



Setting protection requirements

- Model dispersion based on type, size of release
- Select various categories of worst-case agents, based on toxicity, ability to penetrate protective systems
- Establish acceptable exposure levels based on reasonable assumption of risk for single, acute exposure conditions
- Understand responder roles and locations

CPG CHEMICAL PROTECTION GROUP ROYAL MILITARY COLLEGE

CRTI-IRTC

Guidance document

- **Selection and use of personal protective equipment for the Canadian first responder to a CBRN terrorism event: Interim Guidance Document (Oct. 2005)**
  - Found at http://www.rmc.ca/academic/chem/research/crti/projectreports_e.html

Table 2. Protection requirements for an unknown small-scale release event.

Event	PPE class	Zone/Protection requirement	Suggested style	Relevant standards	Other comments
Unknown small-scale release	RPD	Initial isolation zone: NIOSH SCBA CBRN equivalent protection, SWPF of > 20,000	SCBA	NIOSH CBRN approved SCBA	30 minute total time in isolation zone followed by immediate decontamination.
	DPE	Initial isolation zone: NFPA 1991 (2005 edn) protection	Totally-encapsulating vapour tight (Level A) suit	NFPA 1991 (2005 edn)	Full skin decontamination should be implemented on exit to support zone after 30 minutes.
	RPD	Support or protective action zone: SWPF of > 10,000 and protection against 40,000 $mg.min.m^{-3}$ of chemicals of most concern	SCBA Other ASR APR or PAPR	NIOSH CBRN approved SCBA None None	Use for several hours makes ASR/APR/PAPR use more practical No ASR/APR/PAPR have been demonstrated to have required capability
	DPE	Support or protective action zone: NFPA 1994 (2006 edn) class 2 equivalent protection; plus Class 2 shower test for decon role	Class 2 or similar	NFPA 1994 (2006 edn), or NFPA 1971 (2006 edn), CBRN option, for firefighter turnout gear	

Major issues identified: respiratory protection

- **CBRN-approved SCBA must be used in isolation zone until magnitude of event has been established**
- **If scale/nature of release can be estimated**
  - If large-scale chemical released, then APR cannot be used even in support/protective action zones
  - If small-scale rad, bio incident, APR use is possible in support zone/protective action zones
    - APR use may be possible in isolation zone if event identified as rad/bio

CPG
CHEMICAL
PROTECTION
GROUP
ROYAL
MILITARY
COLLEGE

CRTI-IRTC

Major issues identified: respiratory protection

- **Chemicals of concern have been identified against which NIOSH CBRN-approved or military air purifying respirators may not provide sufficient protection**
  - Canadian standard should include requirements for protection against these chemicals for small-scale events in support/protective action zones
  - Existing active carbon systems are being investigated for their performance
  - Modeling is being performed in order to assist in improved design
  - Plan to develop new APR cartridges

CPG CHEMICAL PROTECTION GROUP ROYAL MILITARY COLLEGE

CRTI-IRTC

Major issues identified: respiratory protection

- **Fitting of respirators and workplace protection factors have significant impact on ability of air-purifying respirators to provide adequate protection**
  - Procedure for rapid on-site fit-testing for fundamental fit of respirator using condensation nuclei counters has been developed
- **Appropriate individual fit-testing for high protection levels is a requirement**
  - NIOSH CBRN APR requires laboratory PF of 2,000
  - However higher PFs should be achievable/desirable during individual fit-testing

CPG CHEMICAL PROTECTION GROUP ROYAL MILITARY COLLEGE

CRTI-IRTC

Major issues identified: body protection

- **Have provided input to *NFPA 1994 (2006 edn)* and *NFPA 1971 (2006 edn)* in order to bring standards requirements more closely in line with types of chemical hazards and updated toxicity estimates, using MIST assessments for certification**
  - Focus on hazmat/fire requirements
  - Comfort/burden specifications have been improved
  - Still over-emphasis on “total” rather than “toxicologically relevant” protection
    - More information on dermally toxic chemicals needed

Major issues identified: body protection

- **A number of garments for hazmat response and turnout gear for CBRN rescue are under development by industry and US government teams**
  - are being evaluated against NFPA 1994 and 1971 (2006 edn) requirements

CRTI-IRTC

Major issues identified: body protection

- **Garments certified against standard will not be available till 2006**
- **Garments are particularly focused on isolation zone and decon team requirements**
- **Canadian standard is planned to include more classes of clothing**
  - To ensure match between functional requirements and minimal burden vs required protection for all categories
  - Need to understand performance and capabilities of air-permeable active carbon garments

CPG CHEMICAL PROTECTION GROUP ROYAL MILITARY COLLEGE

CRTI-IRTC

Major issues identified: systems integration

- **Systems should be certified with clothing and respirator worn together**
- **Integration between respirator, clothing, specialized helmets is critical**
  - Current NIOSH approval procedures do not measure respiratory protection of system

The way ahead

- Continue to develop realistic performance evaluation methodologies for certification
- Continue to model and measure performance
- Work with CSA and CGSB to establish Canadian standards committee (summer 2006) for standards in 2008/9
- Work with industry to assist in development of appropriate systems to meet projected standards requirements (Canadian, NFPA 1994/1971)
- Assist in certification vs NFPA 1994, 1971 (2006 edn)

DEFENCE R&D DÉFENSE

Dr Scott Duncan

Head/Soldier and Systems Protection Group

Chemical and Biological Defence Section

DRDC Suffield

Defence R&D Canada

Who is Defence R&D Canada ?

- Agency within the Department of National Defence with the mandate to provide S&T advice to the Canadian Military

Defence R&D Canada - Suffield

Chemical Biological Defence Section

- Preventive Medicine Group
- Molecular Biology Group
- Biological Detect/Ident Group
- Medical Therapy Group
- Chemical Synthesis and Analysis
- Chemical Detect/Ident Group
- Simulation and Modeling Group
- Decontamination Group
- Soldier and System Protection Group


Functional Materials
for CB Protection
Against the
Asymmetric Threat

What do we mean by…

"Functional materials for the asymmetric threat "

Starting position … existing CB protective materials were developed for the “Cold War”

- Not functional …
  - thick, heavy, stiff
  - task restrictive
  - inefficient permeability
- Result …
  - over protection (not optimised)
  - high burden
  - integration issues
  - poor moisture management
  - many commanders decision issues

Outcome …

Protective clothing and equipment drives the mission

What do we want from a functional material ?

- A material, that when incorporated into a system, will contribute to **a measurable improvement in capability** provided by the system, and …
- will result in a **distinct operational advantage for the users of that system**

The Canadian approach

- Asymmetric threat different from Cold War
  - Alteration of Force Planning Scenarios
  - Change in Conduct of Operations

- Cold war protection and sustainment requirements are reduced by **matching level of protection to threat**
  - enabling superior warfighting capability, survivability and maintenance of op tempo

Capitalise on difference to develop materials that are more functional

Situate the context of use …

- **Cold War**
  - “history” – enemy was known
- **Asymmetric threat**
  - “now and future” – rogue nations/terrorist groups acting against national and global interests

Cold War battlefield

- Defensive operations in Central Europe - defend in-place "terrain denial"
- Large CB weapons stockpiles - warfighter faced possible large scale use of CB agents
- Fighting "dirty" for extended periods
- Wide range of delivery systems (aircraft, missiles, MLRS etc)

Asymmetric Threat battlefield

Very different from Cold War …

- Highly mobile battlefield
- Availability of CB weapons is much smaller
- Reduced capability to deliver and sustain attacks
- Asymmetric attacks – enemy avoids Force on Force, minimise technological advantage – enemy seeks disproportionate effects
- Attacks less massive, but less predictable - unconventional delivery
- Real time intelligence – greater situation awareness
- Greater ability of coalition Forces to dictate Op Tempo
- NATO and Coalition Air superiority

Define protection requirements for Conduct of Operations (in the Asymmetric battlespace)

- Enemy with reduced capability; less massive, less contaminated footprint; well defined operation and exit strategy
  - **Chemical protection required for <u><2 h</u>**
  - **Biological protection required for <u><30 min</u>**
- Liquid contact/vapour penetration
  - **<2 µg total in 2 h**
- Direct vapour challenge
  - **Ct of <50 mg min m^{-3} in 2 h**
- Aerosol penetration
  - **>90% reduction over existing**

Integration of the Threat into Design

Threat and hazard scenarios

- CB agents
- Delivery means
- Challenge levels (spatial and temporal)

Protective materials design

- Acceptable levels of exposure
- Exposure durations
- Physiological burden
- Task/performance functionality

Material requirements

- "Tailored" protection – toxic effects have negligible impact on military task performance
- Low physiological burden (thermal, weight)
- High task functionality

Outcome

	Protective Posture					
	Combat Uniform	**MOPP 1**	**MOPP 2**	**MOPP 3**	**Asymmetric Threat Posture**	**MOPP 4**
Body	X	√	√	√	√	√
Feet	X	X	√	√	√	√
Hands	X	X	X	√	X	√
Head	X	X	X	X	X	√
Respirator	X	X	X	X	X	√

X – no protection

√ – protection

Asymmetric Threat Posture

- Applied in the appropriate theatre of operations…
  - well defined level of protection <u>all</u> of the time
- Rather than…
  - no protection (combat uniform)
  - logistical burden of too much protection that is not need most of the time

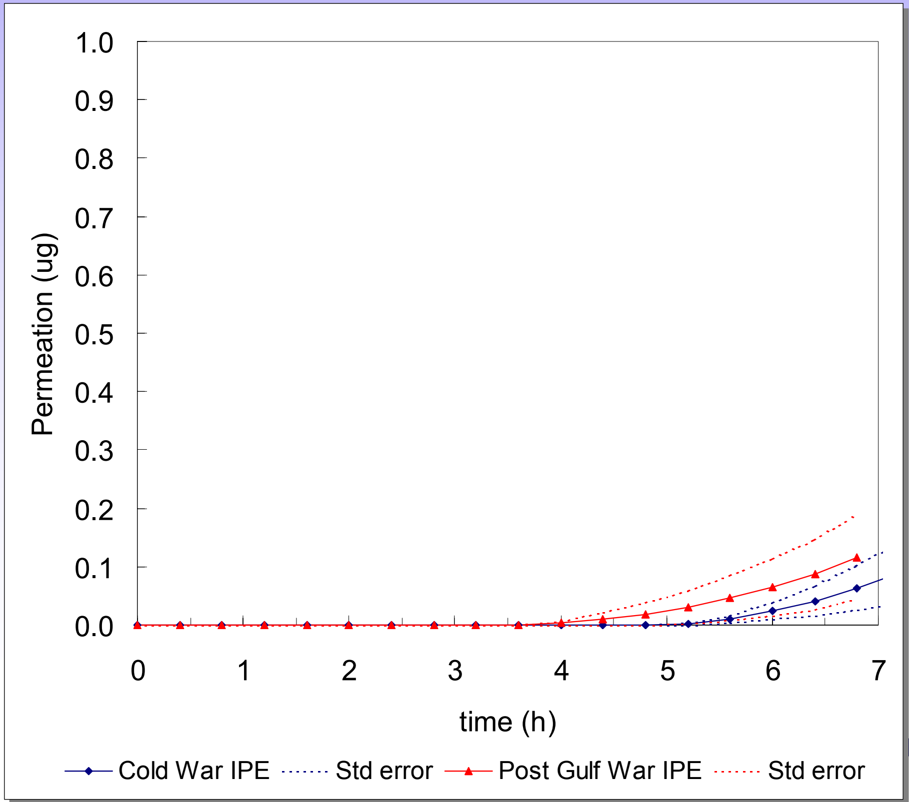
Functional materials

Examples of R&D effort at DRDC Suffield

- Fabric based protective systems
  - chemical
    - liquid
    - vapour
  - aerosol
  - biological

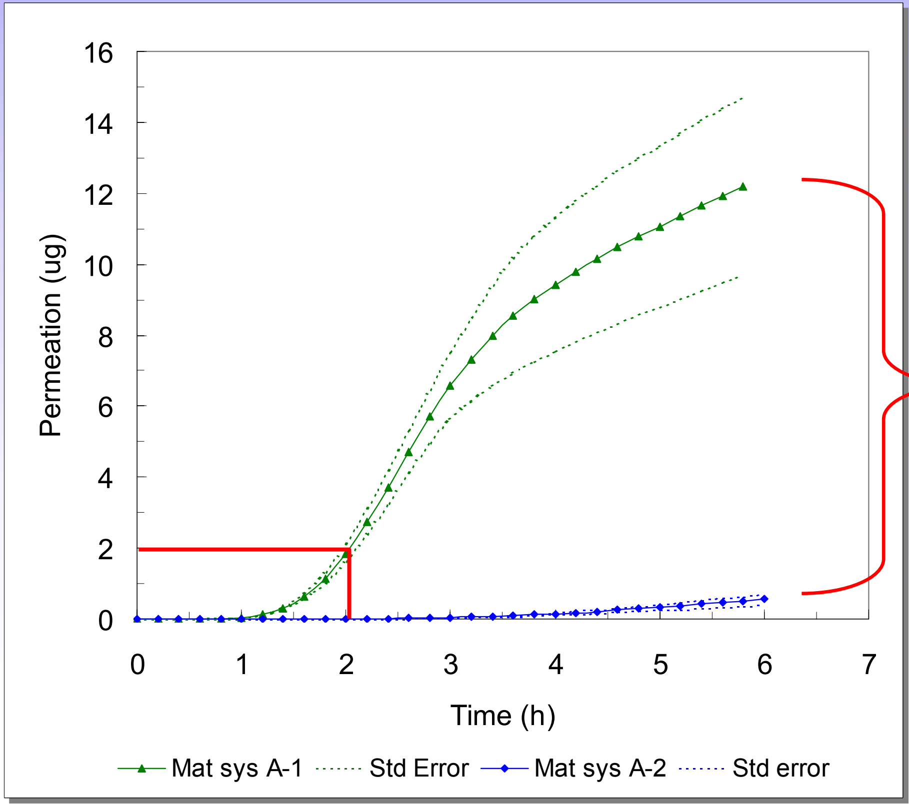
Current IPE materials

- Cold War IPE (legacy) – blue curve
  - Mass: 482 g m^{-2}
  - Air Permeability: 25 $cm^3\ cm^{-2}\ s^{-1}$
  - Thickness: 2.35 mm
- Post Gulf War (Horizon 1) – red curve
  - Mass: 400 g m^{-2}
  - Air Permeability: 18 $cm^3\ cm^{-2}\ s^{-1}$
  - Thickness: 1.10 mm



Asymmetric Fabric Systems (A)

- System A-1 (green curve)
  - Mass: 200 g m^{-2}
  - Air Permeability: 43 cm^3 cm^{-2} s^{-1}
  - Thickness: 0.59 mm
- System A-2 (blue curve)
  - Mass: 259 g m^{-2}
  - Air Permeability: 48 cm^3 cm^{-2} s^{-1}
  - Thickness: 0.83 mm

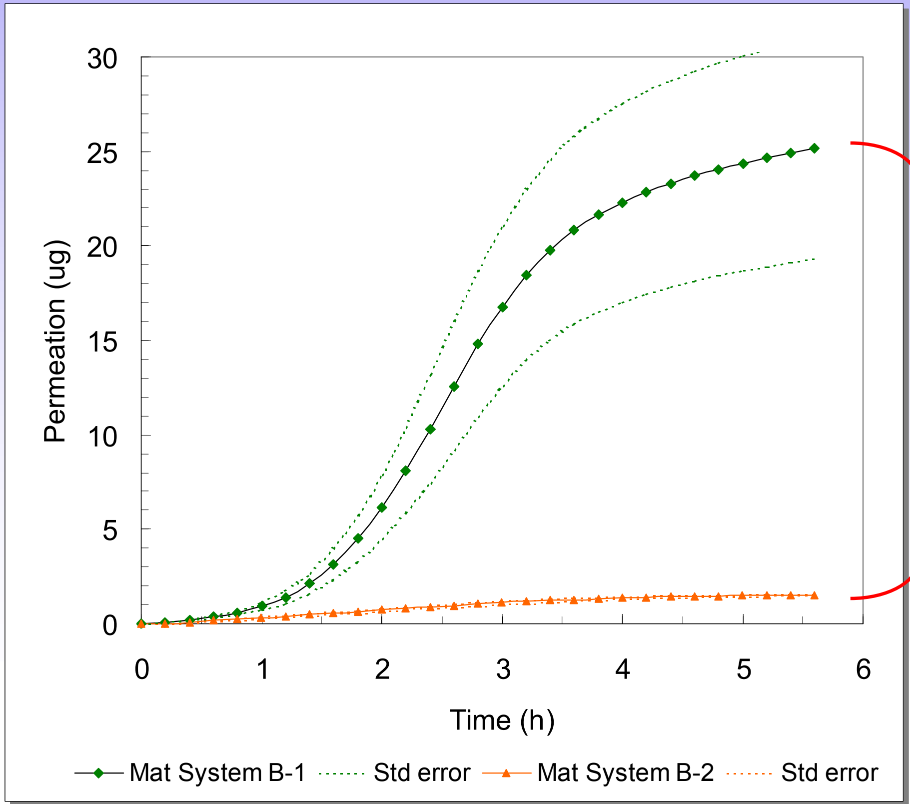


Systems have the same barrier A

Difference due to outer shell

Asymmetric Fabric Systems (B)

- System B-1 (green curve)
  - Mass: 316 g m^{-2}
  - Air Permeability: 36 $cm^3\ cm^{-2}\ s^{-1}$
  - Thickness: 0.79 mm
- System B-2 (orange curve)
  - Mass: 375 g m^{-2}
  - Air Permeability: 52 $cm^3\ cm^{-2}\ s^{-1}$
  - Thickness: 1.02 mm

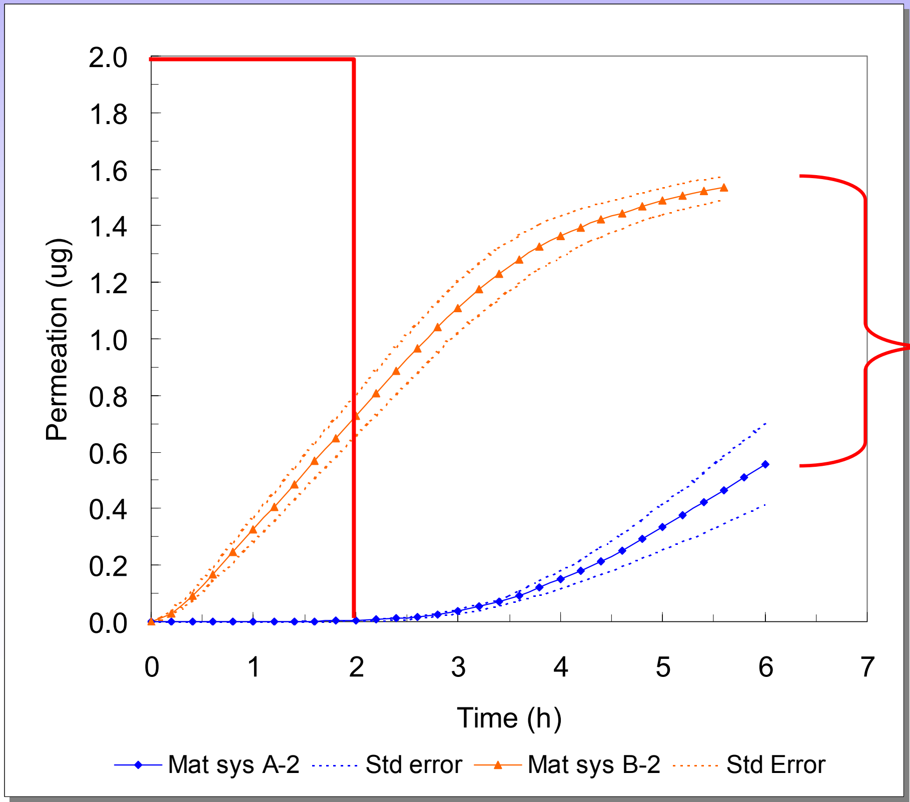


Systems have the same barrier B

Difference due to outer shell

Comparison of Asymmetric Fabric Systems A-2 and B-2

- System A-2 (blue curve) and B-2 (orange curve)
  - Mass difference: A-2 (-116) g m^{-2}
  - Carbon loading ratio: A-2/B-2 (2.0)
  - Air Permeability: A-2 (-4) $cm^3\ cm^{-2}\ s^{-1}$
  - Thickness: A-2 (-0.19) mm

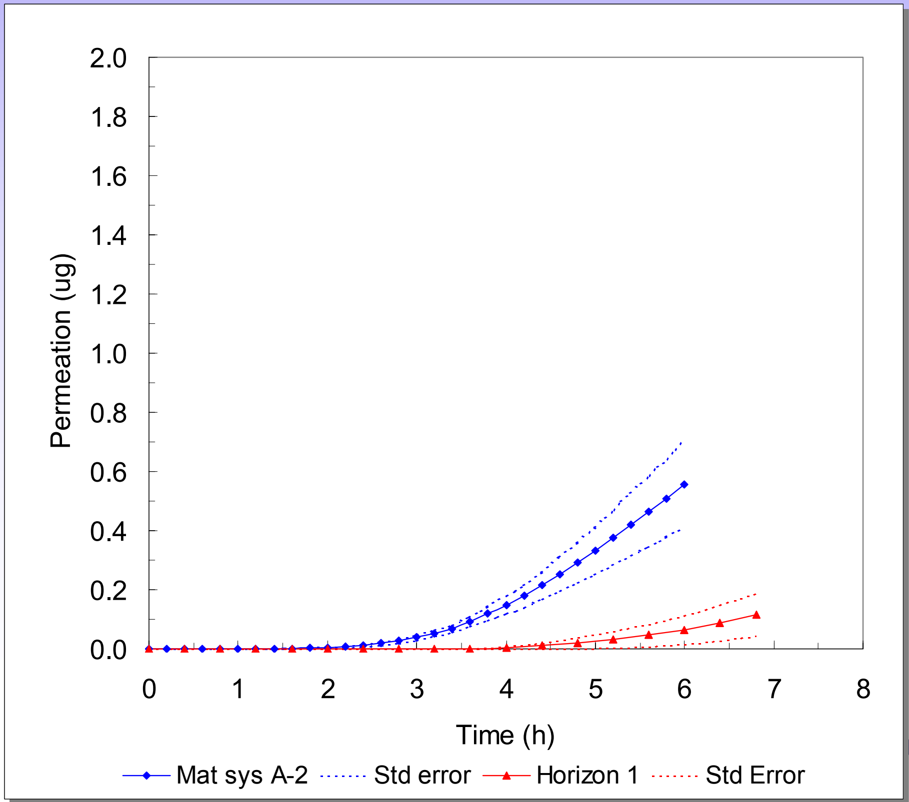


Systems have different barrier

Difference due to barrier layer

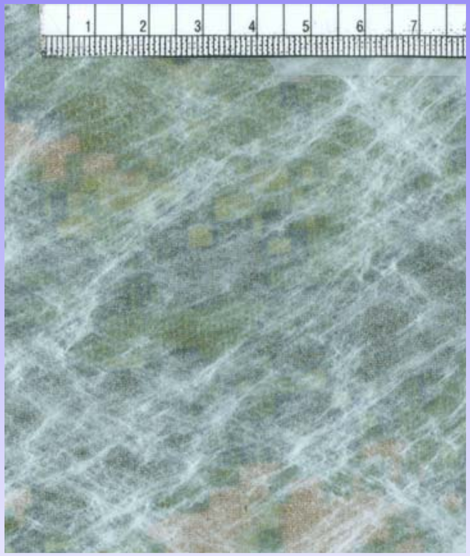
Comparison of New Asymmetric Fabric System A-2 and Current Horizon 1

- A-2 System (blue curve) and Horizon1 (red curve)
  - Mass difference: A-2 (-140) g m^{-2}
  - Carbon loading ratio: A-2 /Horizon 1 (1.0)
  - Air Permeability: A-2 (+30) $cm^3\ cm^{-2}\ s^{-1}$
  - Thickness: A-2 (-0.27) mm



Enhancement of performance against vapour

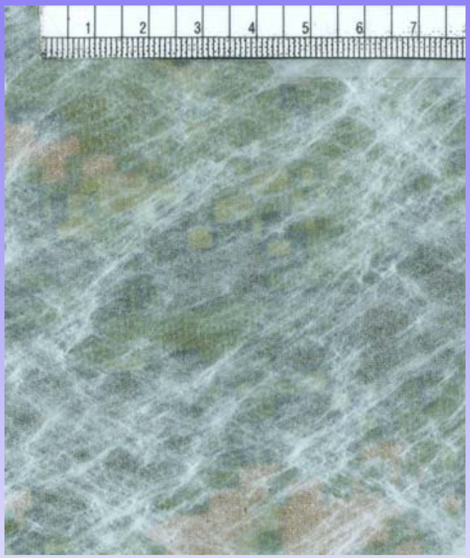
- Improve by introducing an aerosol web (AW) into material system
  - System A-2: change in material properties due to AW
    - Mass (increase): from 259 to 267 g m^{-2}
    - Air Permeability (decrease): from 48 to 9.5 $cm^3\ cm^{-2}\ s^{-1}$
    - Thickness (no change): 0.83 mm
  - Challenge dosage to material at 2 h
    - 1320 mg min m^{-3}; 5 m s^{-1} wind speed



Fabric System	Cumulative penetrated dosage (mg.min.m^{-3})		
	1h	2h	6h
System A-2	55	124	922
System A-2-AW	3	**9**	78

More than factor of 10 reduction of Ct

Enhancement of performance against aerosols



- Improve by introducing an aerosol web (AW) into material system
  - System A-2
- Challenge
  - *Staphylococcus Aureus* ATCC# 6538
  - Concentration 10^6 CFU mL^{-1}
  - Aerosol size: 3 µm
  - Flow Rate: 30 LPM

Fabric System	**Filtration efficiency %**
A-2 outer shell	< 1
A-2 outer shell with AW	98.938

Enhancement of performance against bacterial contact

- Introduce an antimicrobial finish on outer shell
  - System A-2
- Organism:
  - *Staphylococcus aureus* ATCC # 6538
- Concentration: 10^6 CFU mL^{-1}
- Time Exposures: 24 h

Fabric System	Log_{10} reduction
A-2 outer shell	-
A-2 outer shell with treatment	>4.87

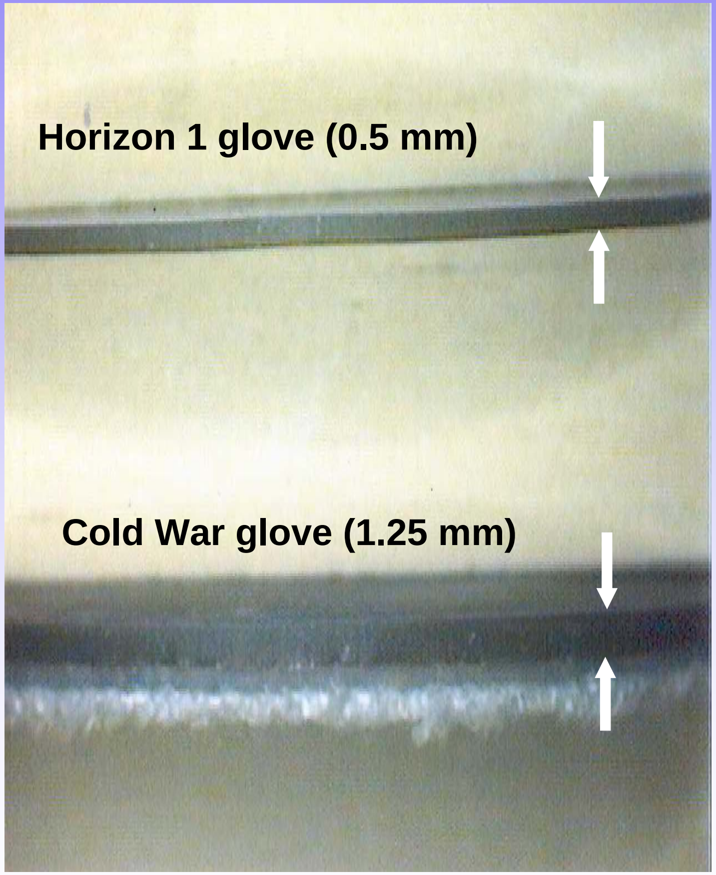
Summary

- We are developing protective fabric materials with properties more conducive to higher functionality
  - lighter (35%)
  - more air permeable (166%)
  - thinner (25%)
  - aerosol web that improves protection against
    - direct vapour challenge
    - penetration of aerosols
  - anti-microbial coatings to protect against contact bacteria

These improvements in the context of the Asymmetric Threat

- Enemy with reduced capability; less massive, less contaminated footprint; well defined operation and exit strategy
  - **Chemical protection required for <2 h**
  - **Biological protection required for <30 min**

Functional materials: Polymers

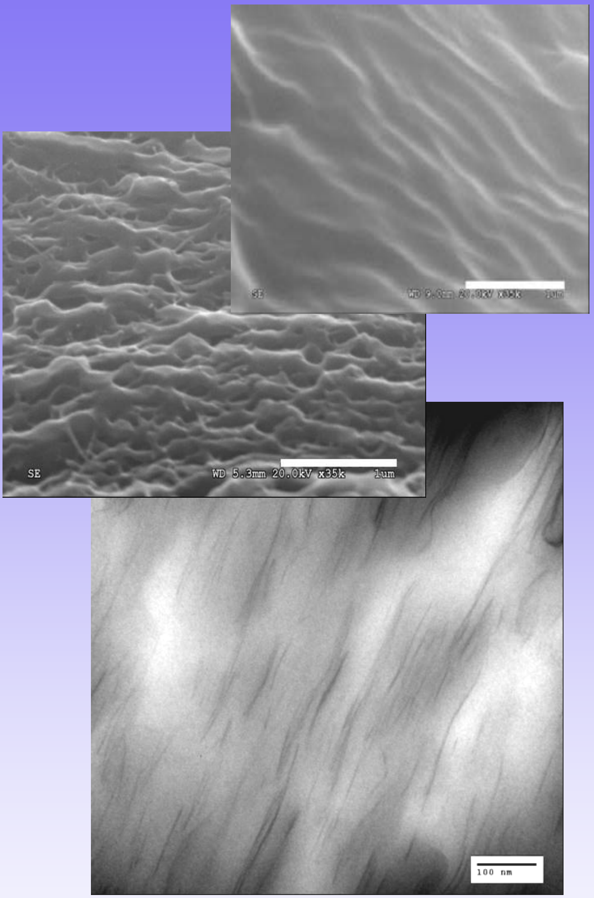


- Typical thickness of polymer-based materials used in current in-service military protective equipment
  - 0.50 mm (the chemical protective glove)
  - >2.0 mm (the facepiece of the C4 respirator)

Polymer Nanocomposites

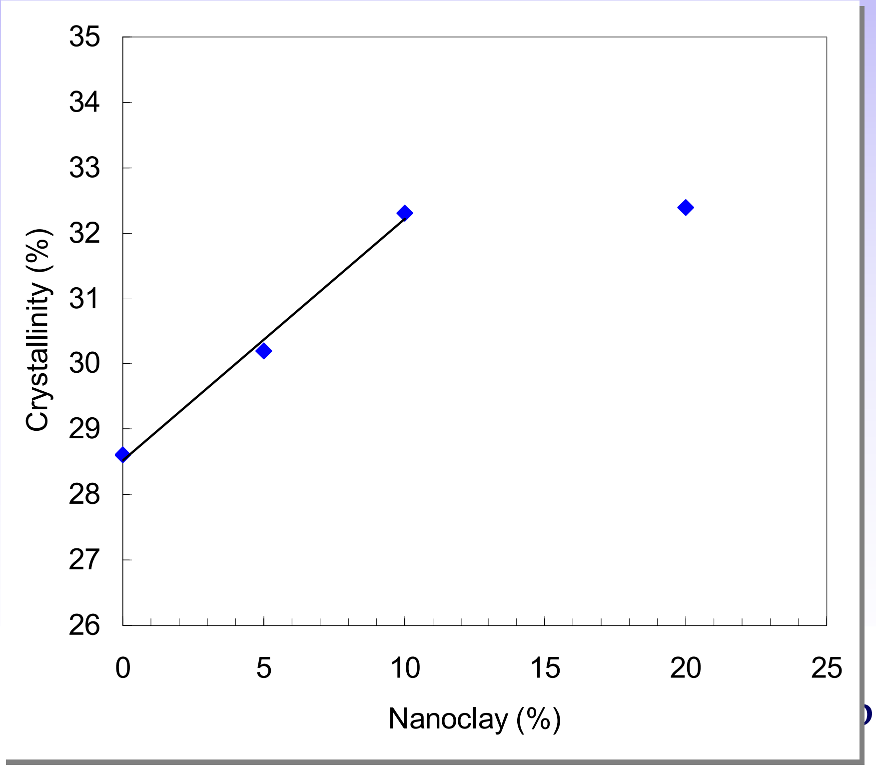
- Aim is to develop micrometer thin CW agent impermeable TPE polymer films
- Nanocomposite materials successfully developed into films ~25 µm in thickness
- Benefits – replace polymers in existing CB protective equipment – reduce burden and improve functionality

Polymer Nanocomposites

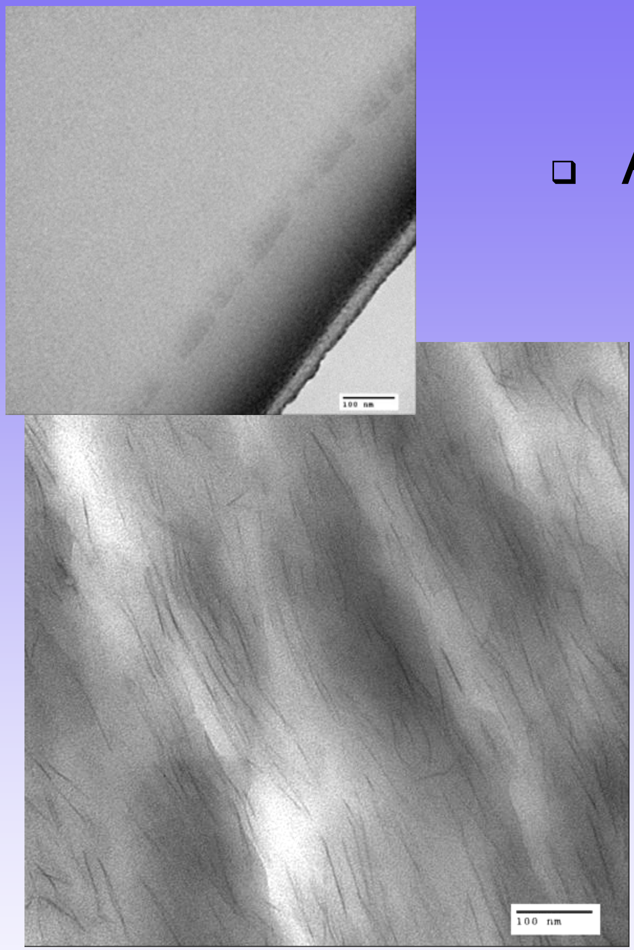


Addition of nanoclay to polymer system

- increases crystalline fraction
- improves physical properties
    - Tear strength (+15%); uniaxial strength (no change); modulus (+50%)

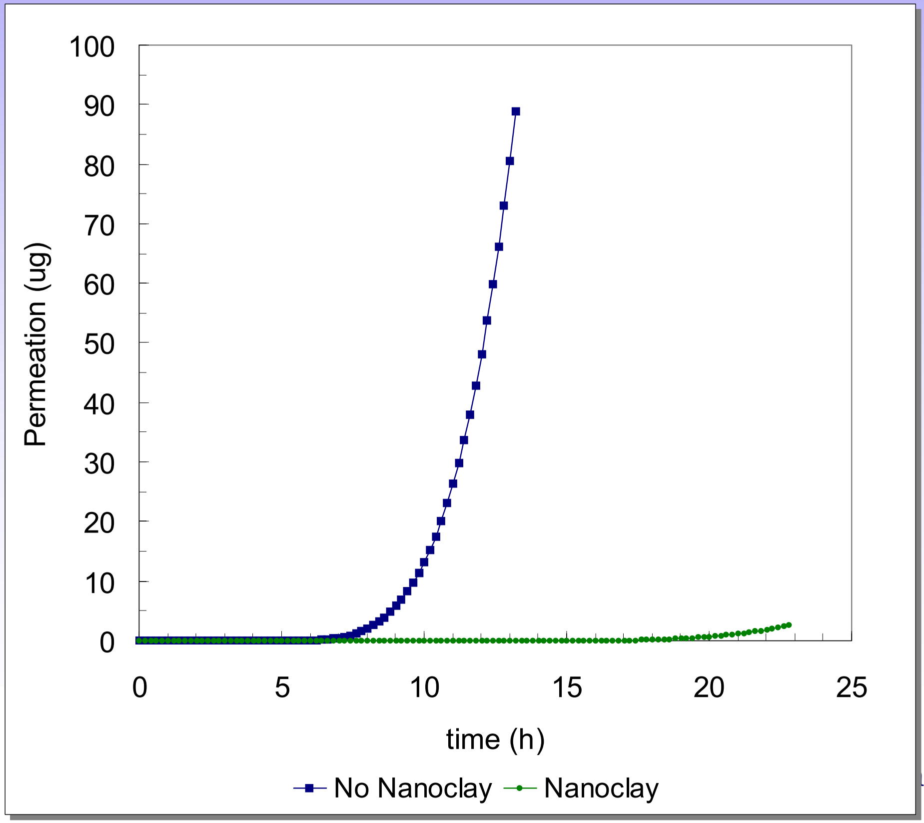


Polymer Nanocomposites



TEM, 200000 x magnification

- Addition of nanoclay to polymer system
  - increases diffusion path (tortuosity)
  - **improves chemical resistance**

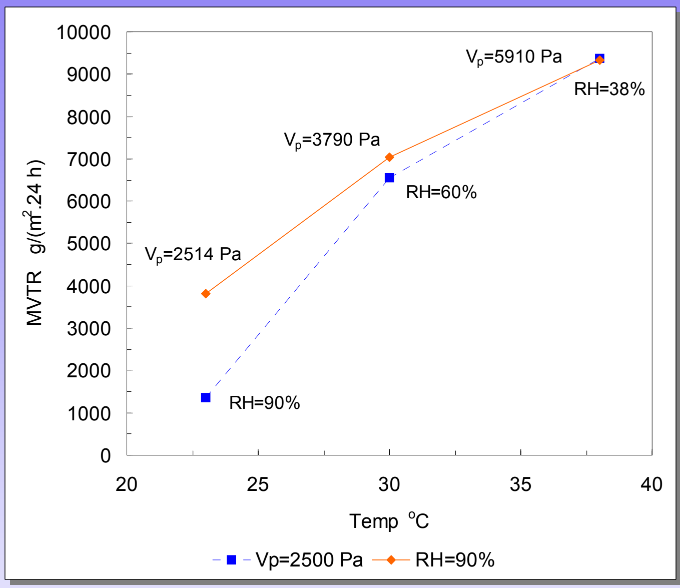


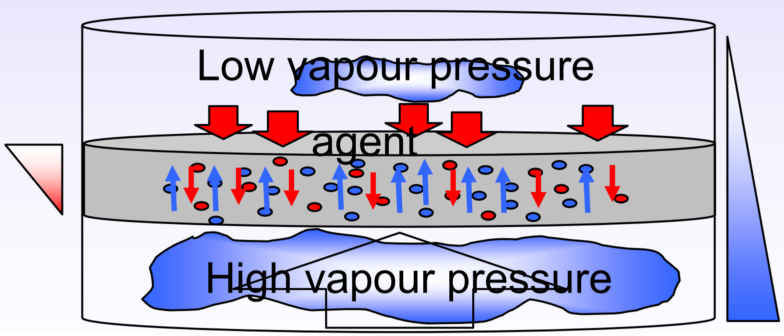
Selectively Permeable Membranes

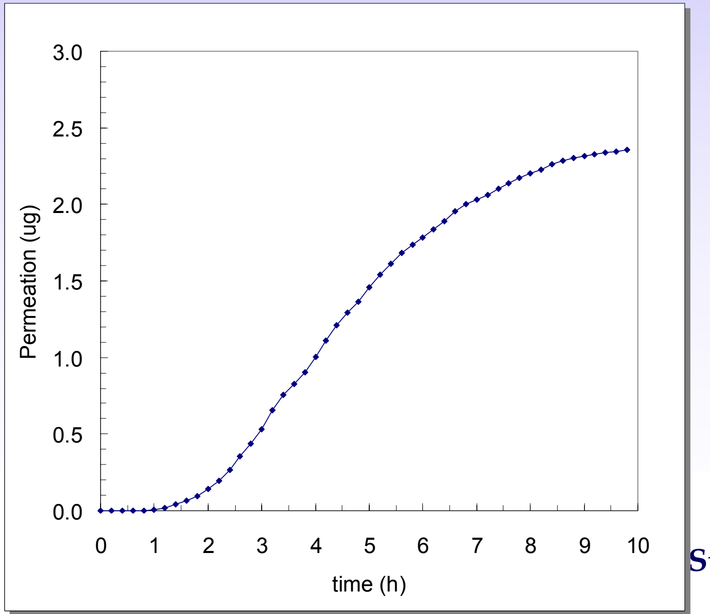
- Objective
  - develop micrometer thin water vapour permeable CW agent impermeable polymer films

Moisture vapour permeable (agent impermeable) monolithic membranes

- Two phase polymer membrane
  - Water diffusion
    - inverted cup method
  - Permeation (simulate high water vapour pressure next to skin)
    - open cell; agent (drop-wise) 5 g m^{-2}; T=30 ^{o}C
    - ΔH_2O v_p= 3400 Pa across membrane
      - no permeation through
    - ΔH_2O v_p= 1500 Pa across membrane



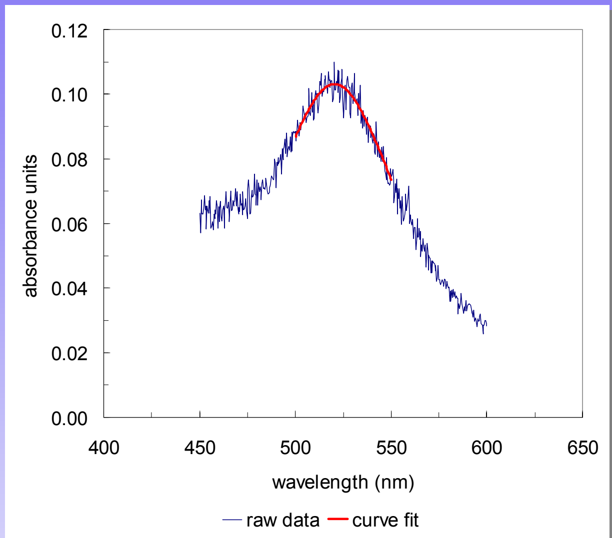




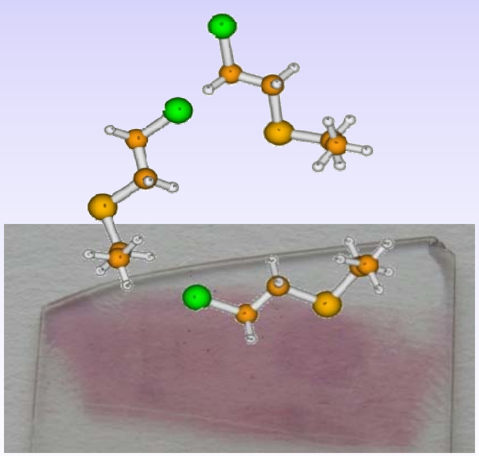
Nanoparticle complexes

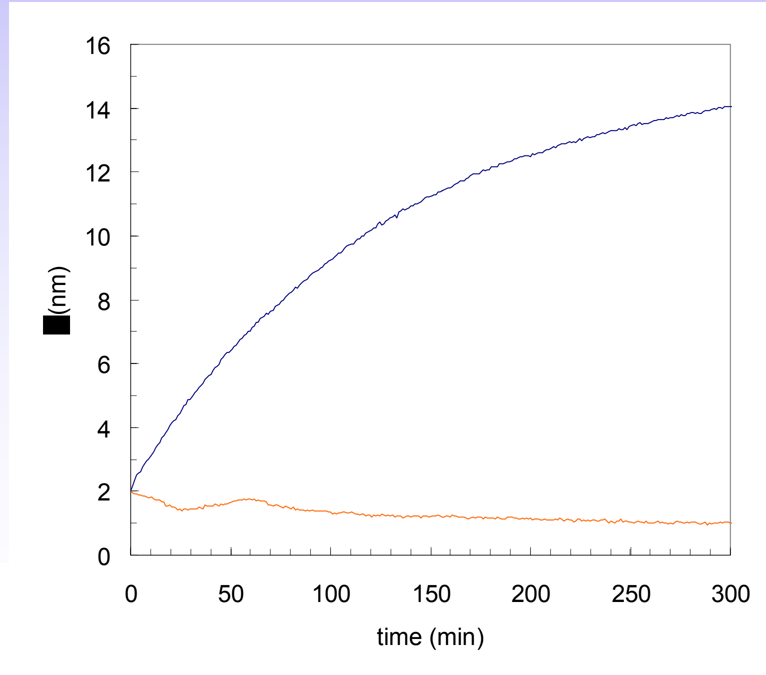
- Objective
  - Develop nano-ordered materials/ complexes
    - control material properties to affect specific outcomes or responses
    - study of uptake of organics, reversible/irreversible adsorption, colorimetric detection, reactivity / degradation / functionalisation properties

Nanoparticle film sensing



- Surface plasmon resonance (SPR) absorption band observed in the absorption spectra of many metallic nanoparticles
  - Au particles 5-15 nm have maximum absorbance near 520 nm
- Expose Au nanoparticle film to organic vapour and monitor shift in SPR peak with time





Summary

- Conducting operations in Asymmetric Threat environment demands different approach to protecting the soldier
- Integrate threat into design and match protection requirements to threat level
- Shorter duration protection requirements allow development of protective materials with properties more conducive to higher functionality
- Progress being made on thin nanocomposite films and thin moisture vapour permeable membranes (~25 µm)
- SPR-based sensors have real-time capability

Motto

Well defined, short duration protection available all of the time…

… is more effective than too much protection that is not needed most of the time

Joint Service General Purpose Mask (JSGPM)
and
Joint Service Chemical Environment Survivability Mask (JSCESM)

March 2006

JSGPM PROGRAM HIGHLIGHTS

- **Mission:**
  - **Provide Face, Eye and Respiratory Protection from Battlefield Concentrations of CB Agents, Toxins, Toxic Industrial Materials and Radioactive Particulate Matter**
- **Key Events:**
  - **Development Program Start – 19 Oct 98**
  - **PDRR Contract Award – 30 Mar 00**
  - **System Demo Option Award – 04 Apr 02**
  - **LRIP Option Award – 30 Aug 05**
  - **FRP Decision – 1QFY07**
  - **FUE – 1QFY07**
- **Team:**
  - **JPMO - IP, JS IPT, Avon, SAIC**

- **User:**
  - **All Services - Replaces Current M40/M42 and MCU-2/P Series Protective Masks**
- **Target Capabilities:**
  - **Improved Protection**
  - **Improved Field of View**
  - **Lower Breathing Resistance**
  - **Reduced Weight/Bulk**
  - **Improved Compatibility**

DESIGN TO REQUIREMENTS

➢ **Key Performance Parameters:**

- **Mask Shall Provide Continuous Above the Neck Eye/Respiratory/Skin Protection Against Vapor, Liquid, Aerosol, and Particulate Threat Agents for 24 Hours After One Year of Continuous Exposure to an Uncontaminated Environment**
- **Filter Shall Provide Continuous Eye/Respiratory/Skin Protection Against Vapor, Liquid, Aerosol, and Particulate Threat Agents for 24 Hours**
- **The Mask Including Outserts, if Needed, Shall Permit Unobstructed and Undistorted Forward Vision**
- **The Mask Shall Provide a Durable Drinking Capability**
- **The Mask and Mask Carrier Shall be Compatible With Current and Co-Development Chemical/Biological Garments**

DESIGN TO REQUIREMENTS

➢ **Critical Threshold Requirements:**

- **Protect Against Toxic Industrial Materials (TIMS)**
- **Protection Factor Greater Than 10,000**
- **Significant Weight and Bulk Reduction Compared to M40/M42/MCU-2/P Masks (Mask <= 1.7 lbs., System <= 4.0 lbs.)**
- **Exhalation Breathing Resistance ,<= 20 mm of Water and Inhalation Resistance <= 30 mm of Water at 85 LPM**
- **Improved Field of View**
- **Compatibility With All Service Individual Clothing and Equipment, and With Individual and Crew Served Weapon Systems and Optics**
- **Improved Comfort and Reduced Physiological Burden**

FEATURES INCORPORATED

- **No buckles in the forehead**
- **Minimal parts to facilitate maintenance and logistic support**
- **Color coding of parts to facilitate maintenance**
- **All masks with an internal microphone capability with a microphone pass through**
- **Low resistance outlet valve/speaking module**
- **Pop valve to allow changeout in a contaminated environment**
- **Conformal twin filters (Primary and Secondary)**
- **Locking tabs**
- **Improved drink system**
- **Flat periphery in the forehead for helmet compatibility**
- **Mask Carrier/Accessory Bag**

MAJOR FEATURES

Head Harness

Facepiece Assembly

Eyelens

Front Module Assembly

Primary Filter

Drink Tube Coupler and Housing

STATE OF THE ART TECHNOLOGY

- **Polynomial spline visor providing excellent equipment interface**

STATE OF THE ART TECHNOLOGY

Facepiece Assembly

- Butyl/Silicone (5%) blend

STATE OF THE ART TECHNOLOGY

- **Filter Time Patch to assess filter life**

STATE OF THE ART TECHNOLOGY

High Efficiency Synthetic Particulate Air (HESPA) filtration material

- **HESPA offers a couple of advantages to the JSGPM filter program. First our filter dimension could remain the same but its performance greatly improved and when combined with the development of pleat encapsulation technology, the shape of the filter is no longer confined to the conventional square/rectangle or round/cylindrical flat shape, thereby providing greater flexibility in equipment design and interface.**

STATE OF THE ART TECHNOLOGY

- **Ethylene oxide, ammonia, and formaldehyde filtration media in a secondary filter**

STATE OF THE ART TECHNOLOGY

- **One of the goals of the Carrier IPT was to develop a design to keep out dust and dirt beyond the capability of the currently fielded carriers. This goal is in response to the after action reports from Operation Enduring Freedom and Operation Iraqi Freedom.**

Joint Service Chemical Environment Survivability Mask (JSCESM)

- Mission
  - Provide a Lightweight/Disposable Mask that Provides 2-8 Hours of Respiratory and Face Protection Against Vapor and Aerosol CB Agents in Low Levels of Contamination
- Key Events
  - JORD Update Approved – Jan 04
  - Program Initiation (MS B) – Aug 03
  - Contract Award – Nov 03
  - Milestone C (Block I) – Jan 06
- Team:
  - Development Lead – JPMO IP
  - JIPT: USSOCOM, USAF
  - DOD Interest : USA, USMC
- User
  - USSOCOM, USAF, Others TBD

- Target Capabilities
  - One Size Fits All
  - Protection for 2 Hrs (Block I), 6 Hrs, 8 Hrs [O] (Block II)
  - Package size 128 in^3, 50 in^3 [O] (Block II)
  - Drinking Capability Without Compromising CB Protection (Block II)
  - Provide an Alternative for Commanders to Use for Force Protection

Program Need

- Requirement established for Joint Service Chemical Environment Survivability Mask, ORD – 8 January 2004
  - The ORD describes a lightweight, low bulk, short duration, one-time-use mask that is one-size-fits-all and provides above the neck, respiratory, and ocular protection against low-level threat NBC attacks as opposed to direct gross contamination, where standard Mission Oriented Protective Posture (MOPP) protective equipment would be used
  - The JSCESM is intended to provide commanders at all levels with greater options for protection, especially in operations other than war, such as emergency evacuation and first responder personnel
  - The JSCESM may also be worn for short duration missions to provide above-the-neck protection in operations in which forces may incur collateral NBC threats (e.g., downwind effect, encountering contaminated areas in route to targets, or when evacuating hazardous areas).

Capabilities Required

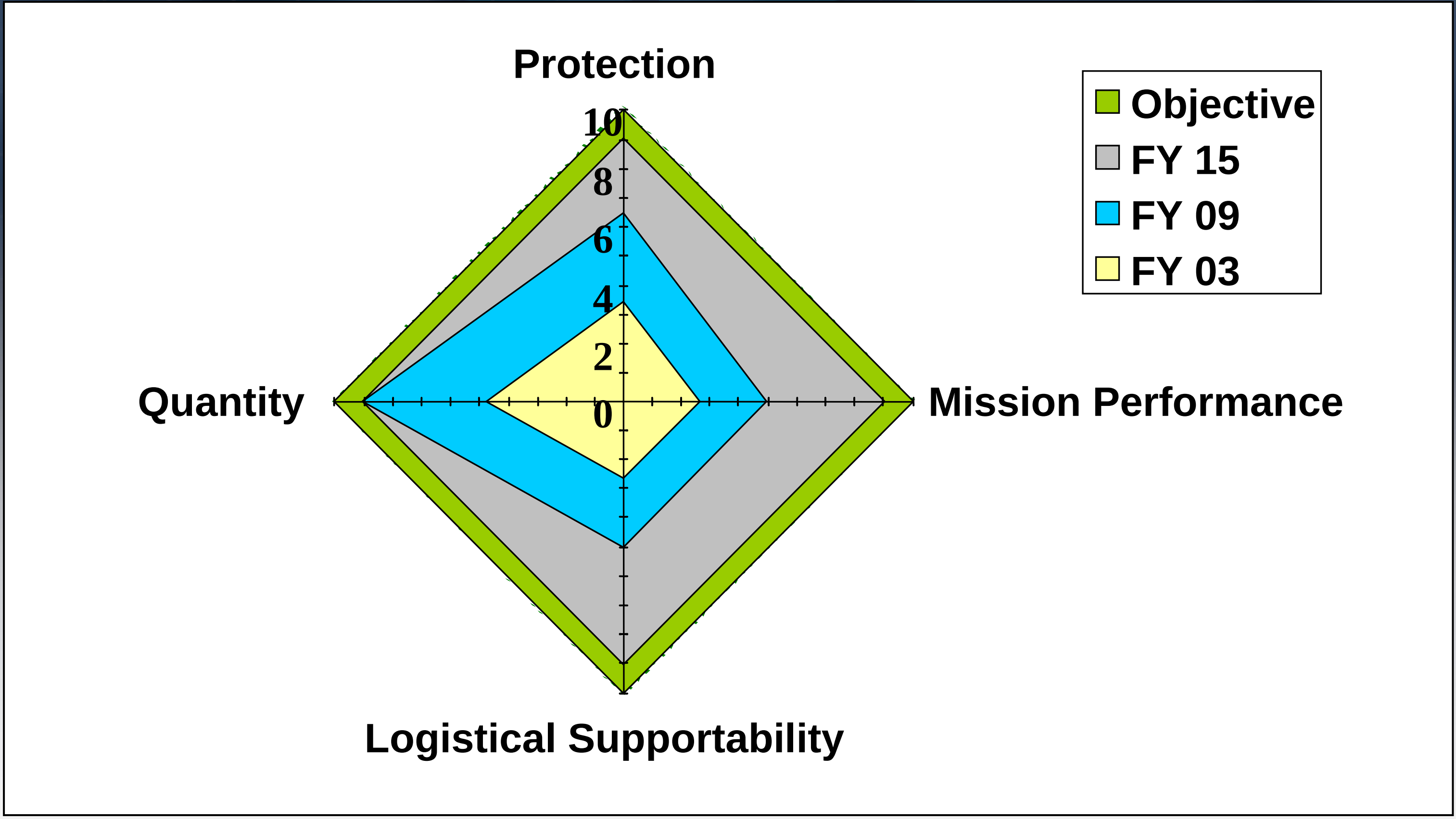
- **JSCESM shall:**
  - **Provide above the Neck Protection against low level NBC Threats for 2 hours, 8 hours [0]**
  - **Be one Size Fits All**
  - **Weigh less than 2 lbs**
  - **Fit into the cargo pocket of a Battle Dress Uniform**
  - **Provide a Protection Factor greater than 1000**
  - **Fit the 2^{nd} to 98^{th} percentile population**
  - **Have an inhalation breathing resistance less than 70 mm of water**
  - **Have an exhalation breathing resistance less than 20 mm of water**
  - **Have 98% off the shelf reliability**

Advanced Mask Concepts

Corey M. Grove
Respiratory Protection Technology Team
Edgewood Chemical Biological Center
(410) 436-6651

Advanced Mask Concepts

User Assessment

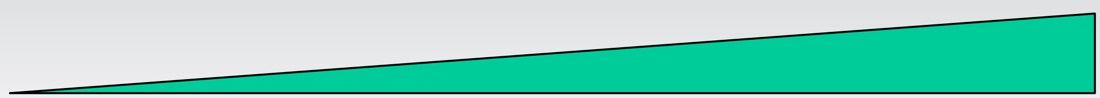


Advanced Mask Concepts

Technology Assessment

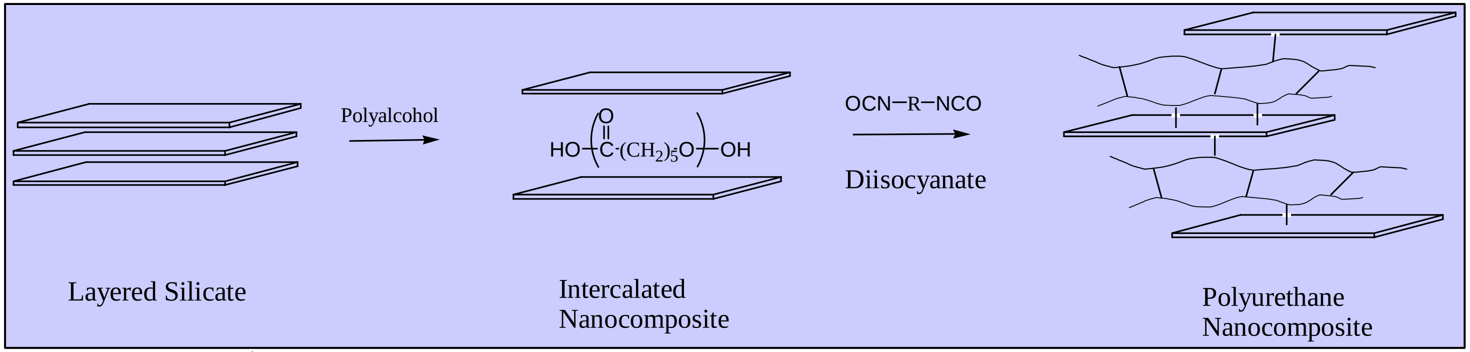
NGGPM	Enhanced NGGPM
Nanocomposite Materials	Powered Technologies
Nanocomposite Filter Media	Nanotechnology
System Pressurization	Microelectronics
System Integration	Micro-machines
Mid Term (3-6 years)	Long Term (6+ years)

Power



Advanced Mask Concepts

Nanocomposite Materials



Polyurethane Process

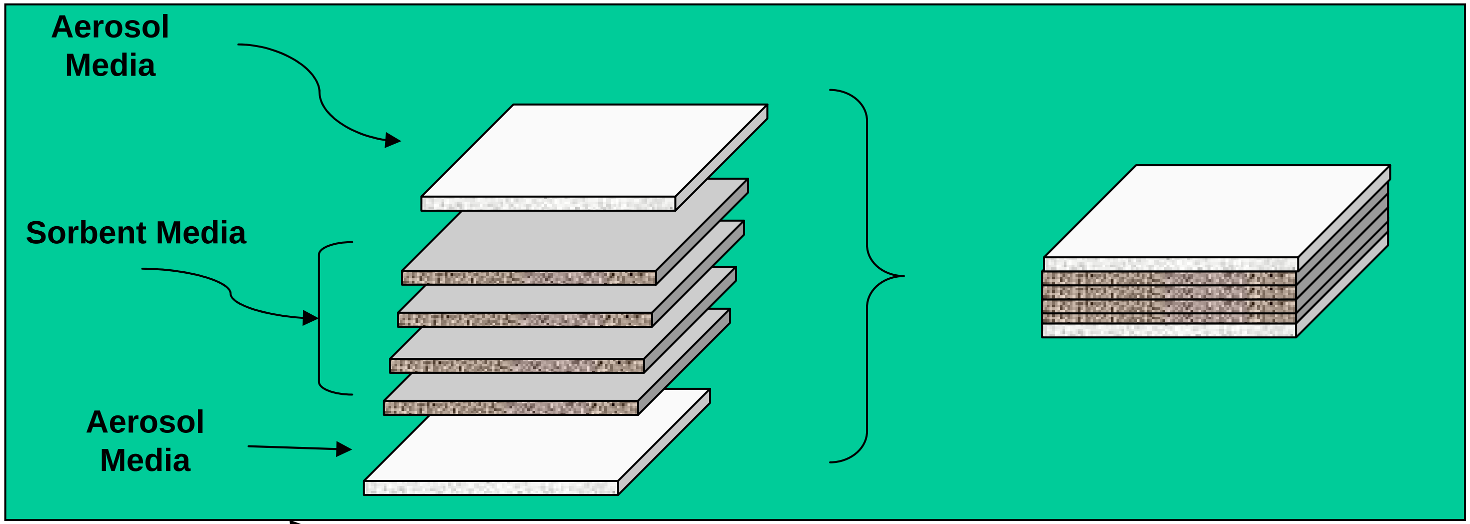
Material Goals:

- **Improved Chemical Resistance**
- **Tailored Performance**

Graphic provided by Triton Systems

Advanced Mask Concepts

Composite Filter Media



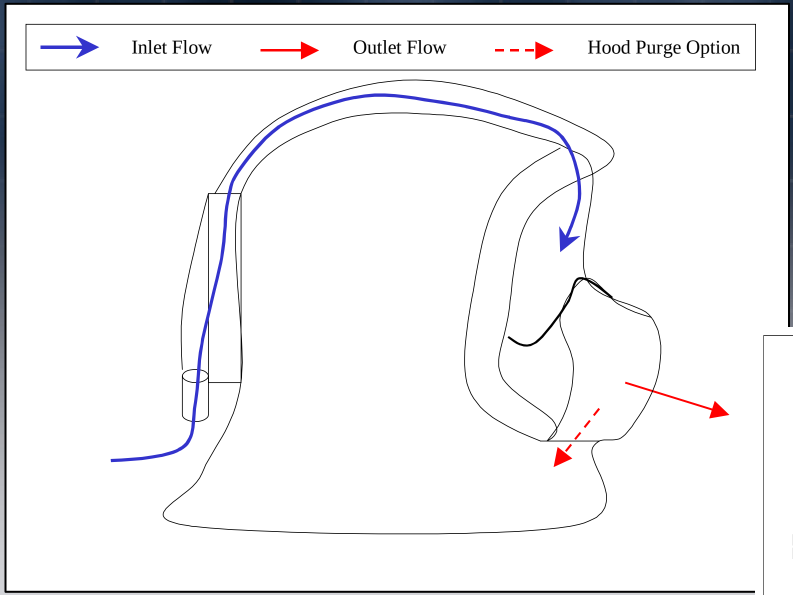
Layering Process

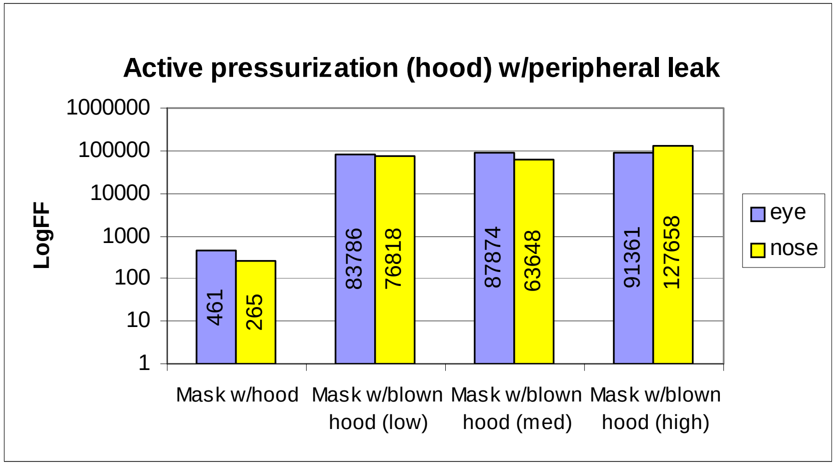
Filter Media Goals:

- Improved Filter Performance
- Tailored Performance

Advanced Mask Concepts

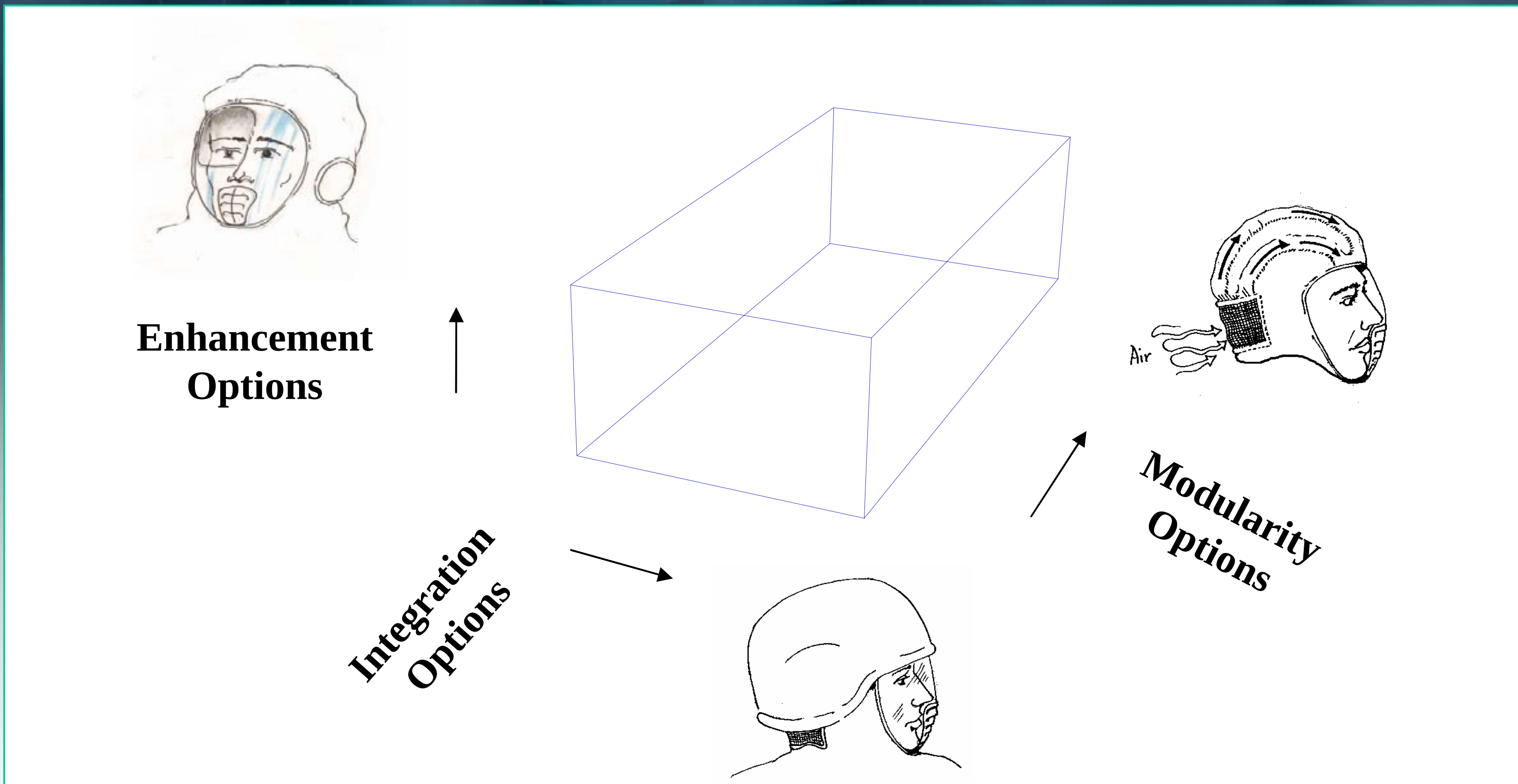
System Pressurization



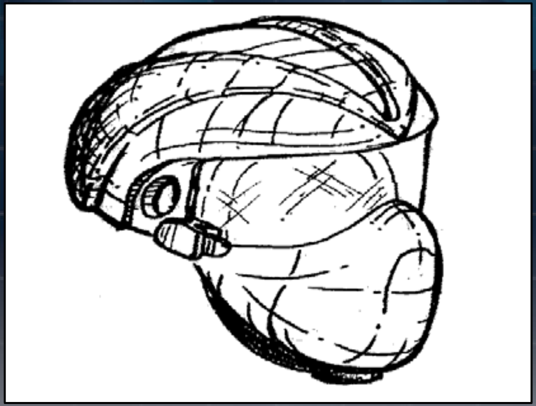


Advanced Mask Concepts

System Integration



Advanced Mask Concepts



NGGPM Concept
(An Integrated Approach)

<u>NGGPM Features</u>

Family-of-Systems
Tailored Protection
Performance Optimization
Operational Modularity
Enhancement Adaptability

Advanced Mask Concepts

Family-of-Systems

Escape

APR

PAPR

SCBA

Portability

Tailored Protection

Protection

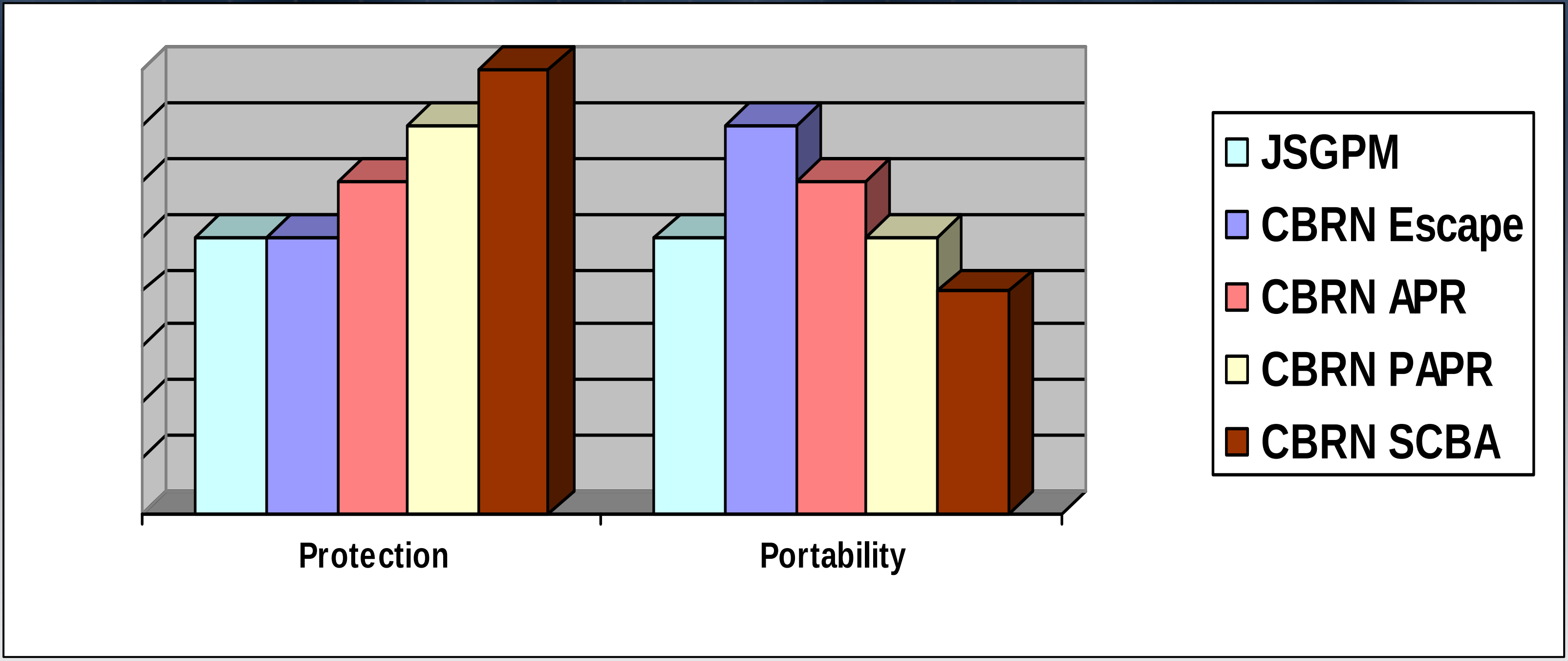
LOW

Exposure Level

HIGH

Advanced Mask Concepts

Overall System Goals



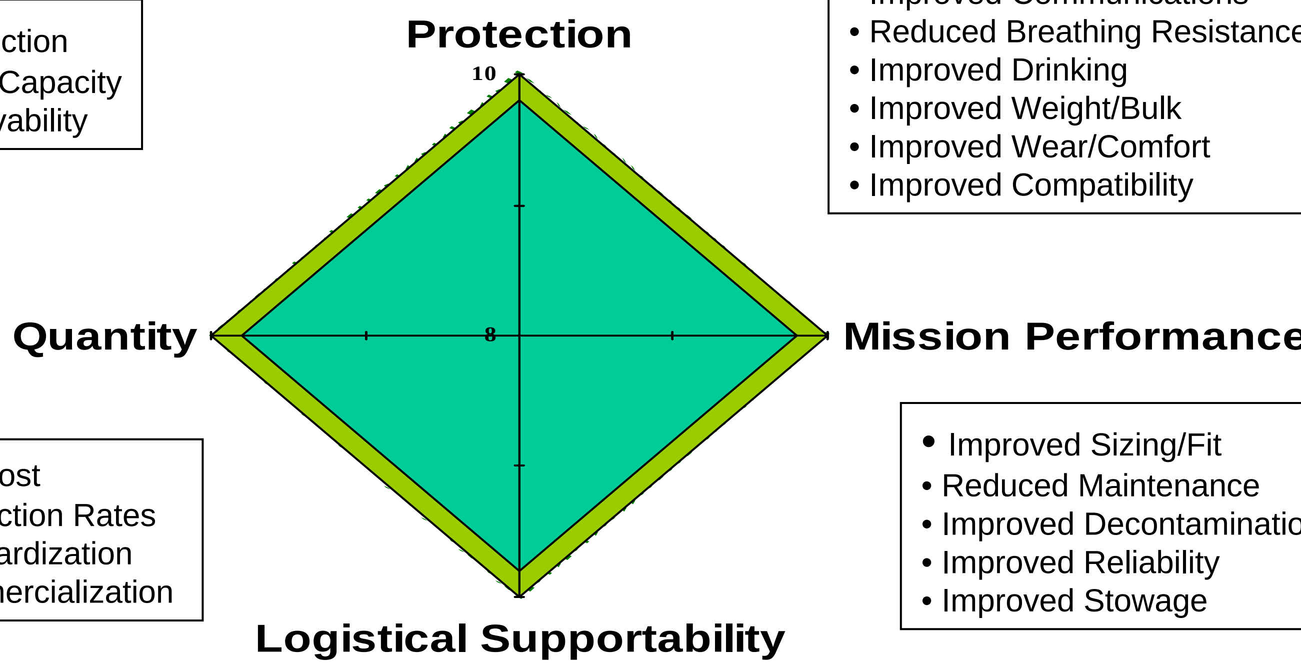
Advanced Mask Concepts

Performance Optimization

(The 90 - 95% Solution)

- Improved Protection
- Improved Filter Capacity
- Improved Survivability

- Improved Field-of-View
- Improved Communications
- Reduced Breathing Resistance
- Improved Drinking
- Improved Weight/Bulk
- Improved Wear/Comfort
- Improved Compatibility



- Reduced Unit Cost
- Improved Production Rates
- Improved Standardization
- Improved Commercialization

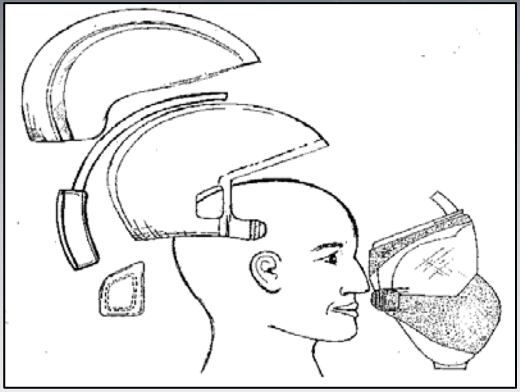
- Improved Sizing/Fit
- Reduced Maintenance
- Improved Decontamination
- Improved Reliability
- Improved Stowage

Advanced Mask Concepts

System Integration

Integration Benefits
- System Pressurization
- Communication Liner System
- High Surface Area Filters
- Helmet/Suit Interface Control

Modularity



Future

Enhancement Options

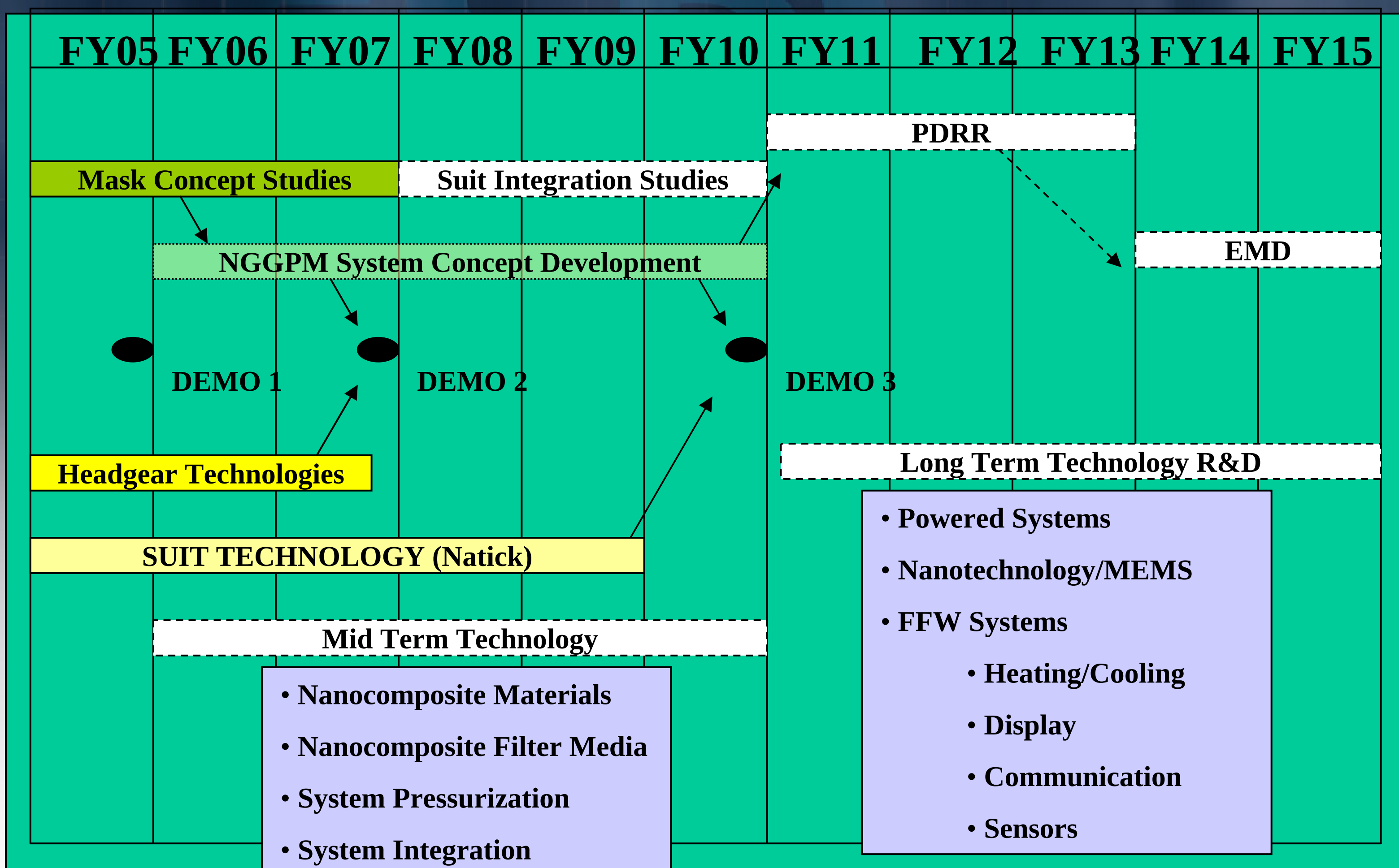
Microclimatic Cooling*
Communications*
Displays/Sensors*

*** Leverage FFW**

Adaptability

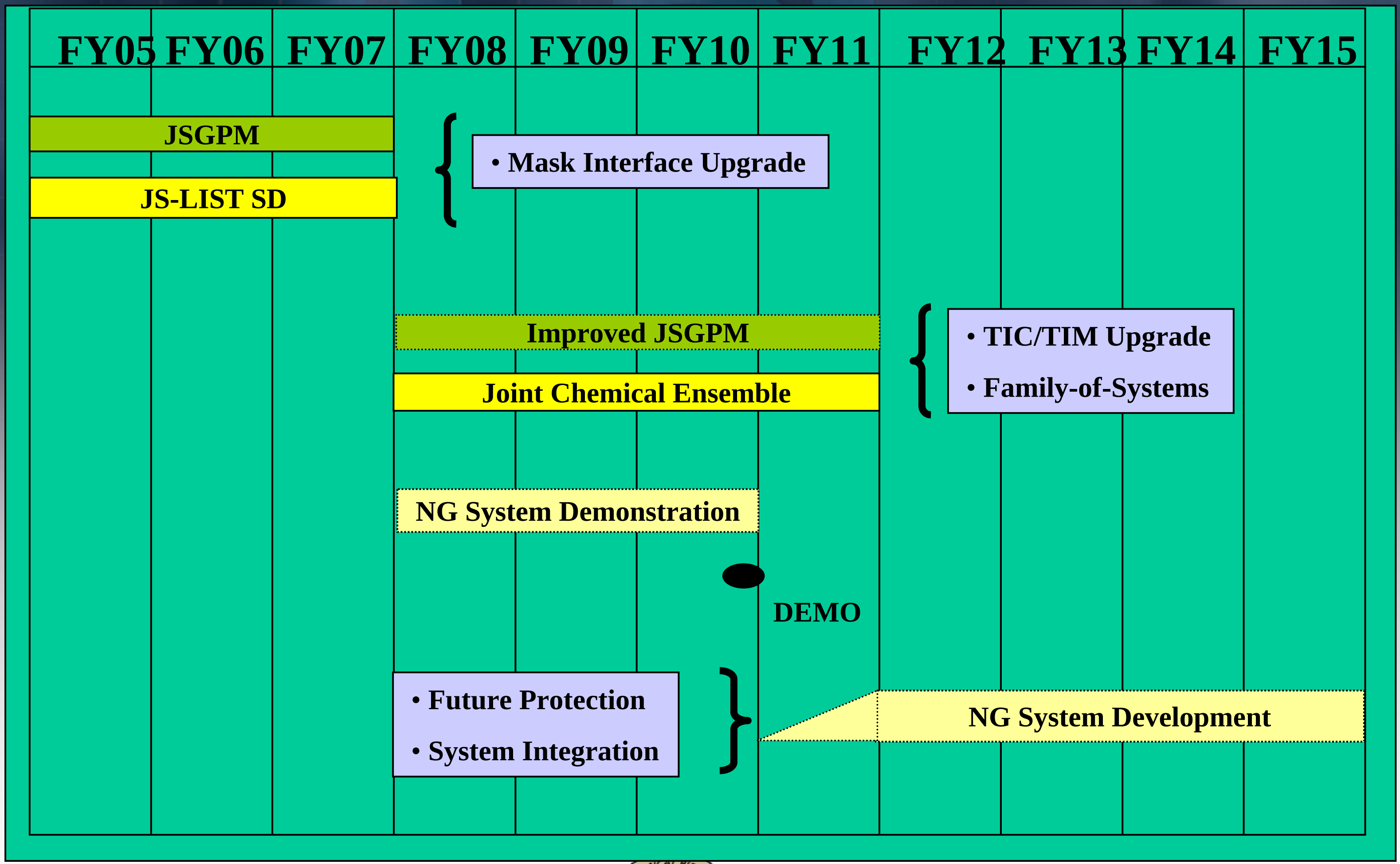
Advanced Mask Concepts

Technology Roadmap



Advanced Mask Concepts

Transition Roadmap



Rapidly delivering war-winning capability

NDIA Conference
March 7-9, 2006

Joint Service Aircrew Mask (JSAM)

U.S. AIR FORCE

Major (S) Doug Hanks (Rotary Wing)
HSG/TBI
Phone #210.536-6364/
charles.hanks@brooks.af.mil

CONTRACTED DEVELOPER

ZODIAC

AVOX Systems

225 Erie St. Lancaster, NY 14086

Contracting: Mr. Ken Wild, 716.686.1616

Human Systems Group (HSG)

Dominant Air Power: Design For Tomorrow…Deliver Today

JSAM PMs report directly to JPM-IP Mr. Jim Nelson/Mr. Brooks

HSG Commander (HSG/CC)
Col Donahue

CBRN Defense Sys Division (TB)
LTC H. Tran

Lead Engr
Lan Ninh

IS/Colpro/Med
Maj (Sel) Stewart

- JEM
- JOEF +
- JWARN
- JCPE
- CP-SSS/EMEDS *
- JBAIDS +
- JECP +

Individual Protection
Mrs. B. Haass

- JSAM * Capt Hanks, Capt Blumke
- JSGPM +
- JSCESM +
- JSMLT
- JPACE
- JSLIST
- MCU-2P 2ND Skin *

Decontamination
Maj Tullier

- JSSED
- JPID *
- *M100 Support*
- *MDS Support*
- JSPDS
- JSTDS

Contamination Avoidance
Mr. Stermer

- JCAD +
- JSLNBCRS +
- JSLSCAD
- JBPDS
- ARTEMIS
- JBSDS

*** USAF is System Manager**
+ IPT Assignments

JSAM Team

Dominant Air Power: Design For Tomorrow…Deliver Today

U.S. AIR FORCE

AERONAUTICAL SYSTEMS CENTER

Type I/IA

Major (S) Doug Hanks
JSAM Rotary Wing

- Deputy PM: Lt Cicero

Lead Engineer
D. Kilduff (Army)

- Sys Engr
  C. Fey
- Sys Engr
  R. Coughlan (Navy)
- Sys Engr
  M. Jaffee (Navy)
- Engr Supt
  Capt Nelson
  Lt Cicero
  Lt Eklund
- Engr Supt
  T. Ma (Navy)
- Integration
  J. Craft*
- Anthropometry
  C. Harrison
  I. Filiguerra (USMC)
- Human Sys Integ
  H. Howell
  A. Salinas
- Systems Safety
  C. Bland (JPM-IP)

Test Mgr
D. Chase

- DT&E Lead
  H. Hansen (Navy)
- RTO Supt
  J. Bennett (Navy)
- OT&E Lead
  Lt Fogg
- OT&E Supt
  CMDR Price
  A. Marr
- OT&E Supt
  J. Justice
- Test Engr
  Lt Cicero

Logistics
Lt Ramos

- Log Supt
  M. Villarreal*
- Log Supt
  J. Irizarry (Army)
- Log Supt
  W. Odum (Navy)
- Log Supt
  R. Cox*
- Training
  R. Turner*

Business IPT

- Technical Advisor
  Vacant
- Systems Analyst
  R. Eldridge
- PCO
  G. Lazo
- Contract Spec
  Capt J. McGee
- Contract Spec
  A. Armenta
- Finance
  Bill Pazeretsky
- Finance
  R. Mejia
- CM/DM
  R. Morales
- Risk Mgt
  Lt Cicero
- Risk Mgt Asst
  A Link (USMC)

Type II

Major (S) Mark Blumke
JSAM Fixed Wing

- Deputy PM: L. Gomez

Lead Engineer
L. Ninh (Acting)

- Sys Engr
  J. Rogers
- Sys Engr
  R. Coughlan (Navy)
  M. Jaffee (Navy)
- Engr Supt
  Capt Nelson
- Engr Supt
  R. Lampson (Army)
- Engr Supt
  T. Ma (Navy)
- Integration
  T. Magnall*
- Anthropometry
  C. Harrison
- Human Sys Integ
  H. Howell

Test Mgr
Capt Dusza (TBD)

- DT&E Lead
  H. Hansen (Navy)
- RTO Supt
  R. Mueller (Navy)
  H. Hanson (Navy)
  T. Jones (Navy)
- RTO Supt
  Art Forral
- OT&E Lead
  Lt Fogg

Logistics
Lt Ramos

- Log Supt
  M. Villarreal*
- Log Supt
  J. Irizarry (Army)
- Log Supt
  W. Odum (Navy)
- Log Supt
  R. Cox*
- Training
  R. Turner*

Black = Gov't/USAF Blue = Other Service Green = Contractor Red = Vacant

PM: Capt Hanks
HSG/TBI, DSN 240-6364

What is JSAM?

Dominant Air Power: Design For Tomorrow…Deliver Today

- **The Joint Service Aircrew Mask (JSAM) is a lightweight , aircrew respirator that provides head, eye, and respiratory protection in both fixed and rotary wing aircraft.**

- **JSAM will be compatible with below the neck CB ensembles, it will provide flame and thermal protection, and will reduce heat stress imposed by existing CB protection masks.**

- **For Type II, JSAM will incorporate both CB protection and Anti-G (9+G)**

Key Features

- **Detachable faceplate**
- **Man-mounted system**
- **Improved CB filter**
- **No neck dam**
- **Compact lightweight blower**
- **Replaceable lens**
- **Commonality with JSAM designs for application in other platforms**

Advantages

- **Improved Comfort - Detachable faceplate means that full protection need only be worn when faced with a hazard and NOT the threat of a hazard**
- **Improved CB protection**
- **Improved FOV**
- **Compact man-mounted supply system – no aircraft/LSE modifications**
- **Can be worn un-helmeted**
- **Commonality in design approach, materials and manufacture processes with JSAM for other platforms**

JSAM Types

- **Type-IA IHADSS**

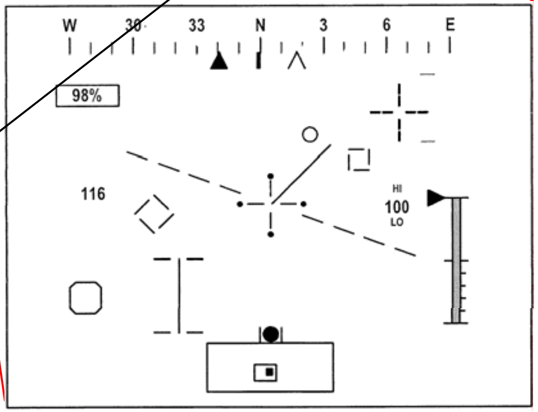
Type I

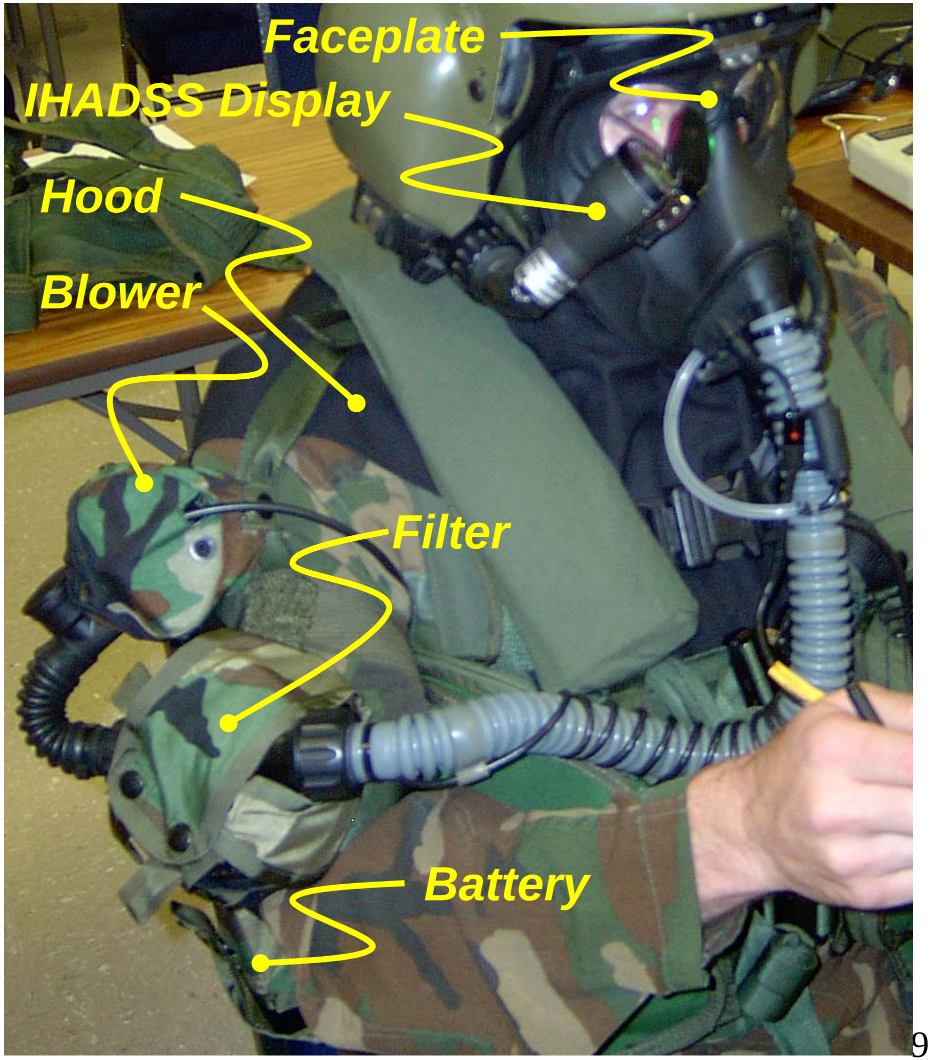
Type II

Currently in Source Selection

JSAM Type IA – IHADSS Apache

Dominant Air Power: Design For Tomorrow…Deliver Today





JSAM Type I – Rotary Wing

Aircraft Types

U.S. AIR FORCE

Dominant Air Power: Design For Tomorrow…Deliver Today

TYPE I

Helicopters

AH-1W*, UH-1N
UH-1N, HH-1N
AH/MH-6
CH-46E, MH-47D/E
CH-47D*/E/F*
CH-53D/E*, MH-53E
MH-53*J/M
OH-58D*
MH-60K/L
HH-60G, HH-60L/M
HH-60H
SH-60B/F
MH-60R*/S*
UH-60A/L*/M/Q
AH-64A/D* IHADSS
LRA, LUH

AH-1Z*, UH-1Y, H-53X, MV-22*

TYPE II

Agile (fast movers)

A/OA-10
AV-8B*
EA-6B*
F-15A/B/C/D/E*
F-16A/B/C*/D*
F-16CG/CJ
F/A-18A/B/C/D/E/F*
EA-18G JHMCS
F/A-22
F-117A

Top Owl

TYPE II

Others

B-1B, B-2A, B-52H, C-2A,
E-2C, EP-3E, P-3C, E-3B/C
E-4B, C-5B/C, E-6B, E-8C
E-10A/B/C, C-9A, C-9, KC-10A
C-12, C-12, RC-12, C-17A*
C-20, C-20, C-21, CV-22
C-23A/B/C C-26B, C-26B,
C-26B, C-32A, C/UC-35
C-37, C-40, C-130E/H/J/J-30
C-130T, AC-130*H/U
EC-130E/H/J, HC-130N/P
KC-130J/R/T, LC-130H
MC-130*E/H/P, WC-130E/H/J
KC-135E/R, OC-135B
RC-135S/U/V/W, KC-XXX

USAF USA USN/ USMC JOINT

* Indicates DT/OT test platform

JSAM Aircraft Priority List

Dominant Air Power: Design For Tomorrow…Deliver Today

Priority 1

USA
- AH-64A/D
- CH-47D/E/F
- MH-47D/E
- UH-60A/L/M/Q
- MH-60K/L
- HH-60L/M

USN
- MH-53E
- MH-60R/S
- SH-60 B/F
- HH-60H

USAF
- MH-53J/M
- CV-22
- UH-1N
- HH-60G

USMC
- CH-53D/E
- CH-46E
- MV-22B
- UH-1N/Y
- AH-1W/Z

Priority 2

USA
- OH-58D
- AH/MH-6,LRA,LUH

USAF
- MC-130E/H/P
- F-22A

USMC
- AV-8B

Priority 3

USN
- C-130T

USAF
- AC-130H/U
- C-130E/H/J/J-30
- EC-130E/H/J
- LC-130H
- HC-130N/P
- WC-130E/H/J
- F-35A

USMC
- KC130/R/J/T
- F-35

Priority 4

USN
- F/A-18A/B/C/D/E/F

USAF
- F16A/B/C/D/CG/CJ
- O/A-10/A

USMC
- F/A-18A/B/C/D

Priority 5

USAF
- C-17A
- F15A/B/C/D/E

Priority 6

USN
- EA-6B
- EA-18G
- P-3C
- EP-3E

USMC
- EA-6B

Priority 7

USAF
- F-117
- B-52H
- B-2A
- B-1B

Priority 8

USAF
- KC-135E/R
- OC-135B
- RC-135S/U/V/W
- E-10A/B/C
- C-5B/C
- E-8C
- E-3B/C
- KC-10A
- KC 767

Priority 9

USA
- C-20/D/G
- C-23A/B/C
- C26B
- RC-12D2-U
- RC-12D-Q
- UC-35A/B

USN/USMC
- C-2A
- C-9
- C-12
- C-20
- C35

USAF
- C-9A
- E4-B
- C-12C/D/F/J
- C21A
- C26B
- C32A
- C37
- C40

Priority 10

USN
- HH-1N
- E-2C
- E-6B

USAF
- Aeromedical

USMC
- HH-1N

Key Performance Parameters
Type I, IA, and II

Dominant Air Power: Design For Tomorrow…Deliver Today

	Challenge (O) Protection (O)	Challenge (T) Protection (T)	Duration O=24hrs T=16hrs
Chem Vapor Protection (HD Mustard)	20,000Ct	5,000Ct	24/16
(GB, nerve)	50,000Ct Miosis<1Ct	20,000Ct Miosis<1Ct	24/16
Chem Liquid Protection (HD Mustard)	10g/m2	10g/m2	24/16
Quantitative Fit Factor (QFF Blown mode)-Chem	120,000	20,000	Verification via Corn Oil, tested Blown&Unblown
(QFF Blown mode)-Bio	120,000	50,000	

(9G sustained for 15 seconds with 6G per second onset for Type II)

Technical Performance Results to Date

Dominant Air Power: Design For Tomorrow…Deliver Today

Initial SMARTMAN configurations only produced 11-13 hours of HD and GB protection…

Current SMARTMAN New blend of materials now exceed 24 hour KPP objective requirement for both HD and GB permeation

AND

at the 10g/m2 challenge level!

Technical Performance Results to Date

- **Quantitative Fit Factor**
  - **Blown protection factor (PF) KPP results exceeded expectations**
    - **100% passed threshold requirement of 50K**
    - **88.8% met objective requirement of 100K**
  - **Unblown PF results also exceeded expectations**
    - **93.8% passed threshold requirement of 6,667**
    - **93.8% passed objective requirement of 10K**
    - **89.6% exceeded 50K**

Technical Performance Results to Date

- **Breathing Resistance- pass**
  - **Meet dynamic breathing requirement based Air Standardization Coordinating Committee (ASCC) Air Standard 61/112/2B, both blown and unblown**
- **Crash Survivability- pass**
  - **Crash deceleration testing conducted at QinetiQ shows no adverse impact of JSAM**
- **Ability to Valsalva- pass**
  - **Effective one-handed capability demonstrated in altitude chamber**
  - **Demonstrated no adverse impact to CB seal**

Technical Performance Results to Date

- **Accommodation-**
  - **Demonstrated accommodation of 98% male aircrew population with current sizes**
  - **Accommodated all tested females with current sizes**
- **Comfort-**
  - **Preliminary results indicate that there were no undue “hotspots” or other severe discomfort as compared to M48**
- **Thermal burden-**
  - **Preliminary results indicate that thermal burden may be higher than M48 due to less blower flow required to meet CB filter restrictions**

Success Stories

Dominant Air Power: Design For Tomorrow…Deliver Today

G	QFF	G	SMARTMAN GB (VAPOR)
G	BREATHING	G	CRASH/DECEL
G	THERMAL	G	SMARTMAN HD* (LIQUID PERMEATION)
G	FILTER QUALIFICATION		

Y	LENS DISTORTION • Evaluating Critical Viewing Area

PM: Capt Hanks
HSG/TBI, DSN 240-6364

Current Program Status

Dominant Air Power: Design For Tomorrow…Deliver Today

- Type IA and Type I completed CDR
- Type IA Design Validation Testing (DVT) completed - results favorable
- Type I DVT currently in progress
- Planning for DTRR in May 06 (Type I and IA)
- Expect DT start in June/July time period (I and IA)
- Type II Source Selection in progress
- Expect fielding for Type I and Type IA to occur 2Q/3Q FY08

Q & A

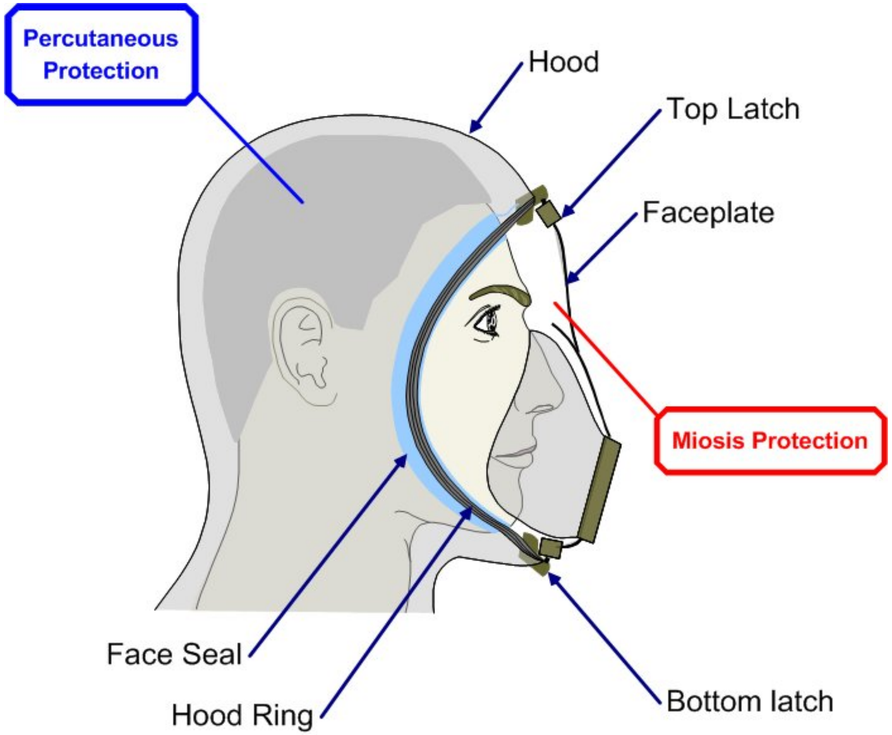
Backups

Key Features

- **Detachable faceplate**
- **Man-mounted system**
- **Improved CB filter**
- **No neck dam**
- **Compact lightweight blower**
- **Replaceable lens**
- **Commonality with JSAM designs for application in other platforms**

Cornerstones of Design
CB Protection & Physiological Burden

- Minimize burden by minimizing time that full protection has to be worn
- Achieved by a detachable faceplate
- Separation of eyes and respiratory tract from skin of head & neck removes the need for a neck dam



Cornerstones of Design
No aircraft or ALSE modifications

- **All JSAM system components, including CB filter and blower, are man-mounted eliminating need for aircraft and ALSE modifications**
- **'Hands Free' assists user in performance of duties**

JSAM Types

- Type-IA IHADSS
  - Non-oxygen
  - AH-64A/D only
- Type I
  - Non-oxygen (HOS capable)
  - Rotary Wing (exc. Apache)

Advantages



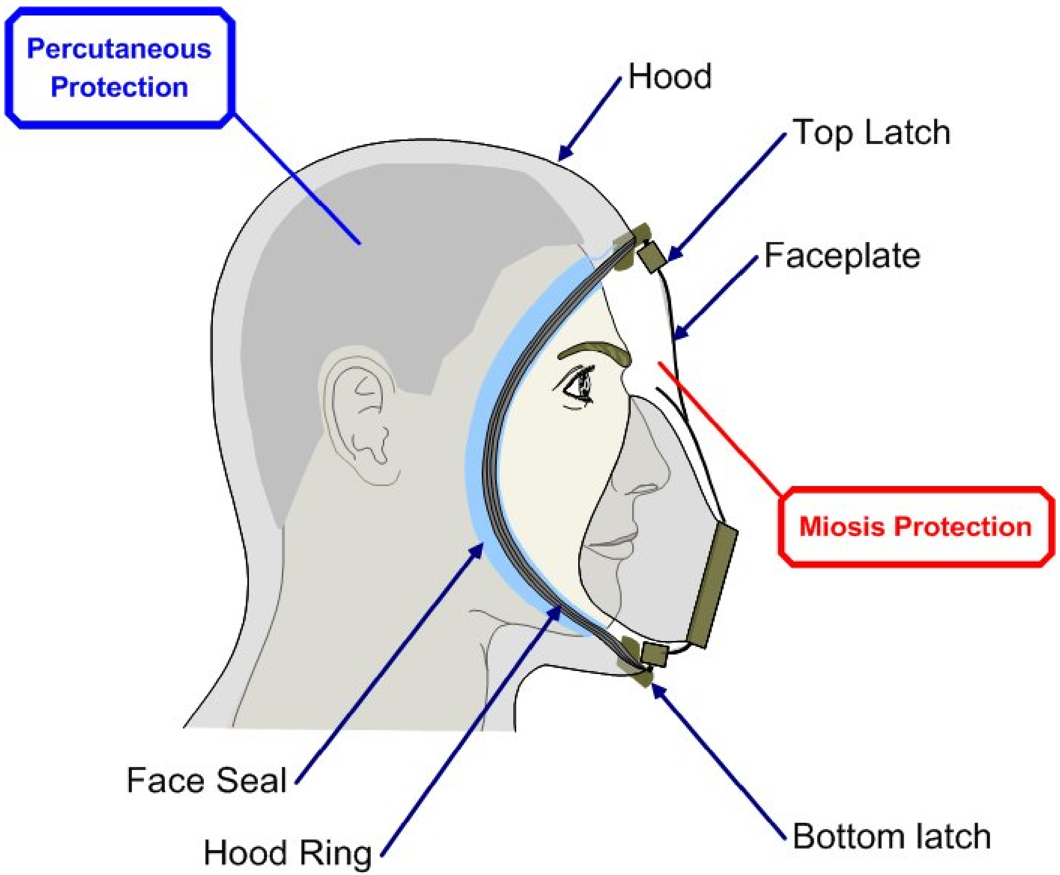
- **Improved Comfort - Detachable faceplate means that full protection need only be worn when faced with a hazard and NOT the threat of a hazard**
- **Improved CB protection**
- **Improved FOV**
- **Compact man-mounted supply system – no aircraft/LSE modifications**
- **Can be worn unhelmeted**
- **Commonality in design approach, materials and manufacture processes with JSAM for other platforms**


JSAM Design Cornerstones

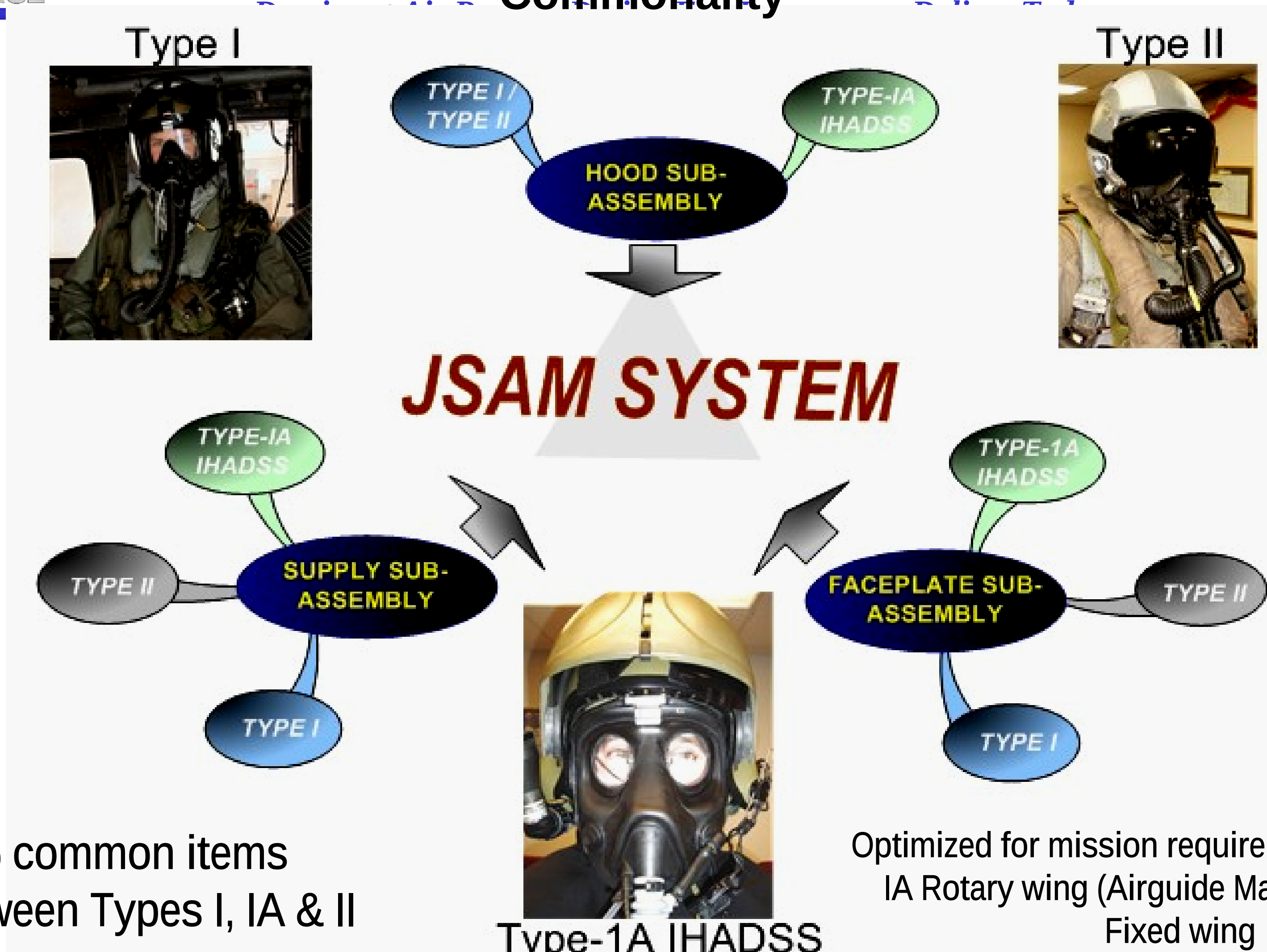
CB Protection & Reduced Physiological Burden

Dominant Air Power: Design For Tomorrow…Deliver Today

- **Improved CB protection over legacy systems (miosis levels)**
- **Minimize wear burden by minimizing time that full protection has to be worn**
- **Achieved by a detachable faceplate**
- **Sealed around facial cavity versus neck dam**



Commonality



70% common items between Types I, IA & II

Optimized for mission requirements of Type I & IA Rotary wing (Airguide Mask) and Type II Fixed wing (Oronasal Mask)

JSAM Test Program Review
Flight Test

Dominant Air Power: Design For Tomorrow…Deliver Today

- **Army**
  - AH-64D
  - UH-60L
  - CH-47F
  - OH-58D
- **Navy/Marine**
  - AH-1W/Z
  - CH-53E
  - MH-60R
  - T/AV-8B
  - MV-22
  - F-18F
  - EA-6B
- **Air Force**
  - MH-53
  - C-17
  - AC-130
  - MC-130
  - F-16C/D
  - F-15E

Fixed Wing

PM: Capt Hanks
HSG/TBI, DSN 240-6364

Chemical Biological Individual Protection Conference
Charleston, South Carolina, 7-9 March 2006

Filtration Technology

Christopher J. Karwacki
Gregory Peterson
Amy Maxwell

Edgewood Chemical Biological Center
Research & Technology Directorate
Chemical Biological Filtration Team

Past-Present-Future

1940s	1950-60	1980	2000-10
M11 Filter	**M13 Filter**	**C2 Filter**	**JSGPM Filter**
H-Capacity	Sorbent/HEPA	M-Capacity	Primary CWA
H-dP	L-M Capacity	M dP	Secondary TIC
H Weight	M dP	M Weight	Packed Bed
H Profile	L weight	M Profile	L-M Capacity
	L Profile		L-M dP
			L-M Profile

2010	2020 +
NGGPM Filter	**NGGPM Filter**
Composite Beds	**Non Sorbent**
Interchangeable Media	**SCBA**
Broad Spectrum Prot	
L-Capacity	
L Profile	
Larger Area	

Direction and Challenges

- Rapid Advancement In Sorbent Technology
- New Requirements
  - Increasing Number And Classes Of Chemicals
- Technical Challenges
  - Broad Spectrum Protection
  - Small Integrated Envelope
  - Lightweight And Acceptable Pressure Drop

Direction and Challenges

- Current Filters Continue To Be Oriented To Granular Packed Bed.

- Community Moving Towards Broader Spectrum Protection With Lower Capacity Requirements.

- There Are Improved Filter Technology Solutions In The Form Of **Supported Sorbent Structures** And Particulate Media That Will Offer Lower Profile Filters With Broad Spectrum Protection Capabilities.

Filtration Principles

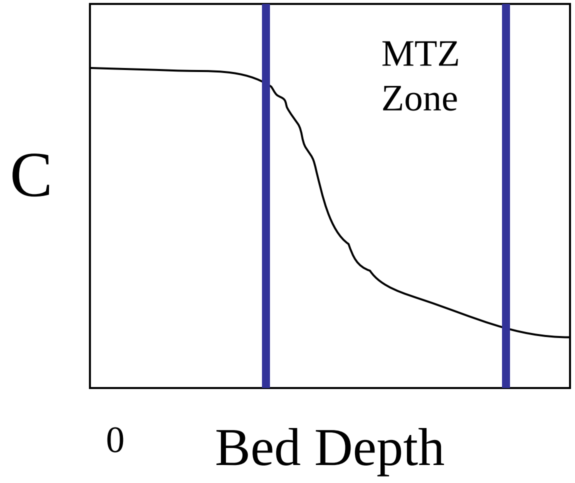
HEPA

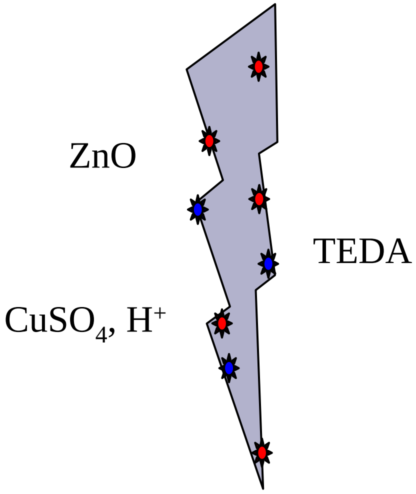
(Particulate)

ADSORBER

(Vapor)

C2 CANISTER

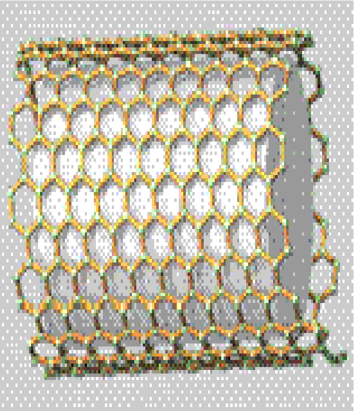




Adsorbent Requirements

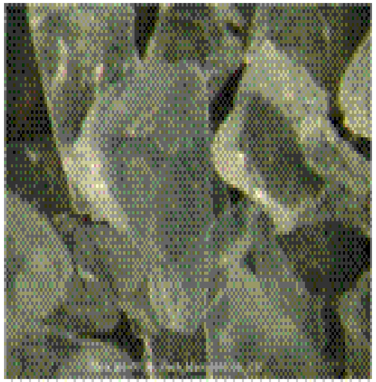
- ✓**Microporosity for physical adsorption**
- ✓**Pore distribution that can support reactants**
- ✓**Basic sites for removal of acid gases**
- ✓**Acid sites for removal of base-forming and basic gases**
- ✓**Access to reactive sites when adsorbed water is present**

Adsorbents

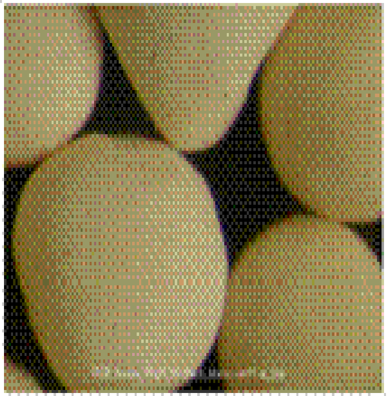


Carbon Nanotubes

Activated Carbon



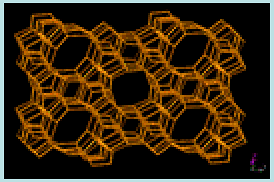
Silica



Zeolites

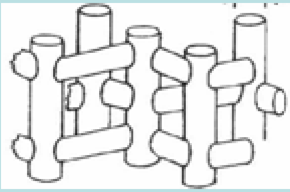
Sorbent Development

BF-38



- **ZSM-5**
  - MFI-type zeolite
  - Acidified
- **Removes basic/base-forming TICs**
  - Ammonia
  - Ethylene oxide

KRM-623



- **ZSM-5**
  - MFI-type zeolite
  - Alkaline
- **Removes fuming nitric acid, nitrogen dioxide**

ARC

- **Ammonia Removal Carbon**
- **Bituminous coal based activated carbon**
- **Impregnated w/ copper chloride**

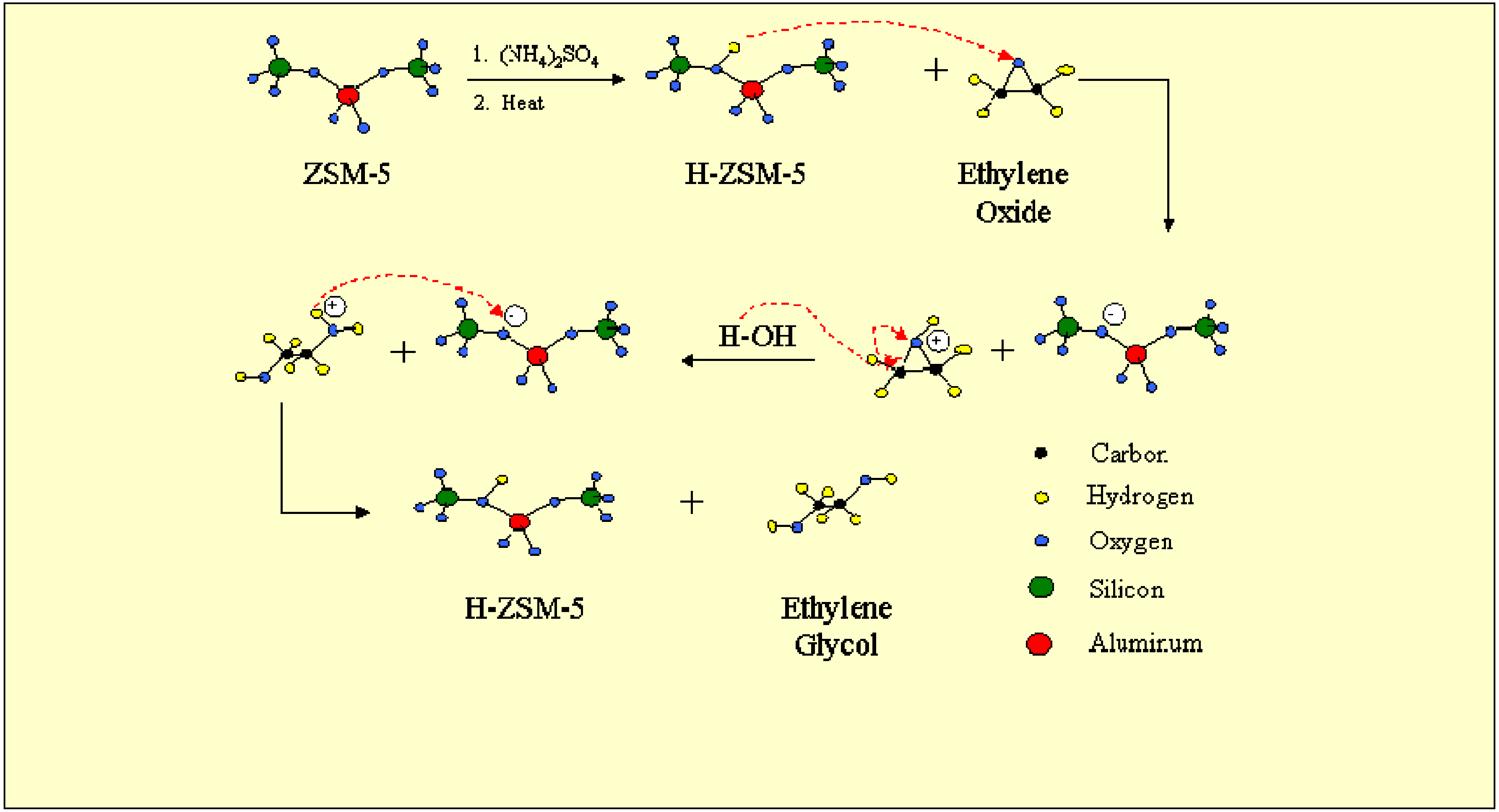
90/10 Blend

- **Blended activated carbon**
  - 90% ASZM-TEDA
  - 10% acid chloride impregnated carbon
- **Removes traditional CWAs + ammonia**

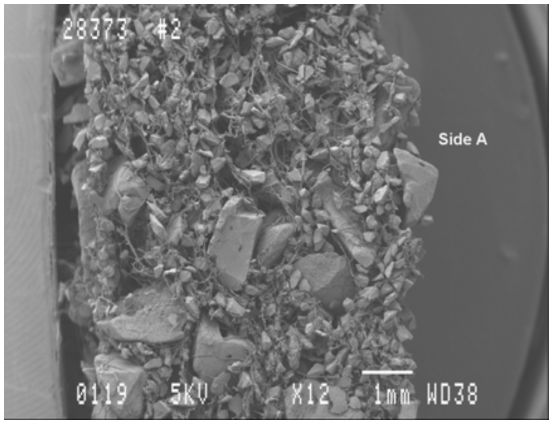
Sorbent Development

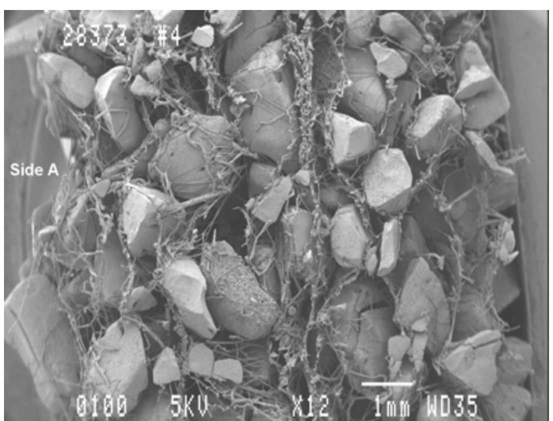
SORBENT DEVELOPMENT

EO Removal Mechanism by BF-38

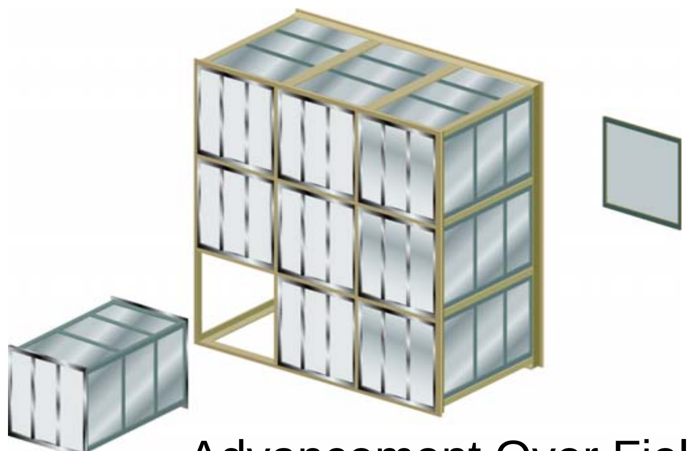


Advanced Adsorbent Supports





<u>Description:</u>
Flexible extruded web of elastomeric fibers loaded above traditional levels with broad range of treated carbon particles and with wide latitude in basis weight capability



<u>Advancement Over Fielded Systems:</u>

- Lower pressure drop, power
- Lighter weight, less maintenance
- Broader spectrum of protection CWAs + TIC/TIMs

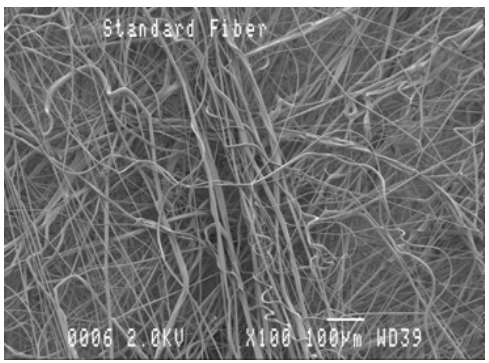
Source: 3M

Advanced Particulate Filtration

Electret Filter Media

Description:

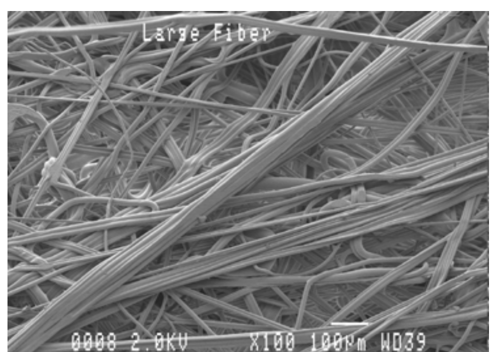
Multiple pleated layers of fiberglass, membranes, or electret webs combine to provide thermally stable non-clogging filters that are resistant to: wetting, oily mist, and Chem/Bio agents.



Large Fiber

(20+ micron)

Standard fiber (7-10 micron)

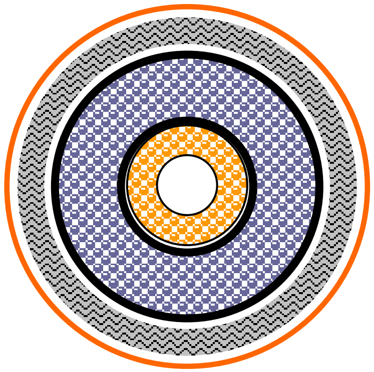


Fine Fiber (3-5 micron)

Source:3M

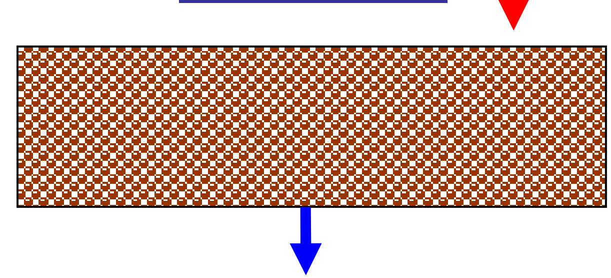
Filter Bed Design

Radial Bed

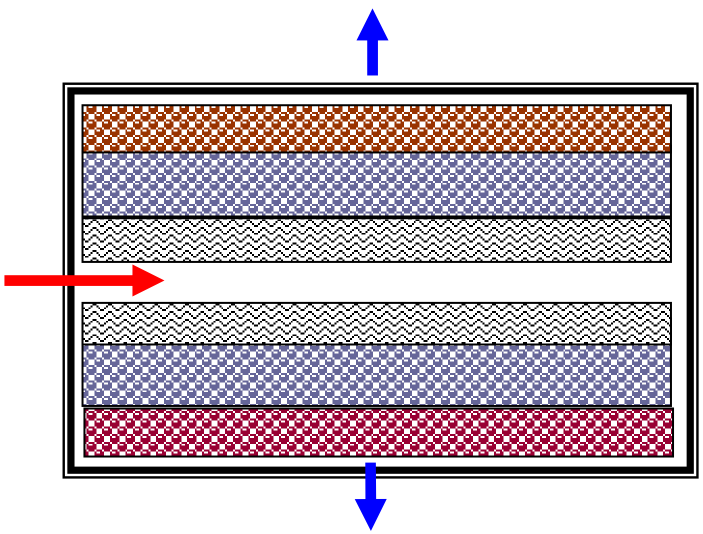


Radial Flow Filter - Inlet flow is directed to outer radial layer first and exits inner core, thus providing significant increase in chemical performance and reduction in airflow resistance

Axial Bed



Split Axial Bed



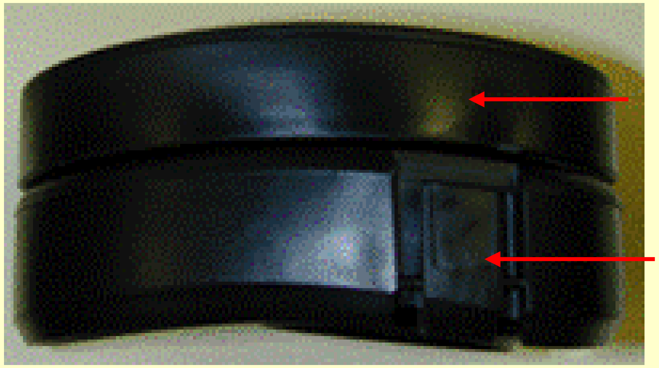
Split Flow Adsorber – Inlet flow is directed to center of two bifurcated cells, each containing particulate, CWA and TIC media

JSGPM

Joint Service General Purpose Mask (JSGPM)

Primary + Secondary Filter

Filter Configuration



Secondary - TIC

Primary -CWA

Objective

- Provide protection against field concentrations of all military agents
- Provide protection against Toxic Industrial Chemicals identified in ITF-25
  - Threshold = Group 1 chemicals
  - Objective = Group 1 + Group 2 chemicals

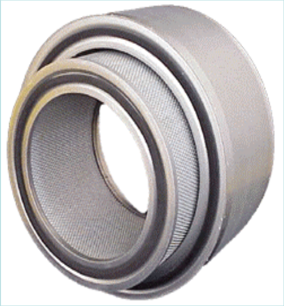
Target TIC's

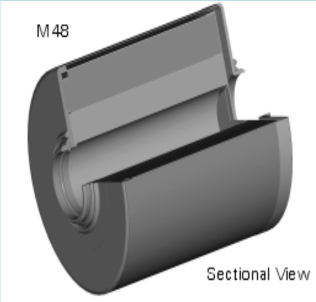
- Ammonia
- Ethylene Oxide
- Nitrogen Dioxide
- Carbon Disulfide
- Formaldehyde

Joint Collective Protection Equipment (JCPE)

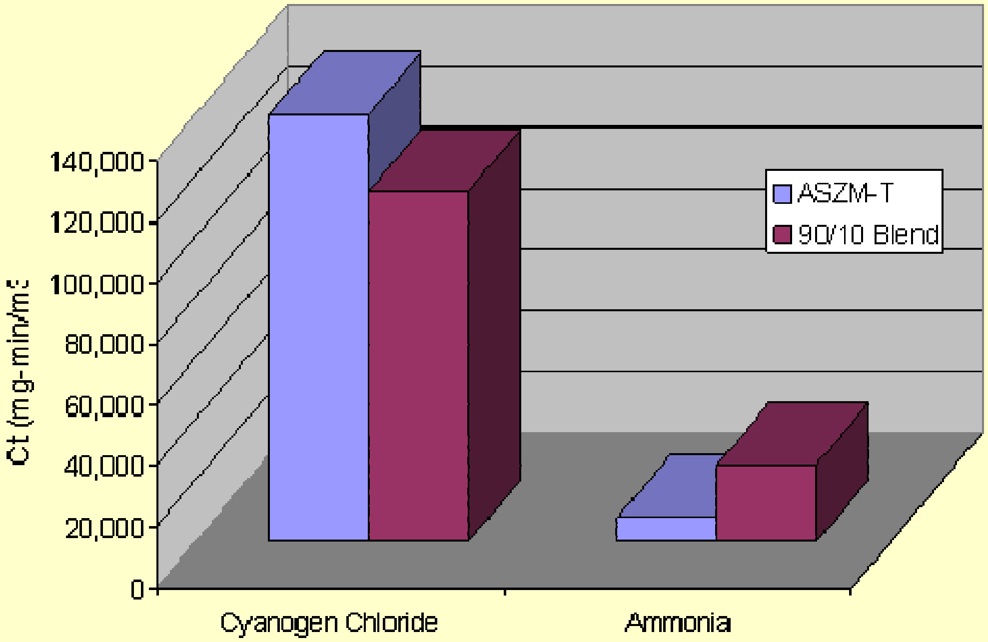
Objective

- Improve performance of current CP filters against target TICs with limited detriment to capacity for CWAs





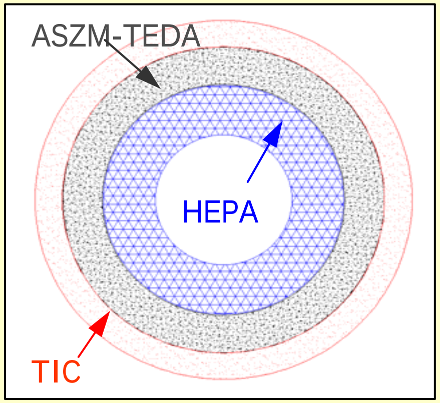
90/10 Blend vs. ASZM-TEDA
M98 Conditions



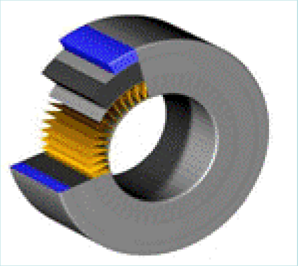
DARPA/NWA

DARPA/NWA CBR/TIC Filter

M98 Radial Flow CBR Filter



Radial Flow CBR/TIC Filter



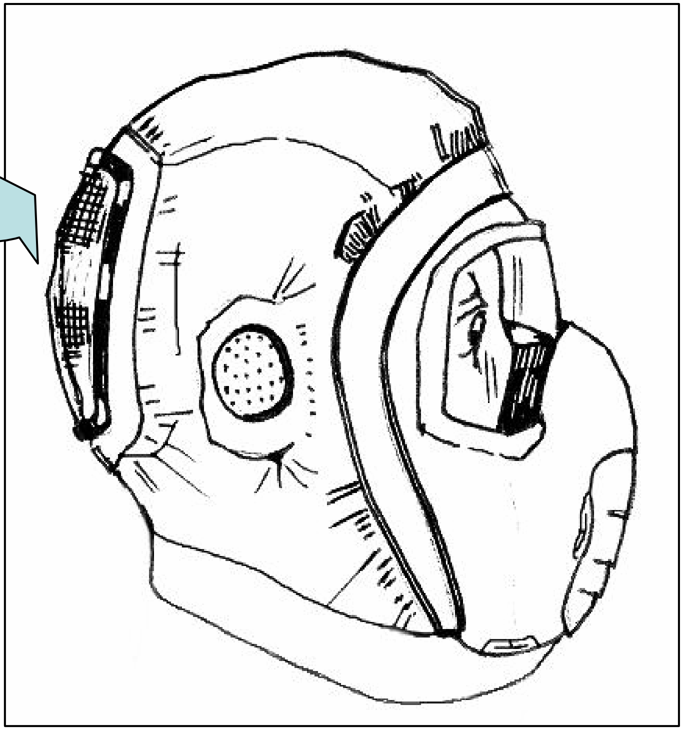
Objectives

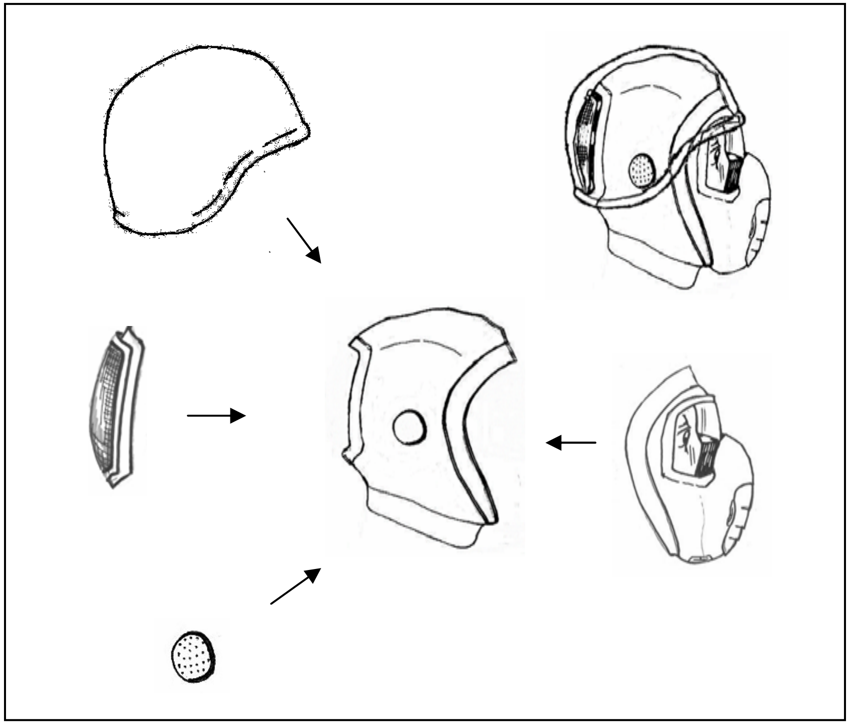
- **Provide ammonia, ethylene oxide and other TIC protection in addition to traditional CWA protection.**
- **Retrofit TIC protection into M98 filter housing.**

Source: NWA

Concepts for Next Generation General Purpose Mask

Filter





Sorbent Bed Type

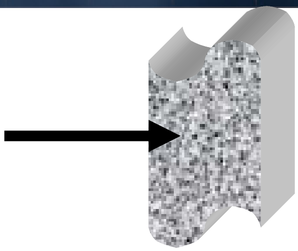
Packed Bed

- Maximum Sorption Activity per unit bulk volume
- Ideal for Higher Capacity Applications (>>50K CT)
- Constrained to Narrow Spectrum Chemical Protection
- Lower Unit Cost

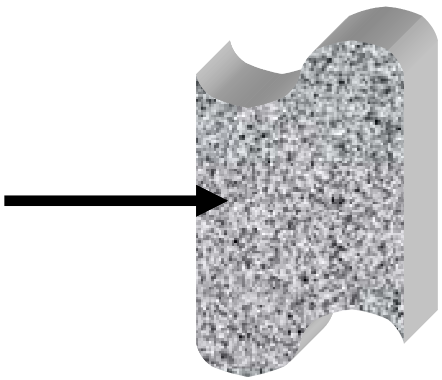
Supported Bed

- Sorbent on Fiber Composite
- Ideal for Lower Capacity Applications (<50K CT)
- Suitable for Broad Spectrum Chemical Protection
- Suitable for Large Bed Area and Shallow Bed Configurations
- Higher Unit Cost

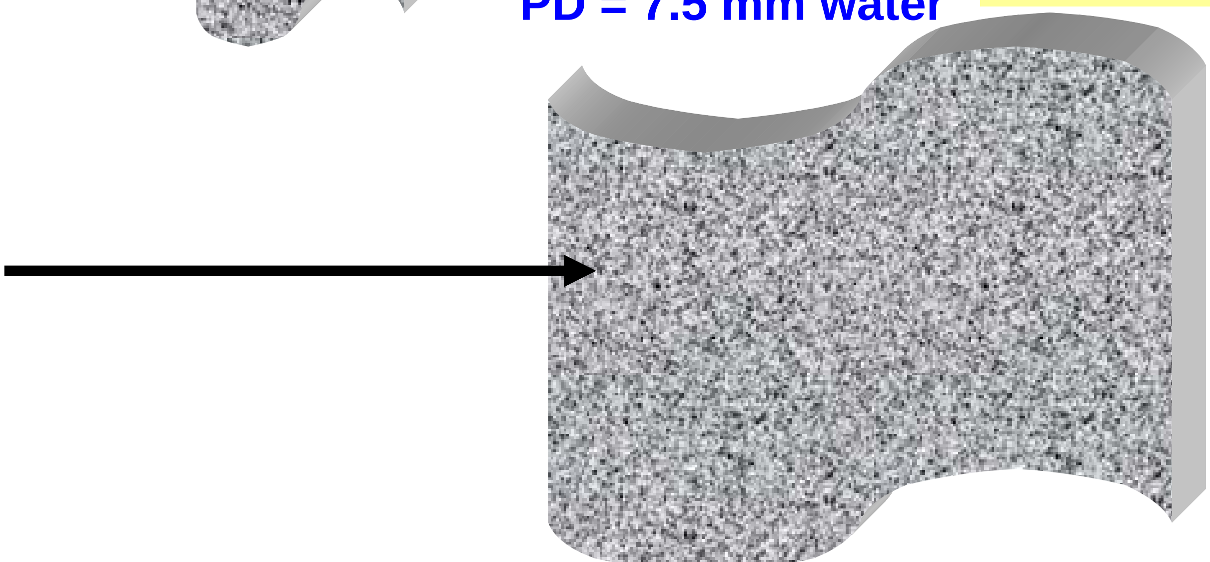
Effect of Filter Cross-Sectional Area on Performance



FR = 50 LPM
AFV = 9.6 cm/s
BA = 86 cm^2
PD = 15 mm water



FR = 50 LPM
AFV = 4.8 cm/s
BA = 172 cm^2
PD = 7.5 mm water



FR = 50 LPM
AFV = 2.4 cm/s
BA = 344 cm^2
PD = 3.8 mm water

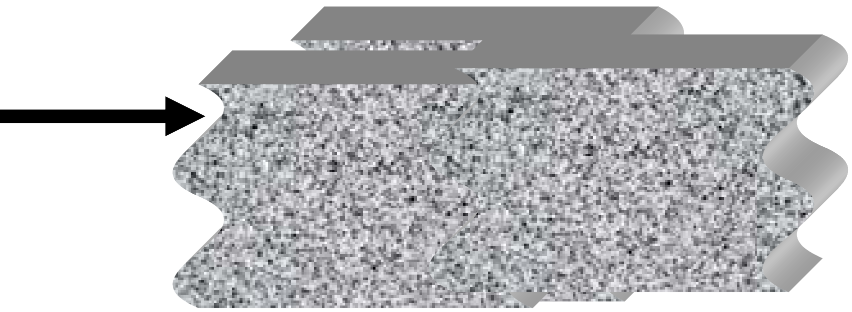
Increasing Filter Area

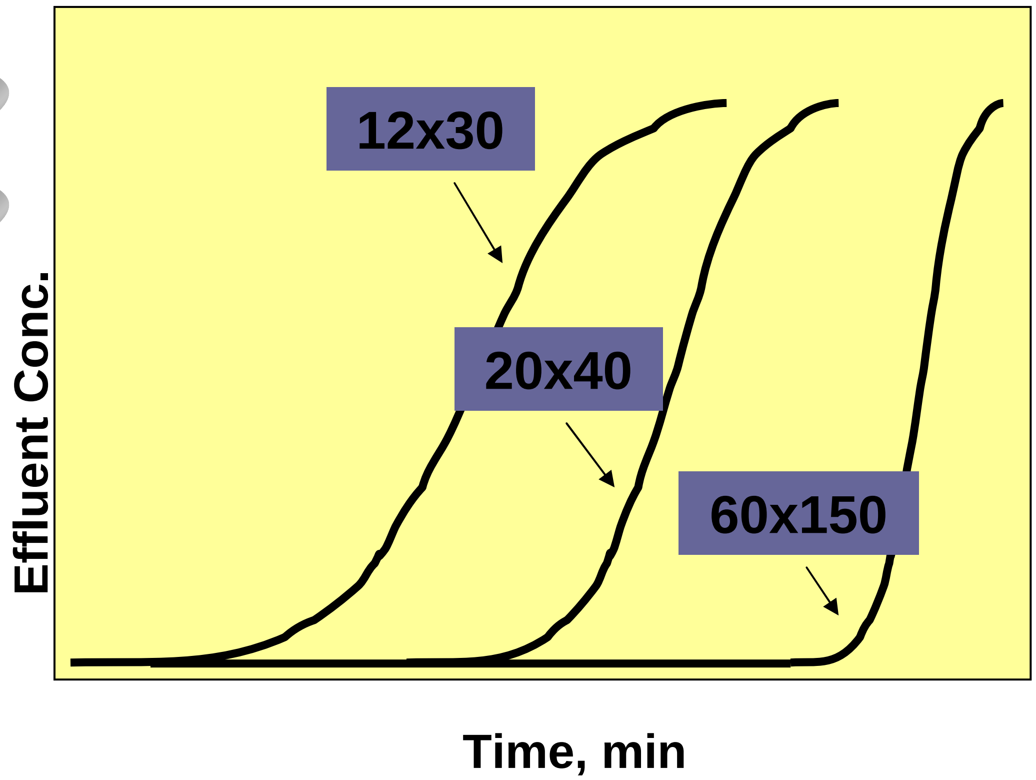
- Reduced AFV
- Reduced PD
- Reduced Particle Size
  - Thinner Beds
  - Increased Chemical Performance

Effect of Particle Size on Mass Transfer Zone

Effect of Particle Size on MTZ

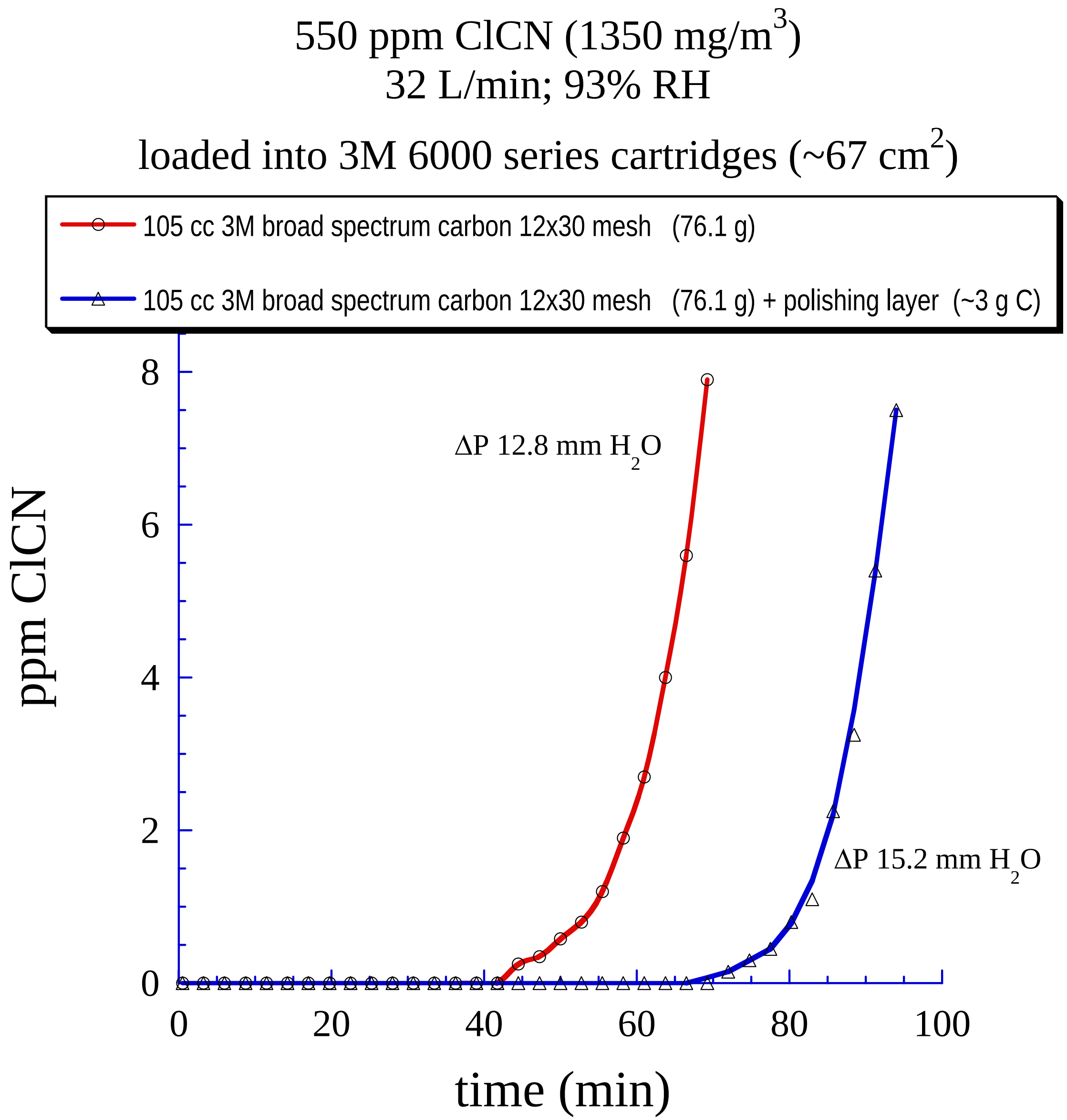
Pleated Axial Flow Bed





100 LPM
External Area: 86 cm2
AFV: <3 cm/s
Pleat Area: 600-900 cm2

Flex-c Web as CK Polishing Layer



Source: 3M

Summary

- For low capacity, broad spectrum protection (TIC/TIMs + CWAs) filter bed designs other than traditional packed bed sorbents may be necessary and advantageous to meet near-term and future requirements.

- **Supported Sorbents** offer a wide range of capabilities:
  - Composite thin beds – with multiple sorbents
  - Suitable for non-conformal and pleated configurations
  - Smaller particle size sorbents
  - Lower airflow velocity and pressure drop
  - Flat sheet particulate media
  - Interchangeable beds and components

Summary

- Need for MATURING supported sorbent technologies
  - Supports
  - Gradual Increase in Sorbent Capability
  - Bed Design Concepts
  - Modeling
  - Compositions/Interchangeability
  - Manufacturability - QA/QC

- Need funding opportunities to MATURE technology in order to equip the Warfighter in the near-term

Acknowledgements

- Corey Grove - ECBC
- Greg Peterson - ECBC
- Amy Maxwell -ECBC
- William Fritch – ECBC, JPM-IP
- Britt Billingsly - 3M Corporation
- Joseph Rossin – Guild Associates
- Tom Van Doren – New World Associates

Aerosol Interaction with Individual Protective Equipment (IPE)

Dr. Jonathan Kaufman
Naval Air Systems Command
Patuxent River, MD
USA

Making the World Safer

Outline

- Problem
- Background
  - Aerosols
  - Driving force: air movement
- Test technology design
- Investigations
  - Literature review
  - Operationally-focused elevated wind study
  - S&T elevated wind study
- Summary

Problem

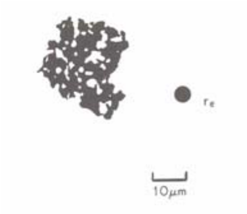
- IPE protective mechanisms that are effective against vapor or liquid agents may be ineffective against aerosols
- Protection against aerosols pose a complex set of issues

Relevance

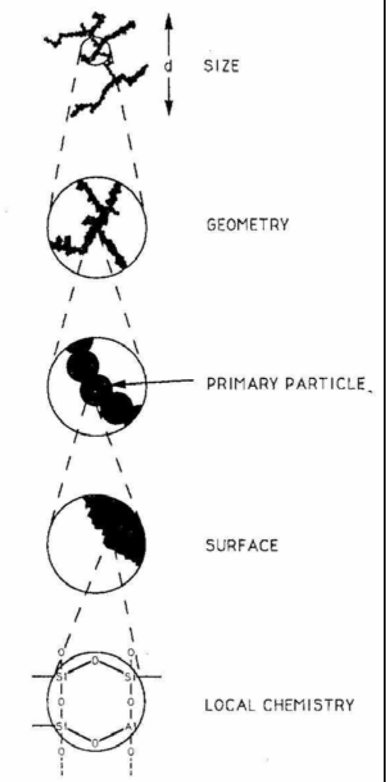
- **Impact operational planning**: review of existing Tactics, Techniques, and Procedures (TTP)
- **Provide basis for developing validated test technology:** evaluate advanced IPE incorporating protection in high winds (e.g., JPACE block 2)
- **Transition into testing:** e.g., JSLIST NTA tests
- **Provide otherwise unavailable data:** validate IPE model simulations (input into JPM-IP modeling & simulation efforts)

Background

- **<u>Aerosol</u>**: Assembly of liquid or solid particles suspended in gaseous medium long enough to be observed or measured (~0.001 – 100 μm)
- **<u>Agglomerate</u>**: Group of particles bound together by van der Waals forces or surface tension
- **<u>Particle size</u>**: diameter of spherical particle (*theoretical*) having same value of specific property as irregularly shaped particle (*actual*)
  - **Aerodynamic Diameter**: diameter of theoretical sphere (density = 1.0) having same gravitational settling rate as actual particle
  - **Size distribution**: spread of particle sizes in aerosol

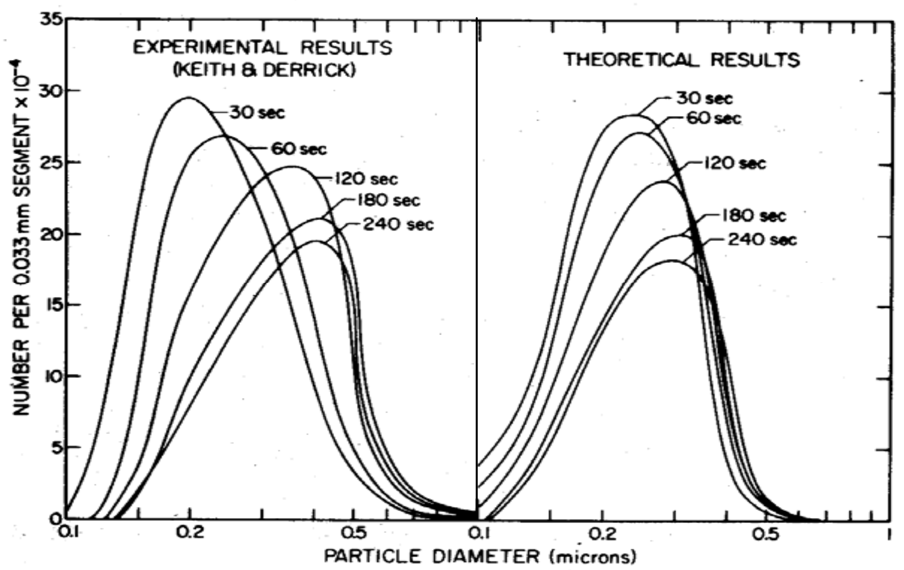


Relationship between actual particle morphology and equivalent aerodynamic diameter *Corn, (1968)*



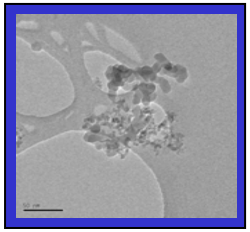
Aggregate structure at increasing resolution
Willeke & Baron (1993)

Change in mean particle size and number as a function of time



D_1 \ D_2	10 nm	100	1000	10,000
10 nm	67			
100	180	8.6		
1000	1700	24	3.5	
10,000	16000	220	10.3	3.0

Coagulation coefficient K x 10^{10} cm^3/s for colliding aerosol particles of diameters D_1 and D_2 (nm) *(Hinds, 1982)*



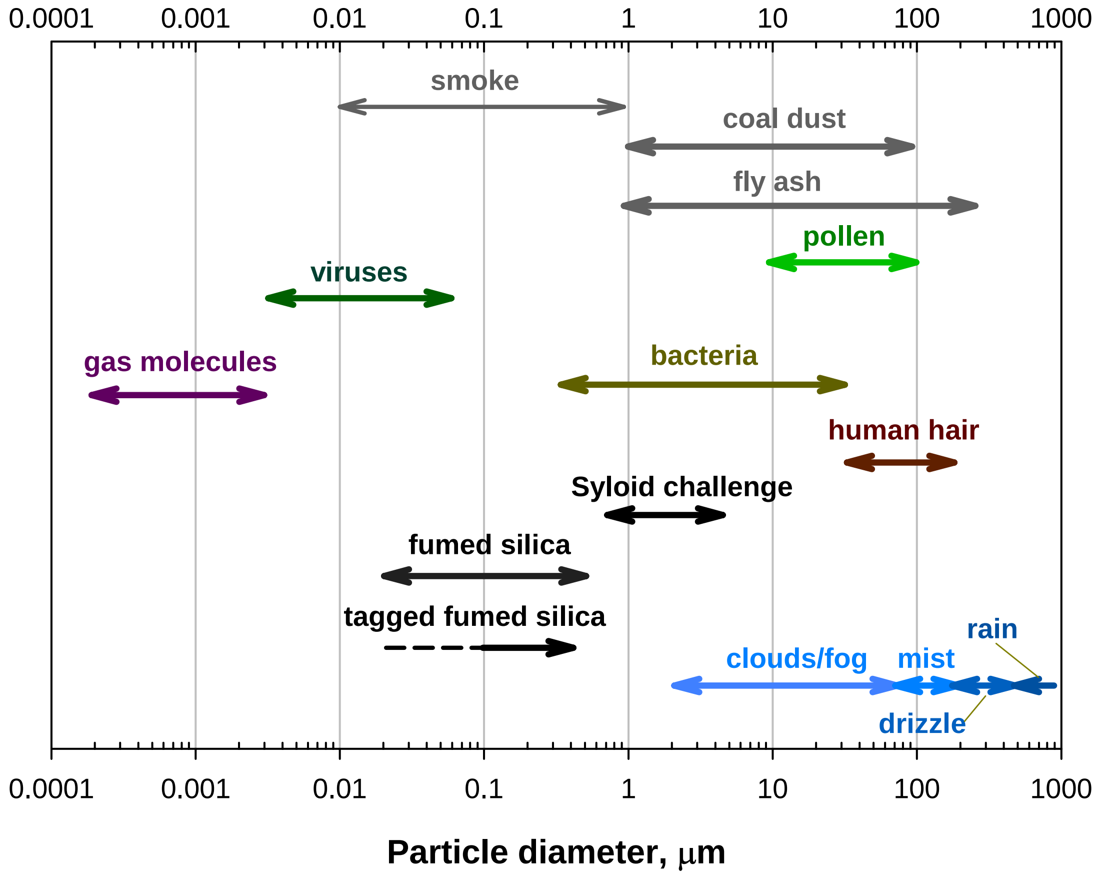
$$\frac{dN}{dt} = -KN^2$$

Smoluchowski (1917)

N = number
t = time
K = Coagulation coefficient

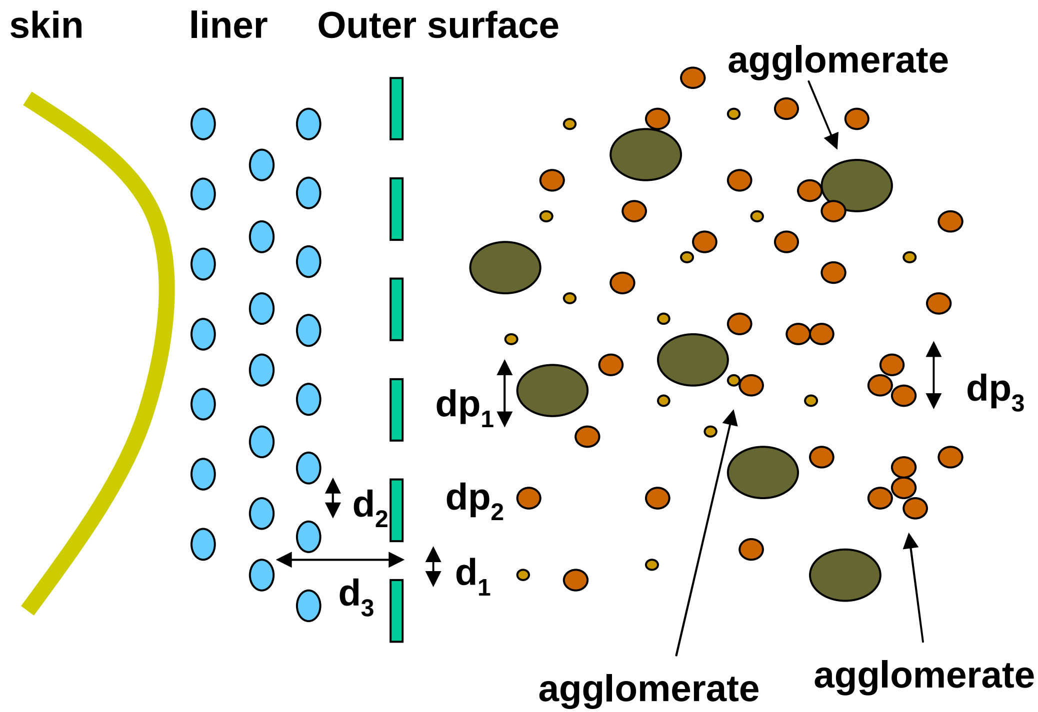
Background

Approximate sizes of representative natural and synthetic aerosols



NAVAIR

Aerosol Penetration Mechanisms

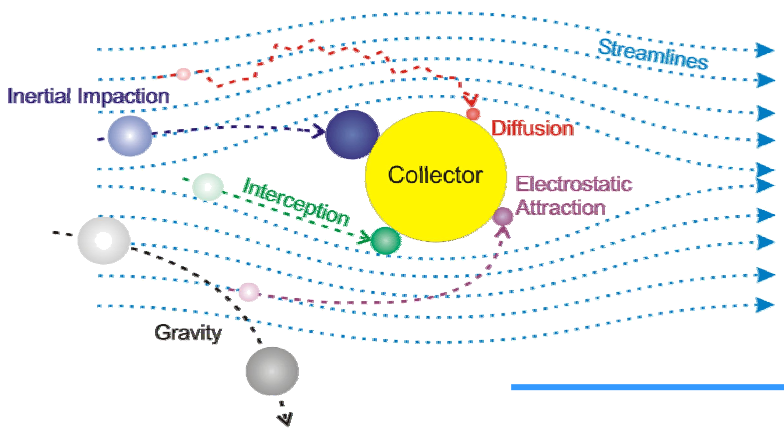


Driving forces:

- hydrostatic pressure gradient (e.g., wind)
- concentration gradient
- temperature gradient

Influencing factors

- particle inertia (m•v)
- dp_i/d_j
- fabric geometry
- diffusion coefficient
- solubility



Deposition mechanisms

Nature of wind

Natural wind
(meteorological)

Vehicle generated
(e.g., rotorwash)

Motion generated
(e.g., tank commander)

Goals

Characterize the effects of aerosols & wind on personnel CB exposure and ultimately physiological risks

- Define extent of operational risk
  - Threat (e.g., agents, concentration, wind speed, missions)
  - Mission impact, numbers affected
  - Likelihood of occurrence
- Establish extent of potential IPE limitations
  - Clothing
  - Masks
  - Filters
- Characterize operational conditions impacting IPE limitations
  - Body movements, physical tasks
  - Physiological demands (e.g., respiration, metabolism, sweating)
  - POL
  - Environmental conditions (e.g., dirt, dust, rain)

Independent variables

- **Standardized test method**
  - Laboratory (e.g., wind tunnels)
  - Field testing
- **Challenge**
  - Agent
    - neat vs. weaponized vs. simulant(s)
    - Vapor vs. liquid vs. aerosol
  - Dissemination (point vs. line source, ground)
  - Aerosols:
    - Liquids
    - Solids: particle size & distribution
- **Wind source** (e.g., rotor, wind tunnel, fan)
- **Penetration/Deposition**
  - Tagging challenge
  - Sampling
  - Quantitative analysis

Approach

- **Characterize conditions external to IPE**
  - Wind speed & characteristics (e.g., pressure, pulsitile vs. steady flow)
  - Challenge concentration at IPE surface
  - Challenge characteristics (e.g., aerosols, vapors)
- **Define impact of IPE characteristics**
  - Material properties (e.g., pore size)
  - Closures, interfaces
  - Inner layers
- **Characterize penetration pathways**
- **Quantify deposition on surfaces exposed to sweat** (skin, inner clothing layer)

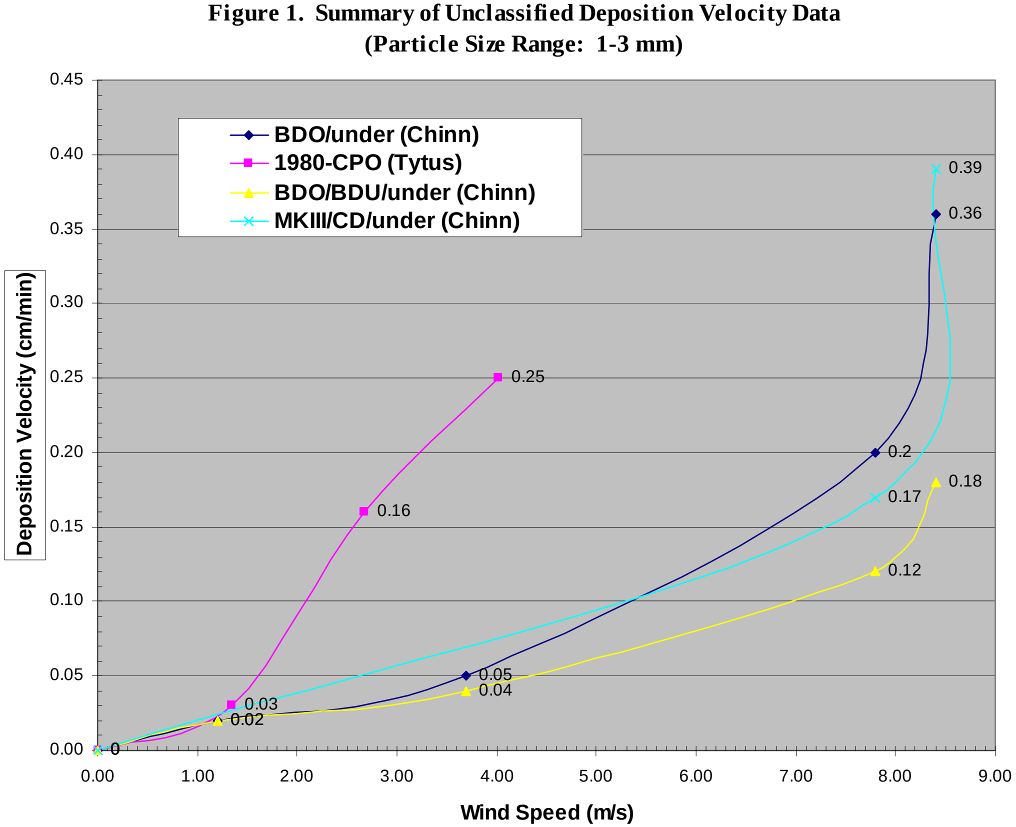
Literature Review

Aerosol Deposition

- < 10 µm mass mean diameter (MMD) can penetrate IPE
- Skin deposition increases as wind speed increases with particle MMD < 3.0 µm
- Skin deposition increases with ambient temp
- RH may not affect skin deposition
- Increasing body hair increases skin deposition

Reviewed available technical literature on wind-driven CB effects on IPE, including test methodologies and agent physiochemical properties: assess technical strengths and weaknesses of work (Documents referenced: 71)

Literature Review: Findings



Relationship between wind speed, IPE, and deposited aerosol mass (literature values)

Deposition Velocity (V_d)

$$V_d = \frac{m_{deposited} - m_{background}}{A_{sample} \bullet C_m \bullet T}$$

M = aerosol mass
A = surface area
C_m = mass concentration
T = exposure time

1980-CPO: Chemical IPE ca.1980s
BDO/ BDU/under: Battledress overgarment over battledress uniform & underwear
BDO/under: BDO & underwear
MKIII/CD/under: Navy chemical IPE over chambray shirt, denim trousers & underwear. *Chinn (2004)*

Study Goals

Block I

- Determine impact of wind speed on aerosol entrainment in IPE layers and skin deposition
- Determine wind speeds resulting in least and greatest aerosol penetration

Block II

- Determine if field-expedient system modifications can mitigate wind speed effects
- Determine the effect of exposure time & wind speed on aerosol penetration of IPE

DO-49 study: Test matrix

Block	Scenario	Configuration: Ensemble[a]	Configuration: System Modification	Exposure Time (min)	Wind Speed (mph)	Trials
Block I	1	IPE	None	10	0 to 2	3
	2	IPE	None	10	10	3
	3	IPE	None	10	20	3
	4	IPE	None	10	~40	3
Block II	5	IPE	None	3	P+[b]	3
	6	IPE	Taped[c]	10	P-[d]	3
	7	IPE	Taped	10	P+	3
	8	IPE	Untaped, Poncho	10	P+	3
	9	IPE	Untaped, Rain Gear (Wet Weather)	10	P+	3
	10	IPE	Taped Rain Gear (Wet Weather)	10	P+	3
	11	IPE + BDU	None	10	P+	3
	12	IPE	None	30	P+	3
	13	IPE	None	10 chamber 20 clean room[e]	P+	3

[a] BDU – battledress uniform
[b] Block I wind speed causing most aerosol penetration
[c] All configurations taped on outside garment
[d] Block I wind speed causing least aerosol penetration
[e] 10 min. in chamber at wind speed P+, 20 minutes in clean room

NAVAIR

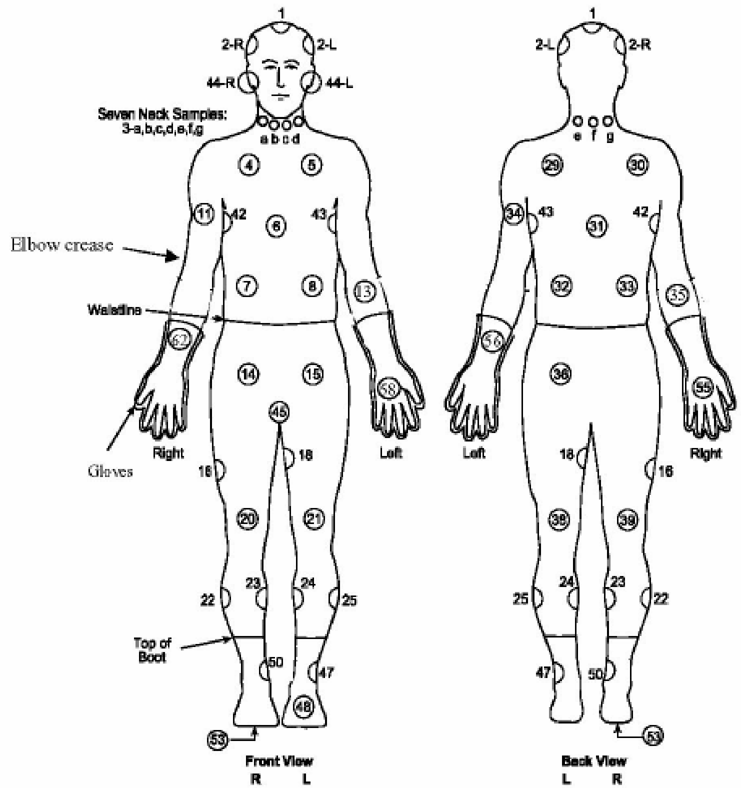
DO-49 study: Test conditions

	mean	SEM
Mass Median Diameter (mm)	2.72	0.08
Geometric Standard Deviation	2.52	0.09
Average mass concentration (mg/m^3)	188.1	8.2
CT ($mg\ m^{-3}\ min$)	1976.6	145.6
Average Temp (ºF)	74.3	0.7
Average RH (%)	43.4	1.1

Wind Speed (mph)

- 3
- 10
- 20
- 40

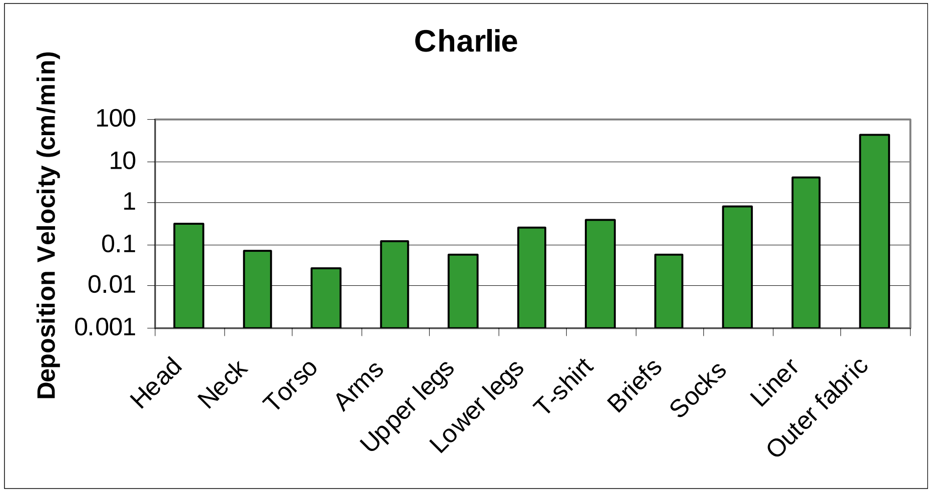
Environmental and simulant conditions



Skin & material sampling sites

DO-49 elevated wind study:
Results of wind speed/garment combinations

Skin deposition of aerosol simulant: UV illumination of Fluorescent tag



<u>Deposition by layer</u>

- liner roughly 10-fold less deposition than outer surface
- tee shirt, socks roughly equivalent
- other layers variable, generally much less

Current JSTO study: Effects of elevated wind speed on agent penetration of IPE

<u>Objectives</u>: Correlate elevated wind speeds (above 10 mph) with aerosol penetration of IPE materials and systems

<u>Approach</u>:

- Develop techniques to disperse and characterize submicron aerosol in wind tunnel ***(task 1)***
- Assess aerosol penetration of materials and system components (e.g., sleeves) ***(task 2)***
- Assess how IPE system design affects aerosol penetration ***(task 3)***

Approach

Task 1 – Wind Tunnel Characterization:

Objective: characterize aerosol dispersal in a wind tunnel

- Air stream
- Target surface (IPE material, component, or system)

• Particulate tagging

• Aerosol characterization

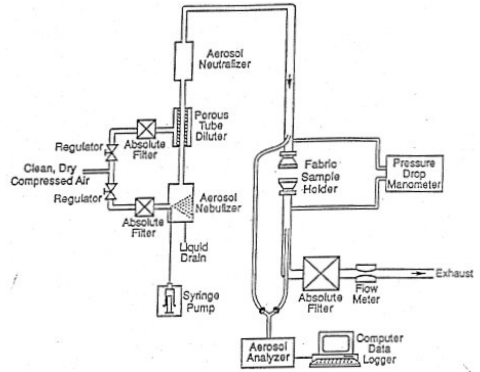
- particle size & size distribution
- tag distribution

• Swatch penetration (RTI)

- Liquid vs. solid phase aerosols (0.02 - 1.0μm)
- Variable pressure gradient (wind speed)

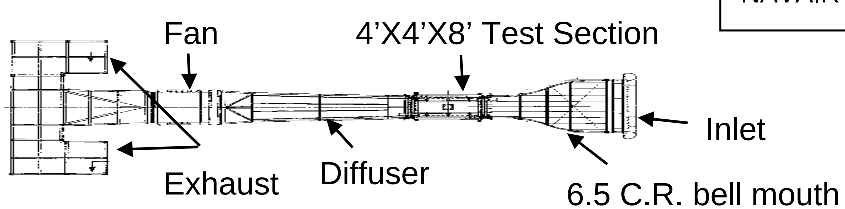
• Dissemination, wind tunnel

• Characterization, wind tunnel



RTI swatch test fixture: aerosol penetration in wind

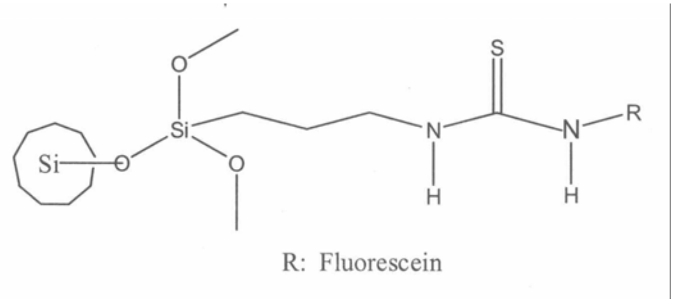
NAVAIR wind tunnel



Effects of elevated wind speed on agent penetration of IPE

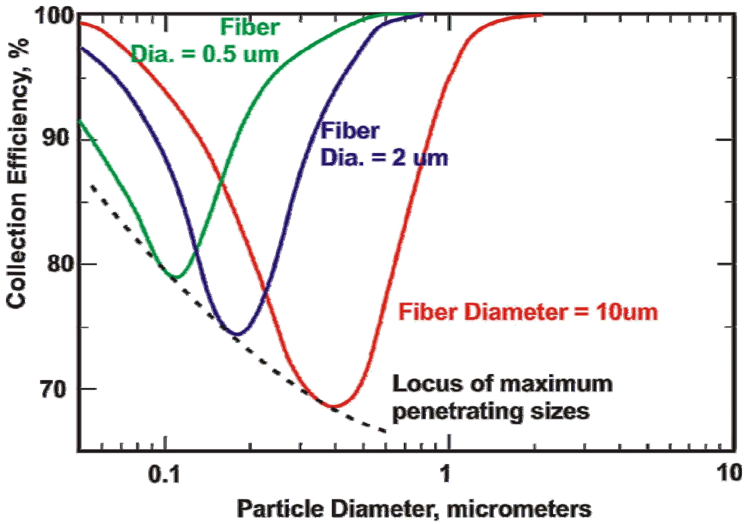
Particle Tagging: **Understand particle surface chemistry regarding tag adsorption and agglomeration**

- Covalent bonding of fluorescent material with fumed silica particle



Filtration: **Quantify filter properties of IPE in flow field and compare with M&S**

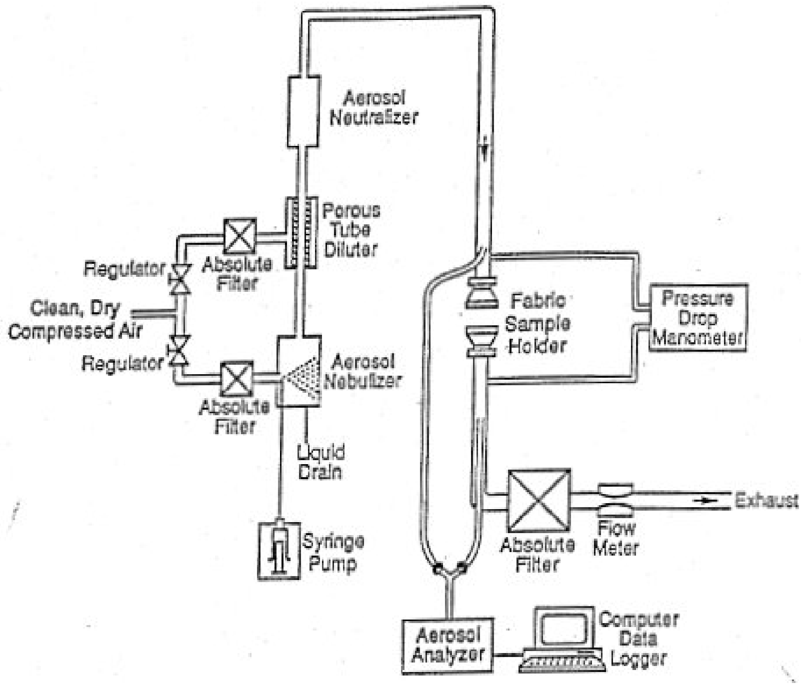
– Most penetrating particle size
– Aerosol/material interaction: solid vs. liquid particles
– Filter efficiency as function of
  • particle size
  • pressure (velocity)
  • IPE material
– Mass flux across IPE layers
  • Windward vs. leeward deposition
  • Mass transport through all layers



Drawn from Hinds (1982)

NAVAIR

Effects of elevated wind speed on agent penetration of IPE



RTI swatch test fixture: aerosol penetration in wind

Swatch sample: outer shell & inner liner

Fabric Pressure Drop (" H2O)	Face Velocity (cm/s)	Wind Speed (mph)*
0.1	0.57 - 0.91	14
0.5	3.14	32
2	13.14	64

Relationship between fabric pressure drop, face velocity through the fabric, and upstream wind speed*.

** Wind speed (for this table) = ambient wind speed needed to create a velocity pressure equal to the fabric pressure drop*

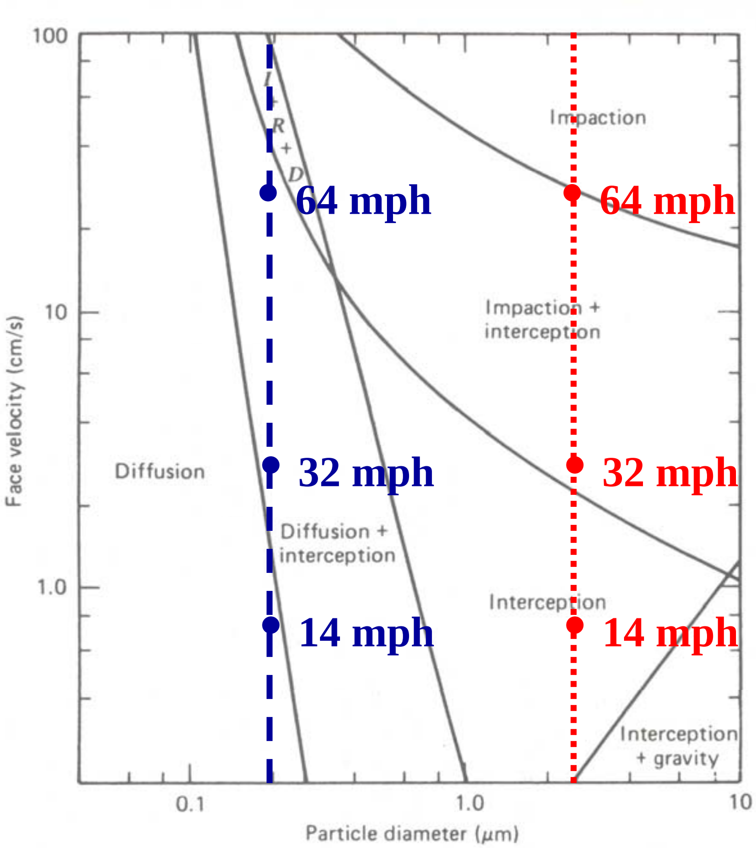
Effects of elevated wind speed on agent penetration of IPE

Airstream characteristics

Deposition mechanisms at varying wind speeds and particle sizes

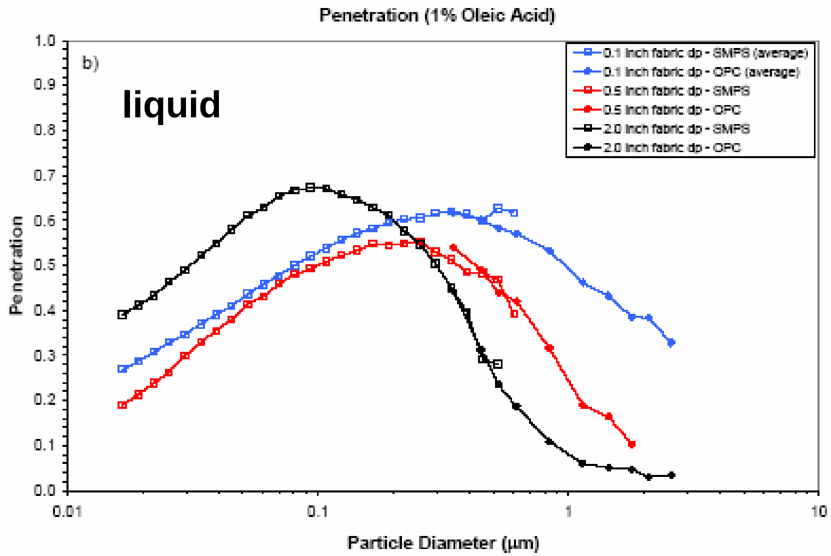
- Fine particles (<1.0 μm): diffusion & interception

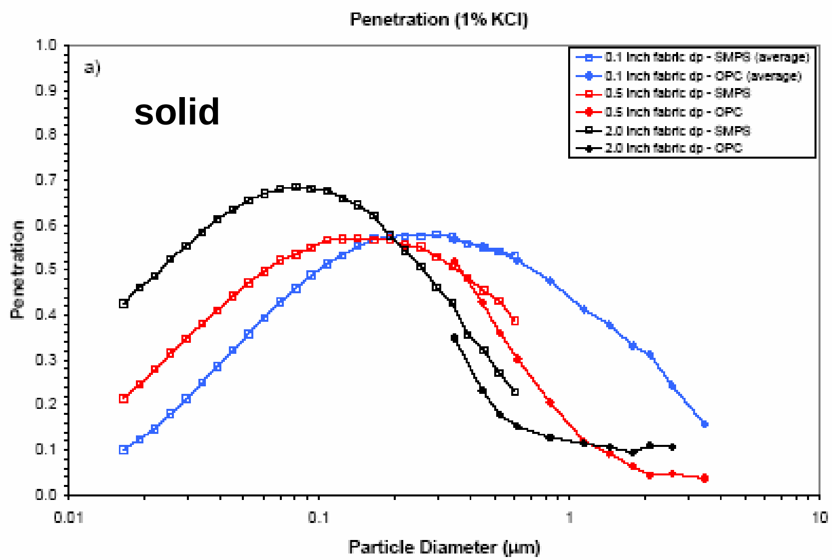
- Std aerosol test (RTI) particles (~ 2.5 μm): interception & impaction predominate



Hinds, 1999

JSTO Elevated wind speed: Phase 1 results





Swatch penetration

- Liquid vs. solid aerosol
- Particle size
- Pressure drop
  - 0.1” (14 mph)
  - 0.5” (32 mph)
  - 2.0” (64 mph)

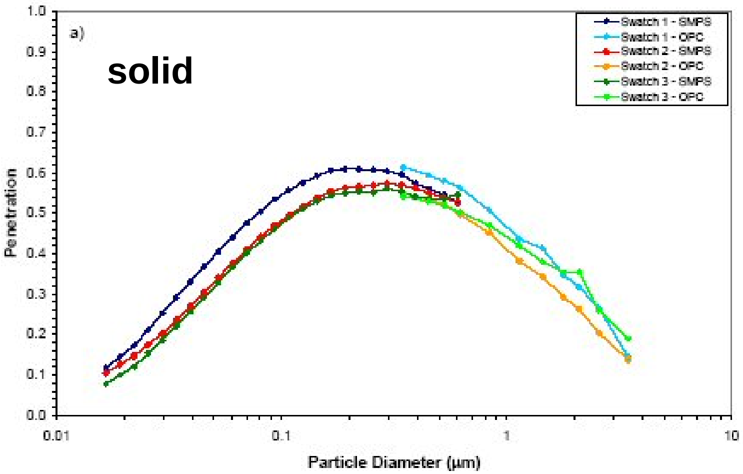
$P_{obs}=C_{downstream}/C_{upstream}$

Results

- Peak penetrating particle size (approx. 0.08 – 0.25µm, vel. dep.)
- Max. penetration (approx. 50-70%, vel. dep.)
- Note: non-penetrating aerosol fraction depositing on/in fabric

NAVAIR

JSTO Elevated wind speed: Phase 1 results



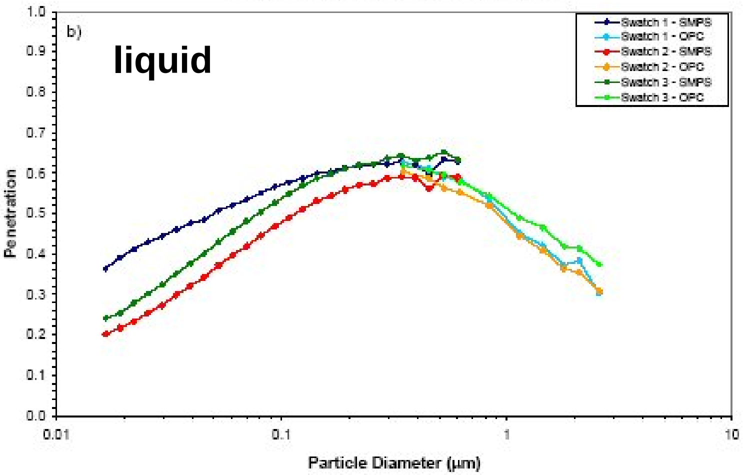


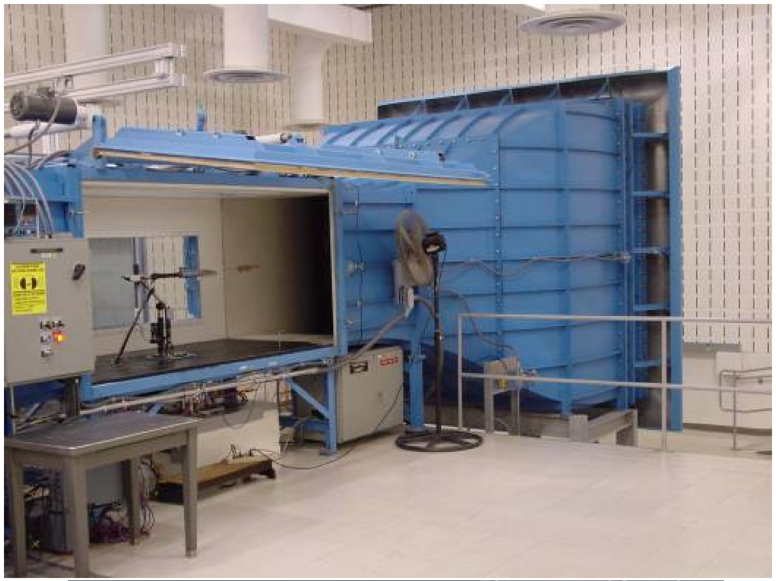
Figure 4. Penetration versus particle diameter for the triplicate fabric swatches at 0.1" fabric pressure drop with: a) KCl aerosol and b) oleic acid aerosol.

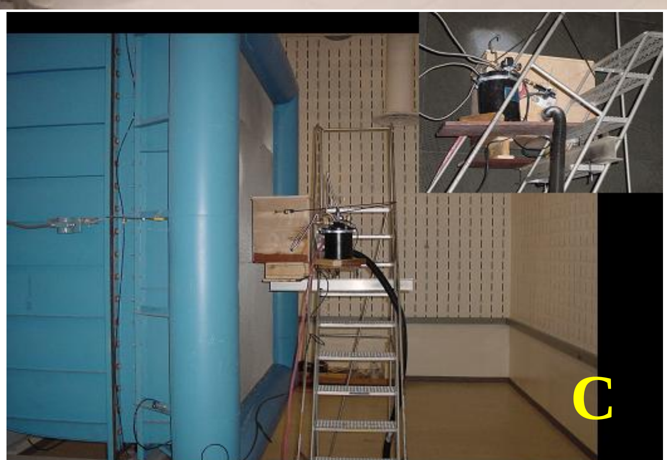
Reproducibility

Results from 3 independent trials at 0.1" pressure drop

NAVAIR

JSTO Elevated wind speed: Aerosol dispersion





<u>Prototype aerosol dissemination</u>

A - Spray system with Laskin nozzle

B - Dispersion box; *Inset: With top removed*

C - Dispersion System mounted in NATF

Inset: Rear of system

Summary

- Aerosolized agents can overcome IPE protection
- Quantifying IPE limitations needs to account for:
  - Mass transport mechanism
    - Magnitude of driving force
  - Particle inertia
    - Particle size & mass

Acknowledgements

Individuals responsible for the success of this work include:

Literature Review:
Dr. Kenneth Chinn
Stephen Coleman
Teresa Kocher
Maura Rudy
Kathy Schaneveldt
Sponsor: JPACE

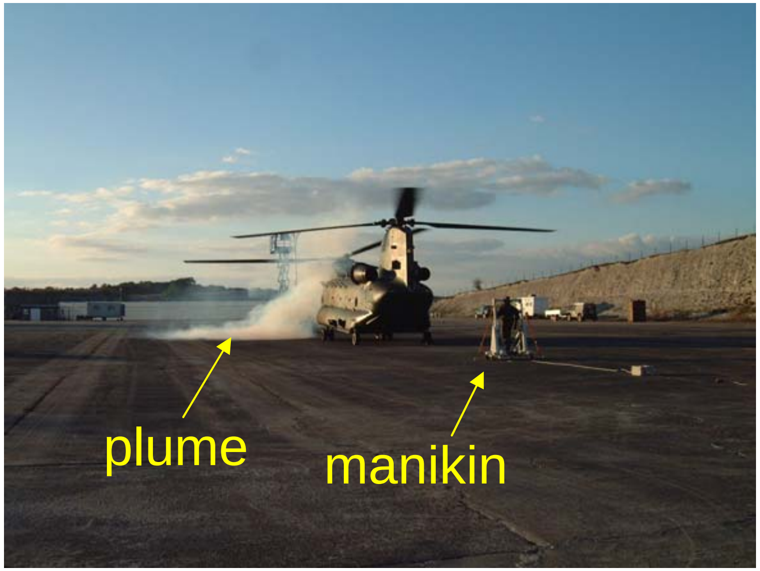
DO-49 study:
Jean Baker
James Hanzelka
Nathan Lee
Grant Price
Charlie Walker
Sponsor: JSIG

JSTO study:
Dr. Tom Cao
Terence Ghee
James Hanley
James Hanzelka
Dr. Chris Olson
Dr. Richard Phan
Sponsor: JSTO
(Tony Ramey, CAPO)

Questions?

Backup slides

Rotorwash effects



Effect of wind & challenge dissemination
(DSTL 2002 study)

Literature Review

Challenge[+]	Ref #	Year	Primary Author	Wind Speed (knots)	Protective outergarment	Primary Focus	Findings
BG[^], solid	1	1949	Wagner	4.1-26.0	Butyl coated cloth	Ss in tunnel	Penetration increases with wind
VX, 9-12 μm[*], liquid	2	1969	Dawson	11.3	1967-CPO	Manikin in tunnel	
Oleic acid, 0.7 μm[*], liquid	3	1988	Hanley	14	1980-CPO	Ss sleeves only	Penetration increases with wind & decreasing particle size
AFL, 0.5 μm[*], liquid	4	1989	Hanley	8.7-34.8	CPO	Manikins with taping	Penetration increases with wind; upwind greater than downwind
TEG, 1 & 3 μm[*]	7	1990	Hanley	8.7-34.8	CPO	Manikin, raingear	Penetration increases with wind
NaCl, 1-3 μm[*]	8	1991	Tytus	2.6-7.8	CPO	Manikins	Penetration increases with wind
TEG, 0.5 & 2 μm[*]	9	1999	Engels, Gibbs	4.3-26.0	Navy CPO (Mk III)	Manikins	Penetration increases with wind
Syloid, 3.0 μm[*], solid	10	1994	Chinn	2.3-16.3	BDO	Manikins, field test	Penetration increases with wind

+ - Aerosol, ^ - particle size unreported, * - mass mean diameter, TEG – tetraethylene glycol, AFL – ammonium fluoroscein

Threat Agent Science Capability Area

Computational Chemistry Thrust Area

Dr. W. Paul Murdock
Thrust Area Manager
Air Force Research Laboratory
AFRL/HEPC
(937) 255-3140
DSN 785-3140
William.Murdock@wpafb.af.mil

Approved for Public Release
DTRA 06-022, 21 Feb 2006

Overview

- Organizational Overview
- New Computational Chemistry Thrust Area within the Threat Agent Science Capability Area Focus Areas
- Potential applications
- Current efforts
- Planned thrusts

Approved for Public Release
DTRA 06-022, 21 Feb 2006

JSTO Organization

Physical Science & Technology Division

- Detection
- Protection
- Decontamination
- Mod., Sim., & Battlespace Awareness
- Threat Agent Sciences

Program Integration Division

Medical Science & Technology Division

- Pretreatments
- Therapeutics
- Diagnostics
- Emerging Threats

Applied Technology Division

CAPOs empowered to make program decisions

Approved for Public Release
DTRA 06-022, 21 Feb 2006

TAS Capability Area

Threat Agent Science
Dr. Dave Stockwell, CAPO
JSTO (DTRA/CBT)

- **Agent Fate** — Dr. Jim Savage, ECBC
- **Low Level Tox.** — Dr. Steve Channel, AFRL @ ECBC
- **Agent Characterization Simulant Development** — Dr. Jon Kaufman, NAVAIR
- **Computational Chemistry** — Dr. Paul Murdock, AFRL
- **Science Info Support** — Ms. Deb Schnelle, DTRA/CBT

Approved for Public Release
DTRA 06-022, 21 Feb 2006

AFRL Organization

HQ AFMC
Material Developer

- Headquarters
- Air Logistics Centers
- Test Centers
- Field Operating Agencies
- Product Centers
- Air Force Research Laboratory
  - Human Effectiveness Directorate AFRL/HE
    - Biosciences and Protection Division AFRL/HEP
      - *CB DEFENSE TEAM AFRL/HEPC CBD*
- Specialized Product Centers

AFRL CHEM & BIO DEFENSE (CBD) TEAM

HUMAN EFFECTIVENESS DIRECTORATE
BIOSCIENCES AND PROTECTION DIVISION
COUNTERPROLIFERATION BRANCH

AFRL/HEPC

- JSTO EXECUTION
- JOINT COMMUNITY MEMBERSHIP
- AF's CB DEFENSE "ANSWER SHOP"

Approved for Public Release
DTRA 06-022, 21 Feb 2006

Computational Chemistry Thrust Area

Objective

Develop and apply quantitative chemistry techniques and tools to provide accurate technical threat agent understanding and prediction

- Agent Fate on complex surfaces
  - i.e. concrete, asphalt, grass, sand, other operational surfaces
- Address emerging and new threat agents
- Agent/Simulant correlation and simulant design
- Application to agent toxicology and hazard
- Decrease dependence on empirical testing and infrastructure

Approved for Public Release
DTRA 06-022, 21 Feb 2006

Potential Applications of Computational Chemistry

- Assist in the Development of Accurate Models of Chemical Hazard Persistence and Risk Duration
- Chemical Agent Fate
  - Live Agent Tests are Expensive
  - Facilities Scarce
- Simulant Correlation
  - Design?
- Provide Insight into Chemical Agent Interaction with Surface Materials
  - What happens to the agent?
  - What “liberates” the agent from the substrate?
- Individual and Collective Protection
- Decontamination Issues
- Operational Considerations
- Toxicological Effects

Approved for Public Release
DTRA 06-022, 21 Feb 2006

Computational Chemistry Thrust Area

- Two Focus Areas
  – Quantitative Structure Activity Relationships (QSAR)
  – Quantitative Chemical Theory (QCT)
  – Possible additional areas per proposal inputs
- QSAR
  – CBRTA Independent Assessment and Evaluation of QSAR in Predictive Modeling underway (Cipher Systems, SRC)
  – Results delivered
- QCT
  – FY06 New Start
  – Performers
    - Naval Research Laboratory (Dr. Bermudez)
    - AFRL (Mr. Kilpatrick, Dr. Evans)

Approved for Public Release
DTRA 06-022, 21 Feb 2006

Quantitative Structure Activity Relationships (QSAR)

- Problem
  - Efforts to “improve” simulants will result in more toxic simulants (Similar Property Principle)
  - Efforts to “improve” simulants still won’t accomplish the goal of the Thrust Area
- Emphasis should be on understanding *correlation* between simulant activity and agent activity, and using this understanding to make predictive statements about agent activity

Approved for Public Release
DTRA 06-022, 21 Feb 2006

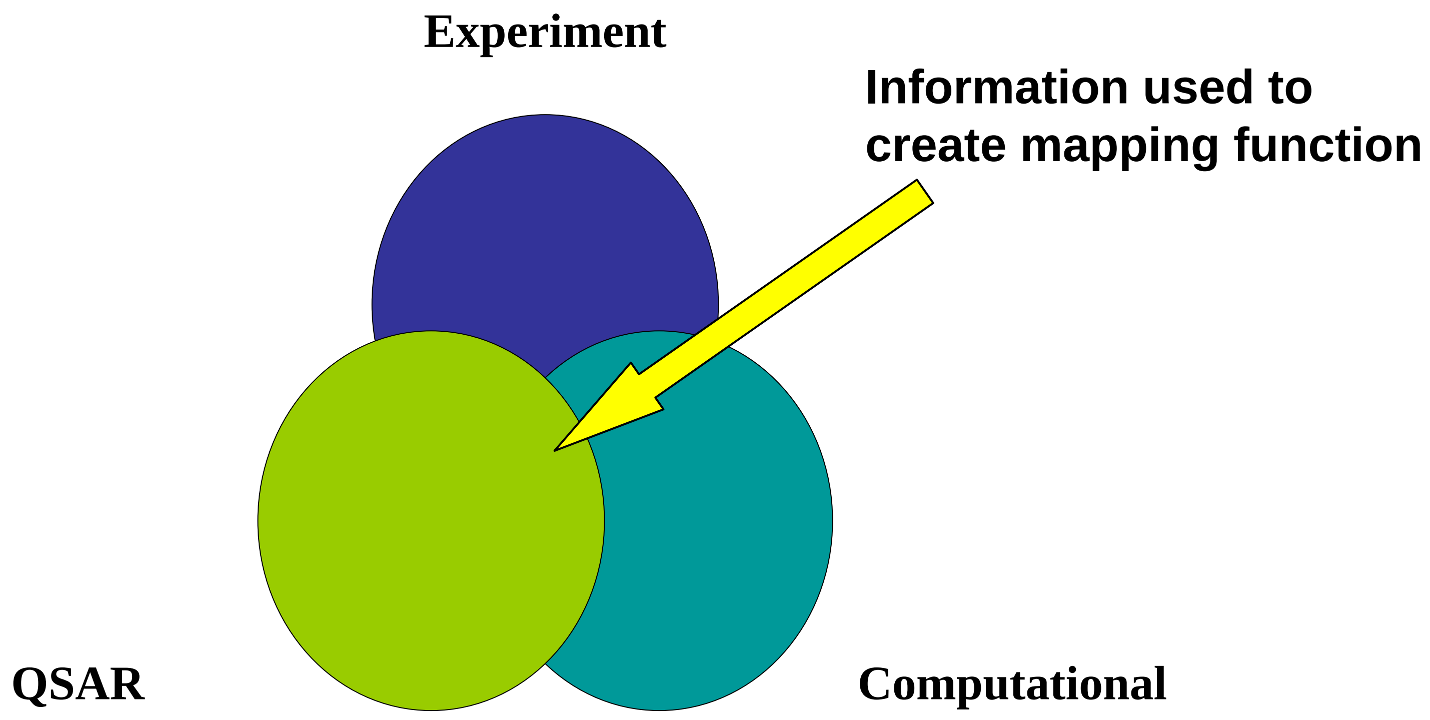
QSAR

Understanding Agent and Simulant Activity

- Use a combination of experimental and computational methods, in connection to QSAR
- Determine the correlation between agent/simulant structure and SPECIFIC activity
- Create mapping functions to map known simulant activity into set of unknown agent activities

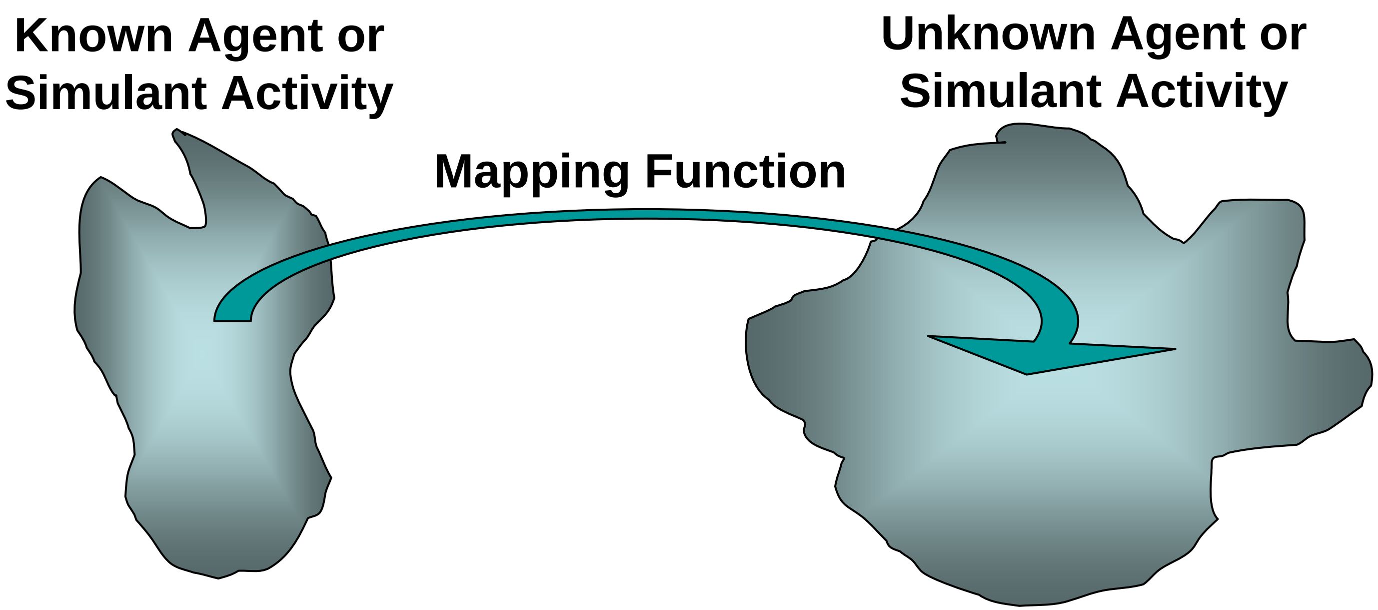
Approved for Public Release
DTRA 06-022, 21 Feb 2006

QSAR
Understanding Agent and Simulant Activity



Approved for Public Release
DTRA 06-022, 21 Feb 2006

QSAR
Predicting Agent Activity



Approved for Public Release
DTRA 06-022, 21 Feb 2006

Quantum Chemical Theory (QCT)

- Problem
  - Shortcomings of experimental approach to agent/surface interaction investigations
    - Too many permutations
    - Risk and cost associated with agent experimentation
    - Rate of emerging threats faster than traditional empirical approach can accommodate
  - Extensive reliance on simulants to represent CWAs
- QCT is a readily available technology
  - First principles approach to understanding agent/surface interaction effects
  - Does not replace experimental efforts
  - Only possible given recent HPC improvements
    - SGI Origin 3900 (128 MIPS R12000 CPUs, 256 Gb memory)
    - Year 1 effort is ~ 50,000 CPU hours

Approved for Public Release
DTRA 06-022, 21 Feb 2006

Quantum Chemical Theory (QCT)

- QCT tools have been extensively developed and thoroughly tested by academia
  - No new software tools needed
  - Application to CWAs is direct extension of existing work
- New start effort
  - Joint AFRL and NRL project
  - Incremental approach to validate application of QCT modeling to agent fate and agent/simulant correlation
    - FY06: Validate quantitative reliability of QCT against simulant data
    - FY07: Evaluate extent of currently used simulants to reproduce properties of CWAs; begin calculations on agent surface interactions with solid oxide surfaces
    - FY08: Extend modeling of CWAs absorbed onto solid oxides to complex surfaces
  - Broad application to other areas within CB defense

Approved for Public Release
DTRA 06-022, 21 Feb 2006

Current Efforts

- Expansion of the Computational Chemistry Thrust Area
- Evaluation of Proposals for FY07 Start
  - Responses to JSTO Service Call
  - Responses to JSTO BAA For Industry

Approved for Public Release
DTRA 06-022, 21 Feb 2006

Computational Chemistry Thrust Area

Questions?

Dr. W. Paul Murdock
(937) 255-3140
DSN 785-3140
William.Murdock@wpafb.af.mil

Approved for Public Release
DTRA 06-022, 21 Feb 2006

DoD Chemical Biological Defense Program

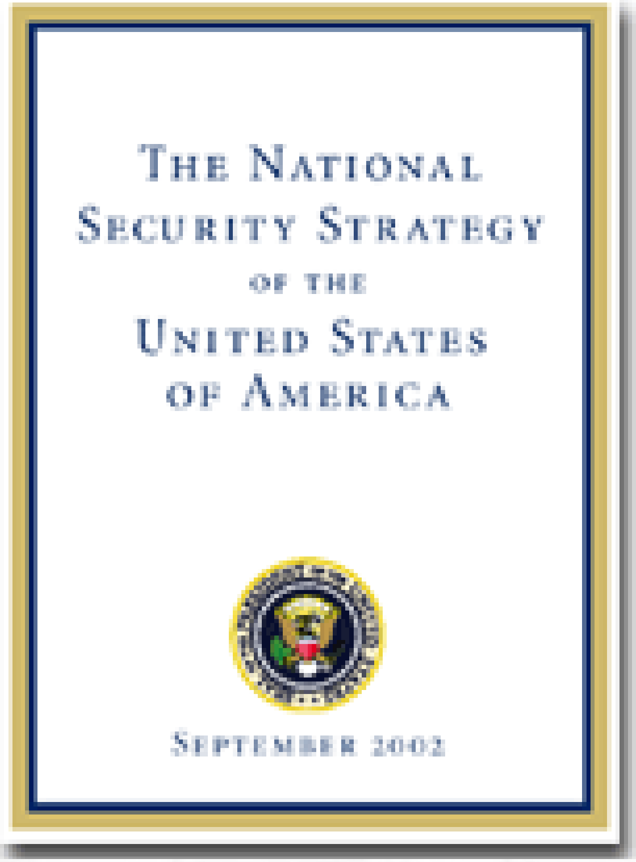
Joseph M. Palma, MD, MPH
Colonel, USAF, MC, SFS
Deputy & Medical Director,
Chemical Biological Defense
and Chemical Demilitarization Programs

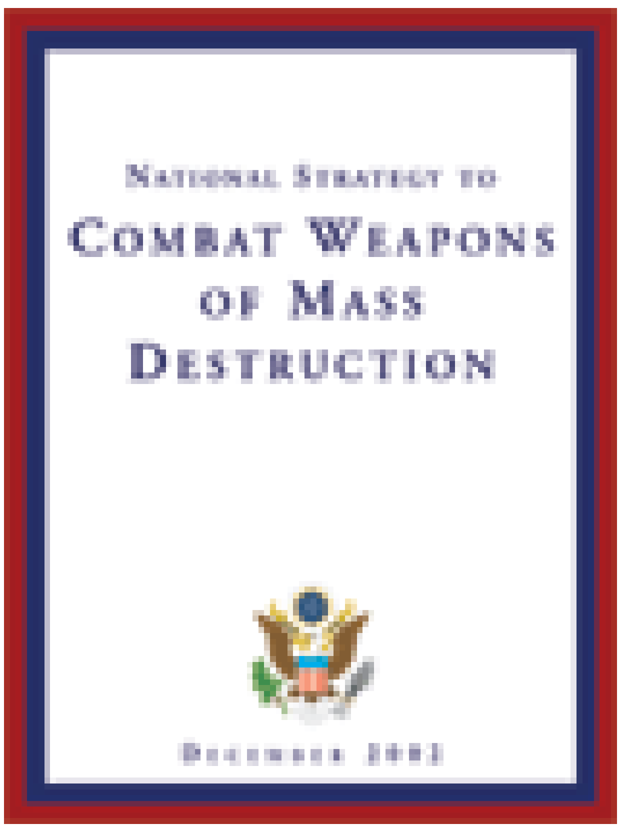
March 7, 2006

Chemical Biological Individual Protection Conference

Guidance

National Security Strategy of the United States of America





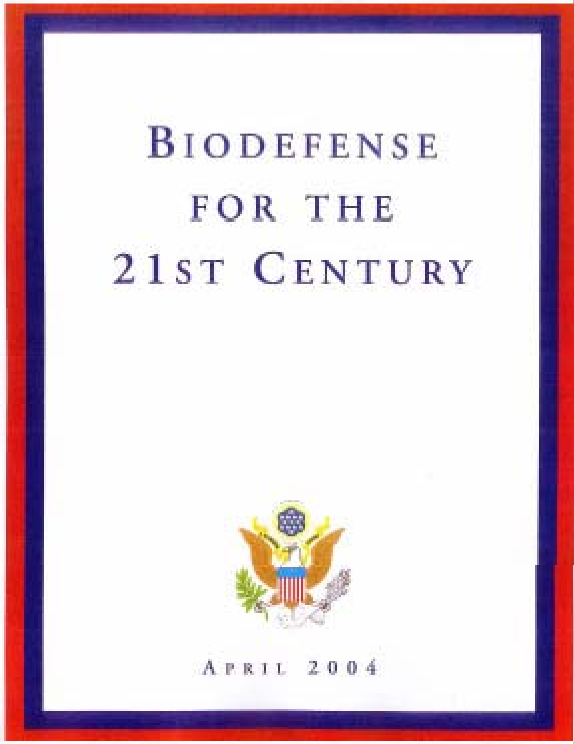
National Strategy to Combat Weapons of Mass Destruction

National Strategies Addressing Emerging Threats

***Biodefense for the 21st Century*, The White House, April 2004 (NSPD-33/HSPD-10)**

– “Preventing and controlling future biological weapons threats will be even more challenging. Advances in biotechnology and life sciences—including the spread of expertise to create modified or novel organisms—present the prospect of new toxins, live agents, and bioregulators that would require new detection methods, preventive measures, and treatments. These trends increase the risk for surprise”

– “The proliferation of biological materials, technologies, and expertise increases the potential for adversaries to design a pathogen to evade our existing medical and non-medical countermeasures. To address this challenge, we are taking advantage of these same technologies to ensure that we can anticipate and prepare for the emergence of this threat.”



Defense Strategy

Security Environment: 4 Challenges

VULNERABILITY

Higher

Lower

LIKELIHOOD

Higher

Lower

Irregular

- Unconventional methods adopted and employed by non-state and state actors to counter stronger state opponents.

(e.g., terrorism, insurgency, civil war, and emerging concepts like "unrestricted warfare")

Catastrophic

- Surreptitious acquisition, possession, and possible employment of WMD or methods producing WMD-like effects against vulnerable, high-profile targets by terrorists and rogue states.

Traditional

- States employing legacy and advanced military capabilities and recognizable military forces, in long-established, well-known forms of military competition and conflict.

(e.g., conventional air, sea, and land forces, and nuclear forces of established nuclear powers)

Disruptive

- International competitors developing and possessing breakthrough technological capabilities intended to supplant U.S. advantages in particular operational domains.

(e.g., sensors, information, bio or cyber war, ultra miniaturization, space, directed-energy, etc)

No hard boundaries distinguishing one category from another

CBDP Vision and Mission

VISION

DoD Operations Unconstrained by CB Effects

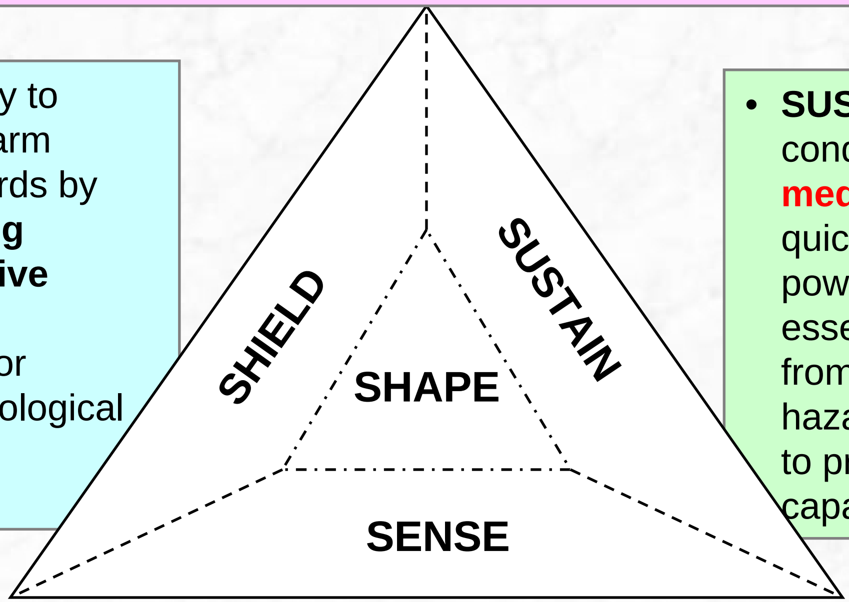
MISSION

Provide passive defense CB capabilities in support of the National Military Strategies.

Joint Defense Functional Concept – Operational Attributes

- **SHAPE –** Provides the ability to **characterize the CBRN hazard** to the force commander - develop a clear understanding of the current and predicted CBRN situation; collect, query, and assimilate info from sensors, intelligence, medical, etc., in near real time to inform personnel, **provide actual and potential impacts of CBRN hazards**; envision critical SENSE, SHIELD and SUSTAIN end states (preparation for operations); visualize the sequence of events that moves the force from its current state to those end states.

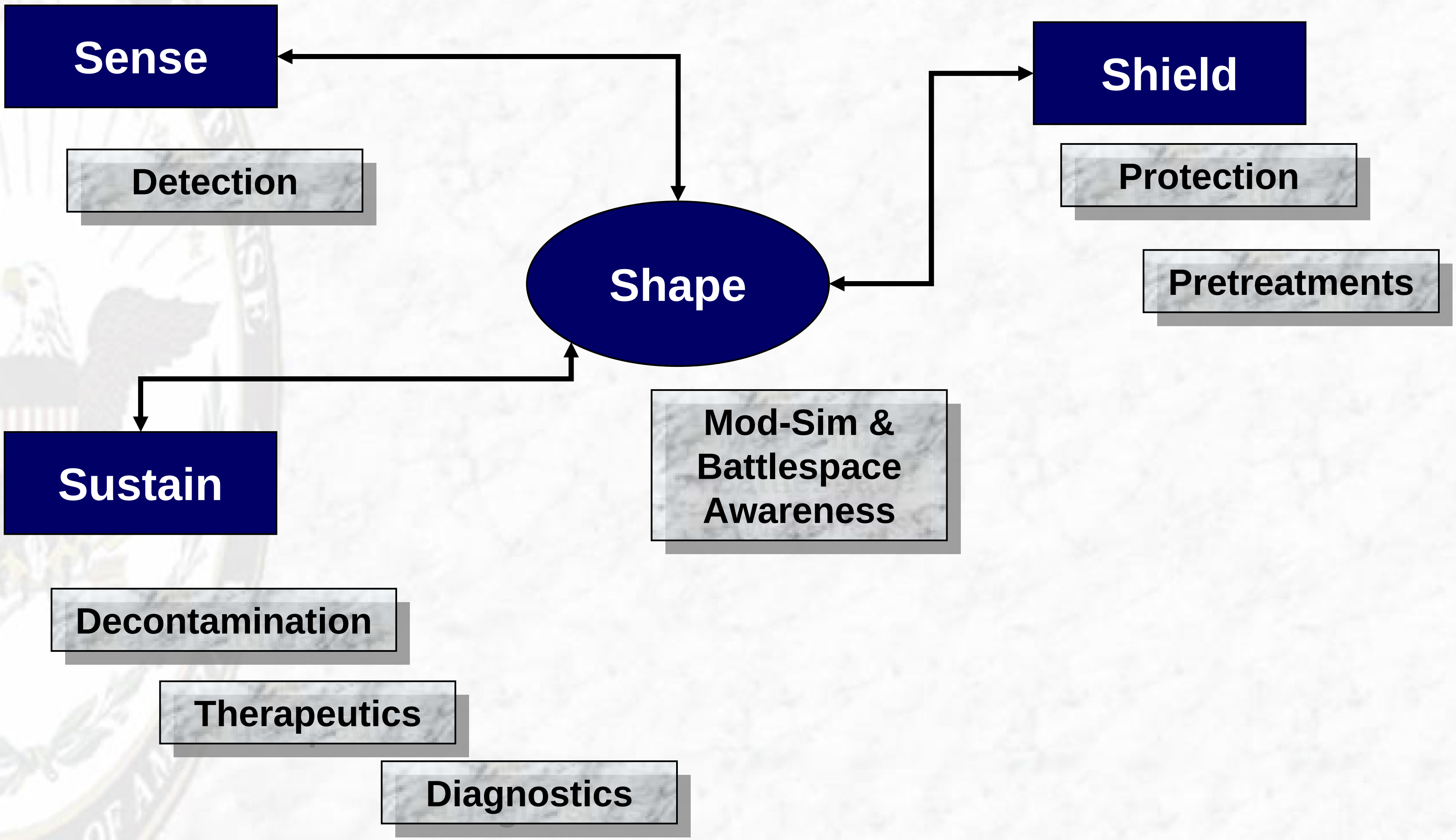
- **SHIELD –**The capability to shield the force from harm caused by CBRN hazards by **preventing or reducing individual and collective exposures**, applying prophylaxis to prevent or mitigate negative physiological effects, and protecting critical equipment



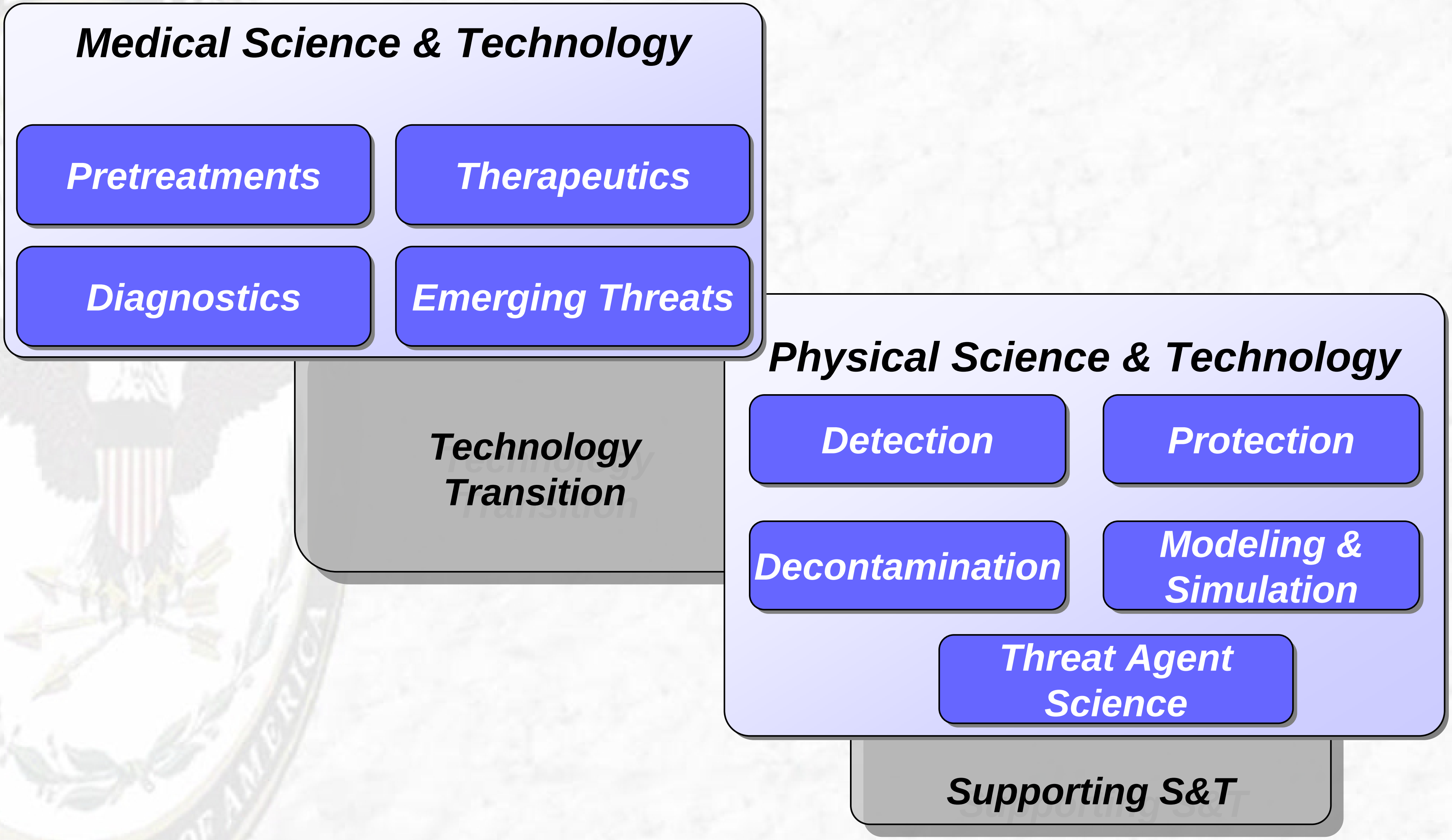
- **SUSTAIN –** The ability to conduct **decontamination** and **medical** actions that enable the quick restoration of combat power, maintain/recover essential functions that are free from the effects of CBRN hazards, and facilitate the return to pre-incident operational capability as soon as possible.

- **SENSE –** The capability to continually provide the information about the CBRN situation at a time and place by **detecting, identifying, and quantifying** CBRN hazards in air, water, on land, on personnel, equipment or facilities. This capability includes detecting, identifying, and quantifying those CBRN hazards in all physical states (solid, liquid, gas).

Chemical Biological Defense Program Capability Areas

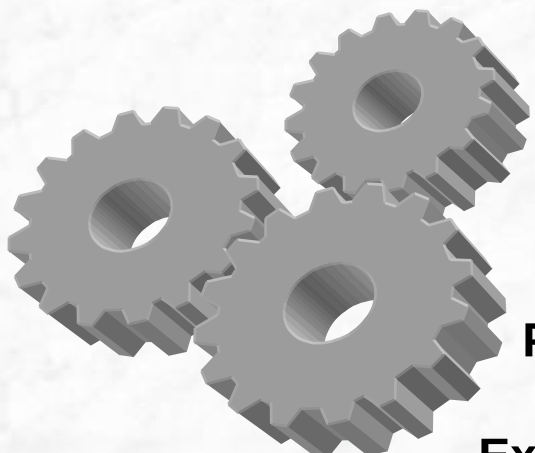


Chemical Biological Defense Science & Technology (S&T) Capability Areas



ATSD(NCB)

- **Advise SECDEF on policies and plans affecting WMD threat reduction**
- **Provide Oversight of DoD Nuclear, Chemical and Biological Defense Programs**



Chemical and Biological Defense

CB Threats & Hazards

Agent Delivery → Doses on Target → Downwind Dispersal → Doses Absorbed → Symptoms → Sustained Combat

Medical Pretreatment

Contamination Avoidance and NBC Battle Management

Individual & Collective Protection

Installation Force Protection

Medical Treatment

Information Systems

Decontamination and Restoration

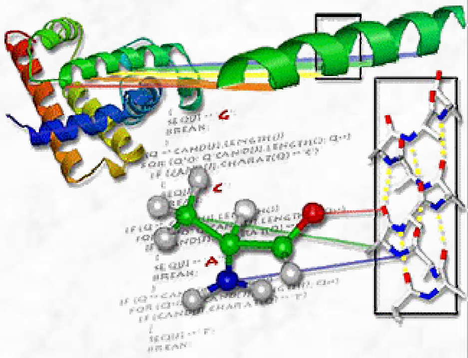
An integrated response to the threat is required – There will be no silver bullet!

Key Initiatives
for the CB Defense Program

Infrastructure Improvements

- Test & Evaluation Facilities
- Non-Traditional Agent Test Chamber
- USAMRIID Recapitalization

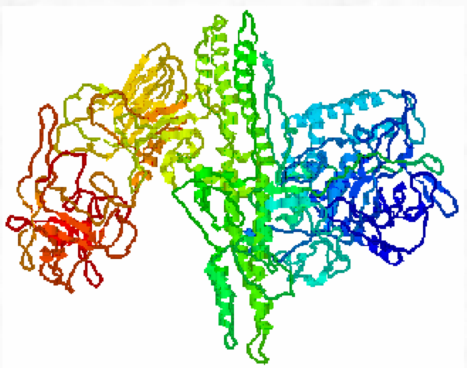
Improved Oxime



RDT&E Areas of Additional Emphasis

- S&T for Non-Traditional detection
- Biological point and standoff detection
- Chemical point detection
- Medical Prophylaxis
- Battle Analysis
- Decontamination
- Bio Defense Initiatives
  (Advanced Medical Countermeasures)

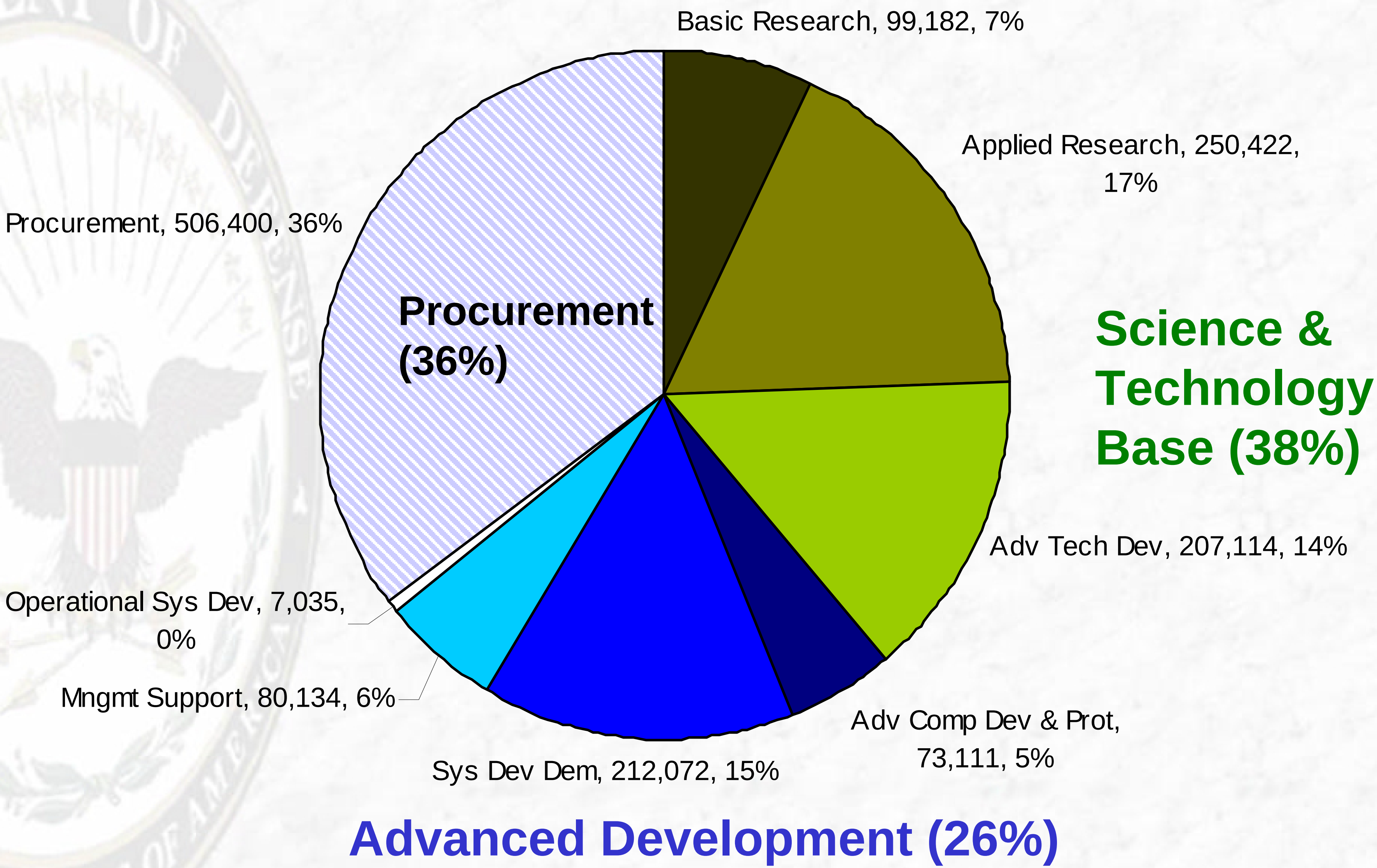
Nerve Agent Bioscavener Pretreatment



Chemical Biological Defense Program

Based on FY07 President's Budget Request (February 2006)

$1.435 Billion



Quadrennial Defense Review (QDR):
Vision for Combating Weapons of Mass Destruction

The future force will be organized, trained, equipped, and resourced to deal with all aspects of the threat posed by weapons of mass destruction. It will have capabilities to:

- **Detect WMD, Including Fissile Material At Stand-off Ranges**;
- **Locate And Characterize Threats**;
- **Interdict WMD** And Related Shipments Whether On Land, At Sea, Or In The Air;
- **Sustain Operations Under WMD Attack**; And
- **Render Safe Or Otherwise Eliminate WMD Before, During Or After A Conflict**.

The Department will **develop new defensive capabilities** in anticipation of the continued evolution of WMD threats. Such threats include … genetically engineered biological pathogens, and next generation chemical agents. The Department will be prepared to respond to and help other agencies to mitigate the consequences of WMD attacks.

Quadrennial Defense Review (QDR):
Implementing the Combating WMD Vision

To achieve the characteristics of the future joint force…, the Department will:

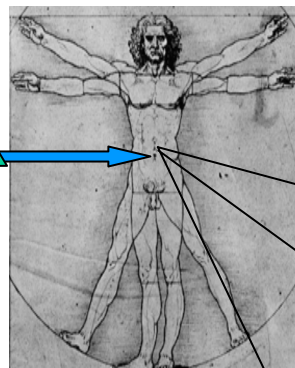
- Designate the Defense Threat Reduction Agency to be the primary Combat Support Agency for **U.S. Strategic Command** in its role as lead combatant commander for integrating and synchronizing combating WMD efforts.
- Expand the Army's 20th Support Command (CBRNE) capabilities to enable it to serve as a Joint Task Force capable of rapid deployment to command and control WMD elimination and site exploitation missions by 2007.
- Expand the number of U.S. forces with advanced technical render-safe skills and increase their speed of response.
- Improve and expand U.S. forces' capabilities to locate, track, and tag shipments of WMD, missiles, and related materials, including the transportation means used to move such items.
- Invest **more than $1.5 billion over the next five years to develop broad-spectrum medical countermeasures against advanced bio-terror threats**, including genetically engineered pathogens.

Medical Countermeasures Against Advanced Bio Threats

Today's Threats

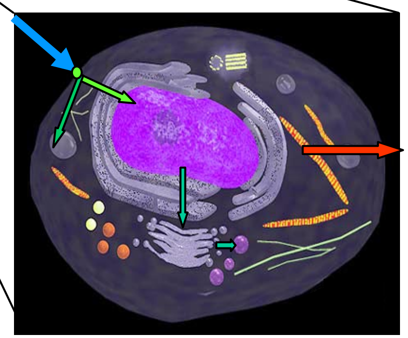
Anthrax
Smallpox
Botulinum
Plague
Tularemia
Ebola/Filo
Hemorrhagic Fever
Encephalitis
SARS
Influenza
Ricin/SEB, others

Bioengineered



Modes of Action

Receptor Binding
Signal Transduction
Decoys
Immune Avoidance
Translation/Transcription
Immune Deregulation
Replication
Virulence Expression



Parallel Systems Approach

Solutions

Target Agent Commonalities

- Block Key Receptors
- Inhibition by Small Molecules
- Modulate Immunity
- Change Gene Expression
- Block Protein Actions
- Modulate Physiologic Impacts

One *PIECE* at a time → Process Analysis → Broad Spectrum

Broad Spectrum Therapies for Novel Biodefense Threats

- **Basic Research/Science**
  - Directed at critical pathways in pathogen & host response
  - Identify the novel points of intervention
- **Applied Research/Science**
  - Expanding technologies
  - Speed the cycle from discovery to license application
- **Advanced Science/Tech Development**
  - Quick wins based on new compounds and technology
  - Minimum: Deliver products with IND approval (Phase 1 trials) for BioShield acceptability and further investment
- **Advanced Component Development and System Demonstration**

CBDP: The Way Ahead

- **Need to build on current strengths…**
  - Integrated collection of systems
  - Multi-disciplinary approaches
  - Well developed doctrine and concepts for the military in operational environments
- **…while recognizing a changing environment**
  - Laboratory and other infrastructure may need overhaul
  - DoD now a key player, but no longer the biggest investment
  - Operational environment must consider homeland
  - Emerging and non-traditional threats may be critical
  - Congress will continue to play an active role
  - Industry will be increasingly important, though DoD-unique assets need to be identified and maintained

CBDP: The Way Ahead

- **…and Planning for the Future**
  - Need to balance investment between current risks (operational and procurement needs) and future risks (S&T and infrastructure)
  - Coordination with other agencies (DHHS, DHS, and others) for an effective national effort
    - DoD may play key role in transitioning technologies from laboratory concepts to field-ready systems, especially medical systems
  - Broad-spectrum, dual-benefit approaches will need to be evaluated in all areas

Questions?

Joint Service Lightweight Integrated Suit Technology (JSLIST) Ensemble

Joint Project Manager – Individual Protection

CB Individual Protection Conference

March 2006

Agenda

- JSLIST Status
- Schedule
- Funding
- Issues and Challenges
- Industrial Transition

JSLIST Status
Fielded Items

- JSLIST Suits
- Multi-Purpose Overboot (MULO)
- JSLIST Block 1 Glove Upgrade (JB1GU)
- Navy Urgent Need Overboot

JSLIST Status
RDT&E

- **JSLIST Block 2 Glove Upgrade (JB2GU)**
  - JB2GU will satisfy JSLIST and JPACE requirements not met in JB1GU
  - JB2GU & AFS: Super WIPT
  - Technical approach for follow-on increments
- **In field testing**
- **MS C scheduled for Dec 2006**

JSLIST Status
RDT&E

- **Alternative Footwear Solutions (AFS)**
  - AFS will meet need for multi-size capable overboot with minimal size and weight
  - AFS & JB2GU: Super WIPT
  - Limited early fielding to USMC
- **In field testing**
- **MS C scheduled for Dec 2006**

JSLIST Status
RDT&E

- **Integrated Footwear System (IFS)**
  – IFS will meet need for foot protection without added weight or bulk
  – Program includes Market Investigation on integration of CB protection into standard Service combat footwear

- **In laboratory testing**
- **MS C scheduled for Oct 2006**

JSLIST Status RDT&E

- **JSLIST Spiral Development**
  - Address OIF Lessons Learned
  - Addressing only Government design
- **In program initiation**

JSLIST Status
Market Survey

- **JSLIST C/B Coverall for CVC (JC3)**
  - JC3 meets Combat Vehicle Crew need for chemical protection that is not degraded by POLs
  - JPACE or JC3 may be outcome
- **In field testing**
- **Production decision scheduled for 1Q/FY07**

JSLIST Status
Market Survey

- **JSLIST Additional Source Qualification (JASQ) Approved Materials List (AML)**
  - Qualify additional additional sources for JSLIST Approved Material (JAM)
  - Reduce garment cost by introducing competition
  - Mitigate potential risk of interruption of foreign sources of supply
- **In field testing**
- **JPM-IP decision scheduled for Mar 2007**

Duro Textiles LLC
Kentucky Textiles, Inc.
Milliken & Company
Lantor Inc.
GENTEX Corporation
W.L. Gore & Associates, Inc.
Donaldson Company Inc.
LANX Fabric Systems
Texplorer GmbH

JSLIST Status

- **JASQ Unique Candidate**
  - Investigate materials and unique designs
    - Reduced Weight and Volume.
    - Reduced Heat Stress
    - Resistance to Petroleum, Oils, and Lubricants (POLs)
    - Low Cost Flame Resistance
  - Design and material could feed into future efforts
- **In laboratory testing**

Program Schedule

Project	FY04	FY05	FY06	FY07	FY08
JB1GU		FIELDING			
JB2GU					
AFS					
IFS					
JC3					
JASQ AML					
JASQ UNIQUE					
Spiral Development					

Milestone B Milestone C IOC

Funding

	FY05	FY06	FY07	FY08	FY09	FY10	FY11
PROC	98.2	37.1	31.4				
R&D	4.7	5.1	3.4	1.0			
			JCE R&D	2.9	11.9	8.9	13.9

JSLIST Issues and Challenges

- **Schedule: Test Resources**
- **Funding: None, but industrial base implications**
- **Performance:**
  - **Heat Stress Reduction**
  - **Glove Tactility/Dexterity**
  - **Low Cost Flame Resistance**
  - **Chemical Defense Training Facility (CDTF) Requirements**

Future Influences

- NGA & TIC data
- Nanoparticle and Nanofiber Market Survey
- Foreign services Market Survey
- Super WIPT
- Program Director, Test and Evaluation Systems Support
- Modeling

Joint Chemical Ensemble (JCE)

(Caveat: This is a JPM IP Concept Brief. What JCE is or is not requires additional coordination with all involved DoD agencies)

Joint Project Manager – Individual Protection

CB Individual Protection Conference

March 2006

Agenda

- Capabilities Documentation
- Program Influences
- Program Description
- MOSA Concept
- Warfighting Mission Areas
- Notional System Relationships
- Proposed RDT&E Contract Concept
- Proposed Production Contract Concept
- Funding

Capabilities Documentation

- Initial Capability Document (ICD) not yet established
- ICD capability gaps based on the "Chemical, Biological, Radiological, And Nuclear Defense (CBRND) Functional Needs Analysis/Functional Solutions Analysis", Final Report dated December 2005. FOR OFFICIAL USE ONLY

Program Influences

- Market Surveys
- Performance Based Logistics (PBL)
- PD TESS Efforts. Validate improved range of agent protection; reduce heat stress through using absolute protection values that allows trade offs. Ties into JPM IP Modeling strategy.
- Advanced Technology Demonstration of a Modular Chemical/Biological Protective System.
- JPM IP Ongoing Programs

Program Description

- Family of Systems. Capabilities across mission spectrum.
  - Warfighter Mission Areas
  - Counterproliferation
  - Consequence Management
- Dual Use Capabilities.
  - Federal Departments (DoD, DHS, DOJ)
  - State and Local Authorities

MOSA Concept

SYSTEM

A system –
is a collection of interacting...

SUBSYSTEMS

...subsystems –
which are collections of interacting...

SUBSYSTEMS

...components –
either hardware, software, or human, ...

COMPONENTS

…that are connected by interfaces –
to support the interchange of information, activity, or material essential to the functioning of the system.

Warfighter Mission Areas

GROUND	AVIATION
LAND-BASED & SHIPBOARD C2	
INFANTRY MECH SpecOps	FIXED WING + ROTARY WING

GROUND

- Amphibious Ops
- Reconnaissance
- Ground Fires
- Heavy Mech.
- Light Mech
- Air Defense
- Combat Engineering
- MOOTW
- Maintenance
- Supply
- Health Services
- AT/FP
- Transportation
- Deliberate Engineering
- Services

AVIATION

- Strike/Interdiction
- Air-to-Air
- Close Air Support
- Maritime Patrol
- Air Reconnaissance
- Airborne Early Warning (AEW)
- Electronic Warfare (EW)
- Anti-Surface Warfare (ASU)
- Anti-Submarine (ASW)
- Search and Rescue (SAR)
- Transport
- Medical Evac
- Assault Support

Notional System Relationships

FOS

MIX & MATCH MODULAR

MISSIONS AREA SYSTEMS

SPECIAL MISSION
RW AVIATION
GROUND
SHIPBOARD
FW AVIATION

SYSTEM COMPONENTS

SUIT
SUIT
SUIT

HANDWEAR
HANDWEAR
HANDWEAR

FOOTWEAR
FOOTWEAR
FOOTWEAR

MASK
MASK
MASK
MASK

Proposed RDT&E Contract

- Initial concept: hybrid type contract
  - Firm Fixed Price
  - Cost Plus Fixed Fee
  - Time and Material

- Competitive Acquisition
  - FAR Part 15
  - Cost and Pricing Data

- A defined unsolicited proposal process will be in place

Proposed RDT&E Contract (continued)

- Best Value Procurement
  - Technical Proposal
  - Past Performance
  - Price
- Indefinite Technical Services
  - Team Approach (polymers, textiles, membranes, nano-technology)
  - Concept Refinement/Design Development
  - Prototyping
  - Technical Data Packages, Specifications, Training Products
  - Packaging/TAV

Proposed RDT&E Contract (continued) Tentative Timeline

• Request for Information	January 07
• Sources Sought Synopsis	March 07
• Industry Day (Pre-proposal conf)	April 07
• Draft Request for Proposal	June 07
• Final RFP	August 07
• Proposals Due	October 07
• Contract Award	January 08

Production Contract

- 2011?
- Performance Based Logistics
- Product Support Integrator
  - Supply Chain Management
  - Warehouse Management
  - Distribution and Direct Vendor Delivery
  - Total Asset Visibility
  - Total Life Cycle Management
- Incorporates All JPM-IP Legacy Items

JCE Funding

	FY08	FY09	FY10	FY11
JCE R&D $M	2.9	11.9	8.9	13.9

Questions

CBIRF initiated, TSWG & MCSC Supported Enhanced Personal Protective Projects

6 March 2006

Realistic Testing & Evaluation

1) Duplication of actual conditions in combat and the field

2) Develop testing methodologies, verification and validation techniques that truly measure realistic conditions found in the field. And not necessarily because they are easy to perform or duplicate in the sterile and clinical venues of the standard laboratory.

3) Develop verification and validation measurements that encompass entire systems testing. (all closures interfaces and ancillary equipment and their impacts considered)

4) As a result, testing development must continue in the arenas of articulated mannequins and other techniques that duplicate human physiological characteristics in order to more accurately evaluate the performance of total systems IPE in live agent conditions.

CBIRF PARTNERSHIPS

- USAF AFFPBL
- DTRA
- NGB CST
- National Guard Bureau
- NMRC-BDRD
- NIOSH-CDC
- Tech Escort

- USCG NSFCC
- US EPA ERT
- DOE
- FBI HMRU
- FEMA
- U.S. Capitol Police

- FDNY
- S.F. Fire Dept
- Balt. City F.D.
- D.C. Fire Dept
- NYPD

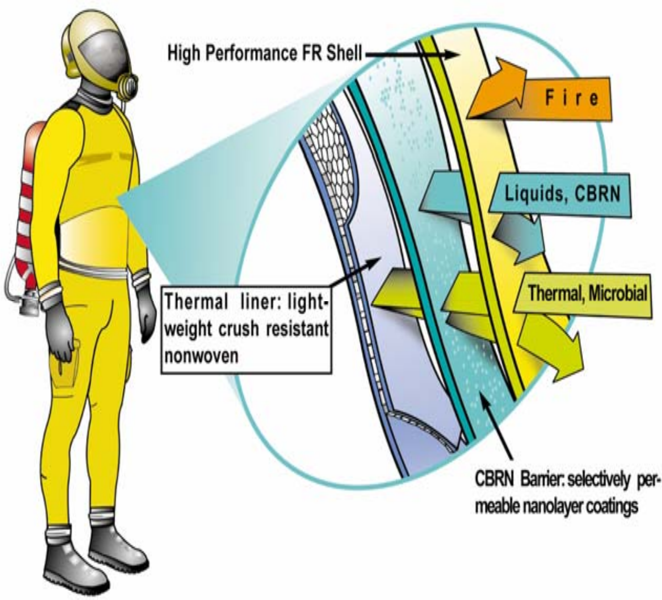
PAST AND CURRENT PROJECTS

- •Improved Filter Protocol
- •Drinking Tube W/COTS Mask
- •Heat Index Calculator
- •Improved Level A Ensemble
- •First Responder Decision Matrix
- •Personal Decontamination Wipe
- •Victim Location Device
- •CBIRF Chemical Concentration Detector/Monitor

All projects will have a dramatic impact on the operational readiness of both Department of Defense (DOD) and Civilian First Responders

Improved Level "A" Ensemble

- Paradigm Shift – Protective factor vice physical description
- Reduce heat related injuries
- Compatible with existing commercial & military PPE –
  - SCBAs, rebreathers, PAPRs & negative pressure masks
- Durable and Fire Retardant Fabrics
- Moisture management & external venting
- Tested against NBC warfare agents and a broad selection of TICS & TIMS
- Cost on a par w/current level A ensembles
- Awarded to Interspiro and W. L Gore



Improved Filter Protocol

- Broad protection from war gases & TIC's.
- Filters tested at realistic human respiration rates of volume & velocity.
  - Cyclic human respiration rates from 50 to a peak of 700 PIAF (Peak Inhalation Air Flows).
- M40A1 & PAPR applications.
- Filter canister failure times in minutes.
- NavAirSysCom and commercial testing of actual Marines' respiration cycles.
- Testing is complete, a whiz wheel was demonstrated with a future computer format to be designed.

Filter Test Plan Overview

- Chemicals to be tested:
  - acrolein
  - carbon disulfide
  - chloropicrin
  - cyanogen chloride (CK)
  - cyclohexane
  - DMMP
  - formaldehyde
  - GB
  - hydrogen chloride
  - hydrogen cyanide (AC)
  - methyl mercaptan
  - phosgene
  - phosphine

- Canisters to be tested:
  - C2
  - C2A1
  - 3M FR-57
  - 3M FR-64
  - Scott CF32 E2-P3
  - Scott CF32 A2B2E2K2-P3
  - MSA Europe
  - MSA IMP2
  - Consideration given to the SEA 50032

Future Considerations (What to do with the results)

- **Filter Performance Database**

- **Filter Performance Predictive Model**

- **Whiz Wheel**

- Hand held PC device
  - Used to provide needed data in the field
  - Can provide information such as protective life or what canister would be best suited for a given situation

- Look-Up Table (Nomogram)
  - Less compact version of the computerized device
  - Would provide same information in a tabular/booklet format

Filter Performance Tool

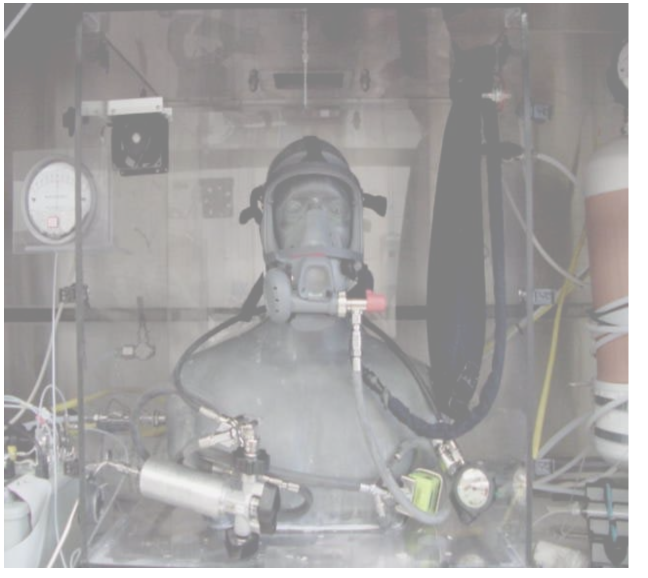
Approach

Using measured data establish design rules (i.e., interpolation) for estimating filter performance.

Develop a broad spectrum filter performance model that can estimate filter service times under a wide range of user conditions.

Re-Hydration in PPE

- Extend strength, endurance and mental acuity down range.
- Hands free drinking system.
- Adaptable to COTS – SCBAs, Rebreathers and PAPRs found in the MEU ENBC packages.
- Initial live agent testing conducted at Battelle Labs produced positive results
- Final testing protocols are completed in accordance with NIOSH
- All engineering, proof of concept, criteria are available with out cost to manufactures from the TSWG.



Heat Index Calculator

- Determine Max safe down range times for first responders in PPE.
- Prevent heat related injuries.
- Input for onsite weather conditions, temp, RH & solar load.
- Input for the level of PPE worn.
- Input for work level intensity.
- PDA configuration.
- Human Physiology thermal testing and evaluation completed with Marines and civilian fire fighters in varying levels of PPE at N.C. State University.

1st Responder Decision Matrix

- A PDA leadership tool for proper selection of PPE based on incident-site analysis and input of:
  - agent concentration
  - climatic conditions
  - personal physiology data of responders
- Establish exact failure & breakthrough times of filters & PPE at various respiratory & work rates as well as concentrations of contamination at the incident site.
- Rapidly assess stay time vs. risk to personnel

Decontamination Wipes

- Provide a “handout” decontamination packet to ambulatory & coherent victims (take decon to the victim)
- Begin the decontamination process w/minimum instruction.
- A mitt or sponge type applicator
- Safe for skin, wounds & mucus membranes
- Color or dye to contrast clean & contaminated areas
- Must neutralize NBC agents or immobilize un-neutralized agent
- Soap & water soluble
- Complete instructions on the external packet
- Replaces the M291 Kit
- LLNL optimizing solution for maximum efficacy.

Victim Location Device

- Determine casualty location and viability to concentrate rescue efforts
- Function in all-environments i.e. heterogeneous rubble, smoke, dust, & urban canyons
- Function in –20°F to 120°F (inclusive).
- Self testing and maintainable by operator.
- Battery and portable generator powered.
- 10’ minimum search scan with maximum stand-off distance.

CBIRF Chemical Concentration Detector

- Set up W/I 5 min.
- Individual or "series" operation.
- Battery ops 24 hrs or Hard wired or telemetry.
- Deconable.

- Detect and monitor War Gases and TIC's CTs @ not more than IDLH.
- Indoor and out door operation (temp range, precip.& RH)

Points of Contact

CBIRF

LCDR Paul Brochu 301-744-2087 brochupa@cbirf.usmc.mil
Sam Pitts 301-744-2029 pittssc@cbirf.usmc.mil

TSWG

Gabriel Ramos, 703-602-6203 ramosg@tswg.gov
Beth Lancaster, 703-604-0502 lancasterb@tswg.gov

MCSC

Ron Brann, 703-432-3208 ronald.brann@usmc.mil
Adam Becker, 703-432-3210 adam.j.becker1@usmc.mil

Novel Closures & Interfaces for Chemical-Biological Clothing

Scena Proodian
Navy Clothing & Textile Research Facility
508-233-4172 X325
sproodian@nctrf.natick.army.mil

Novel Closures Team

- Joint Service
- Co-located with other CB teams at Natick

Objective

Develop & demonstrate

simple, user and mission friendly

closures and/or interfaces

applicable for CB

to

improve liquid, vapor and/or aerosol protection

Closures & Interfaces

Garment Front Opening

Mask - Hood or Neck Area

Hand Protection – Sleeves

Foot Protection - Legs

Coat - Trousers

Technical Approach

- *Leverage past work, lessons learned and user input*
- *Develop and prototype concepts*
- *Test & Evaluate*

Progress to Date

- Survey (Market & Retail)
- Outdoor Retail Show
- Contract with Developer

Progress to Date

Initial JSLIST design to improve neck mobility & reduced bulk

Path Forward

- Down-select & finalize designs
- Fabricate garments or modify current systems
- System testing
  - MIST & Aerosol
  - Human Factors
- Review/downselect optimum designs
- User Review & Input

Individual Protection

Science and Technology

Tony Ramey

Protection

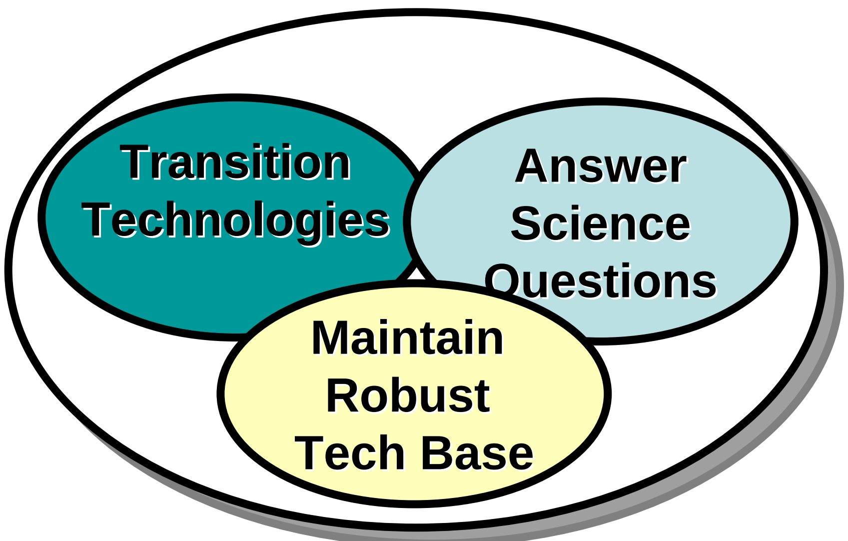
Capability Area Program Officer

Agenda

- **Objectives**
- **Gaps and Priorities**
- **Taxonomy**
- **Strategy**
- **FY06 Program**
- **FY07 Topics**
- **Acquisition Programs**
- **Fiscal Summary**

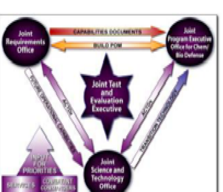
Objectives

Develop science and technology to support acquisition programs of record and to meet future defense capability needs.



Mission Space

- *Maneuvering warfighters*
- *Installation protection*
- *Homeland defense*
- *Global war on terrorism*



Summary of Capability Gaps (JRO)

- Overarching Gaps
  - Protection/performance against emerging CBRN hazards
  - Reduced physiological and logistical burden
  - FDA approval
  - Expeditionary Collective Protection
  - CBRN survivability of Equipment

CPE

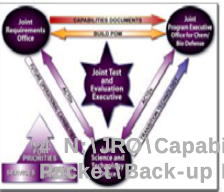
- Reduced size, weight and power requirements
- Insufficient quantities account for bulk of overall transportable CP gap
- Hospital & most amphibious ships lack CP capability

Percutaneous

- Reduced heat load and physiological burden
- Complete protection against dusty agent aerosols

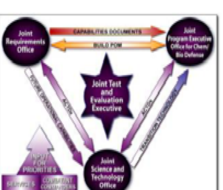
Respiratory & Ocular

- Complete protection against toxic industrial chemicals



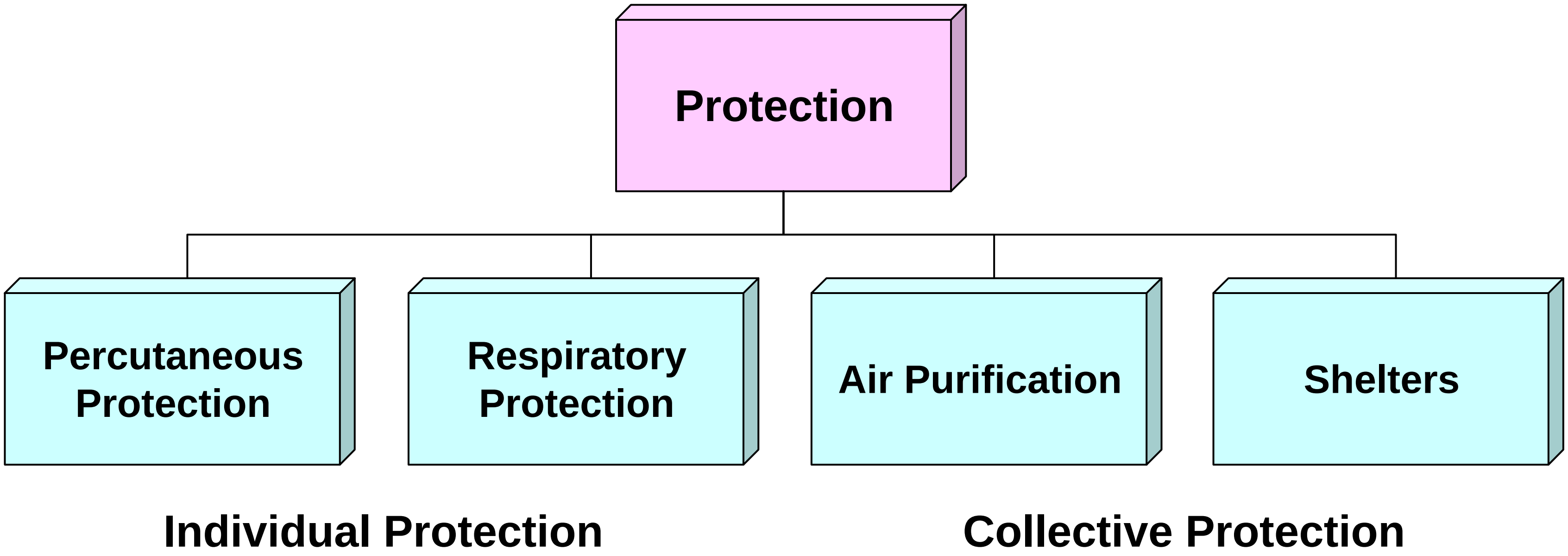
*Prioritize on the user's baseline capability requirements **

- Stand-off CB Detection (range, agents, & accuracy)
- Integrated Early Warning
- Battlespace Management & Analysis
- Expeditionary Collective Protection
- Decontamination of Emerging Agents
- Decontamination (sensitive equipment, materials compatibility, and vehicle interiors)
- Respiratory Protection (Toxic Industrial Chemicals (TIC) protection)
- Point Detectors (size, accuracy, cost of operation)
- Percutaneous Protection (aerosols and heat burden)
- Fixed Site Decon



*** Condensed from Baseline Capability Assessment (BCA)**

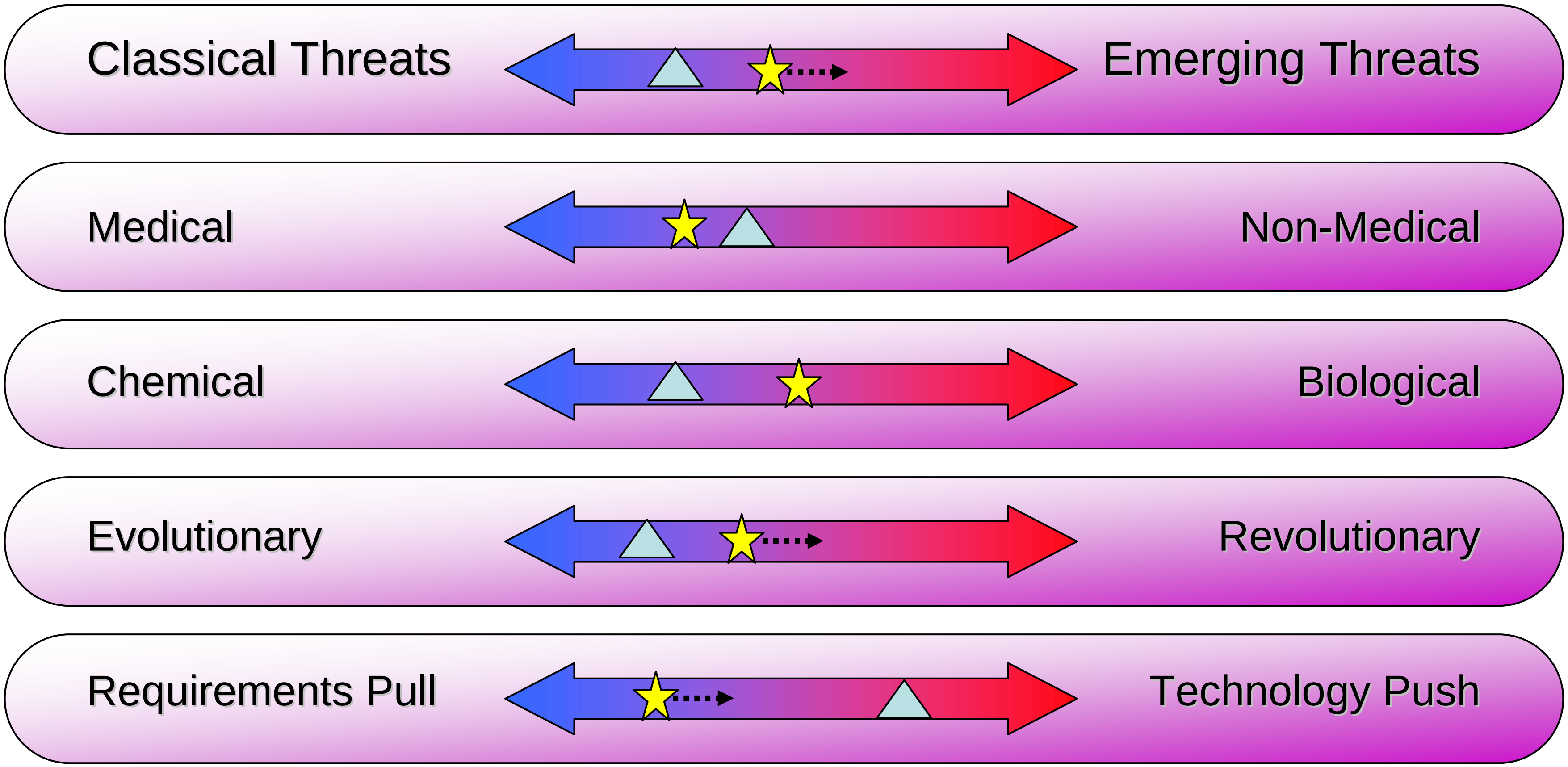
Capability Area Taxonomy



Physical S&T Program Strategy

- Balance between requirements pull and technology push
- Exploit Cutting Edge Technologies
- Find and Fund the Best Performers
- Sustain Long-Term Investment

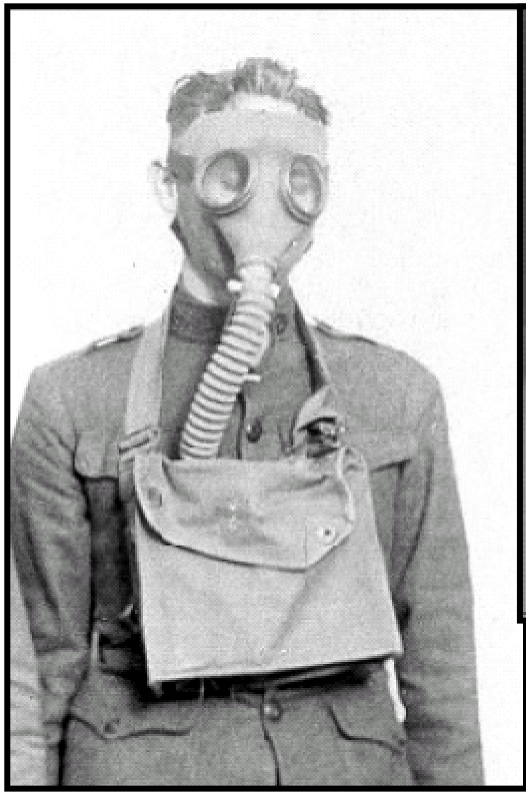
Multiple Dimensions to Consider for S&T Investment



Current

Old

Individual Protection Equipment of the Past



Fielded Individual Protection Equipment

Near Term Objectives (FY06-FY08)

Enhanced TIC protection through advanced filtration

Improved confidence and reduced logistics through filter end-of-service-life indicator

Enhanced aerosol protection through improved materials and closures

Mid Term Objectives (FY09-FY11)

Enhanced TIC and aerosol protection through enhanced mask seals

•Overarching model of IPE
•Standardized T&E procedures for IPE
•Better simulants for IPE

In situ neutralization of C&B through reactive materials in clothing materials

Far Term Objectives (FY12+)

Advanced mask concepts for improved comfort and enhanced equipment compatibility

Elastomeric permselective membranes for enhanced aerosol protection and better fit

Non-sorbent based air purification for reduced breathing resistance and broad spectrum protection

Intelligent garments for enhanced moisture vapor transport

Advanced Sensors

Factors Impacting Far Term Development

Threat

- Type
- Concentration
- Exposure Time

Warning

- Sensor Standoff
- Model Prediction
- Information Flow

FY06 IP Technology Program

Protection/performance against emerging CBRN hazards (Overarching)

- Enhanced Technology for Respiratory Protection
- A Dual-Cavity Respirator Offering Increased Levels of Respiratory Protection and Mask-Fit Indication
- Self-Detoxifying Filter Particulate Media for IP and ColPro (Congressional)

Reduced physiological and logistical burden (Overarching)

- Advanced Mask Concepts

Complete protection against toxic industrial chemicals (Respiratory)

- Optimized Adsorbent Compositions and Modeling

Reduced heat load and physiological burden (Percutaneous)

- Intermittent Microclimate Cooling
- Selective and Responsive Nanopore-Filled Membranes (BAA)
- CB Protective Suit Membrane Research (Congressional)

FY06 IP Technology Program

Complete protection against dusty agent aerosols (Percutaneous)

- Self-Detoxifying Materials for CB Protective Clothing
- Effects of High Wind Speed on Agent Penetration of IPE
- Nanowire Mesh Fabrics for CBA Defense (Congressional)

Test and Evaluation

- Standardized Procedure for IPE
- IPE Airflow Mapping
- TIC/Battlefield Set Standard for IPE and COL PRO
- Overarching IPE Model
- Simulants for Protective Equipment Testing
- Simulant Correlation to Real Agent
- IPE Field Effects – DSTL
- Model-Based Design of Test Systems for Chemical Protective Clothing (SBIR)
- Improved System and Methods for Evaluating Protective Material Performance Against CWA (SBIR)
- Protection Against Toxic Industrial Chemicals (Congressional)

FY07 IP Technology Topics

Protection/performance against emerging CBRN hazards (Overarching)

- Enhanced aerosol/particulate protection (filters)

Reduced physiological and logistical burden (Overarching)

- Mask comfort
- Residual-life indicator for clothing

Complete protection against toxic industrial chemicals (Respiratory)

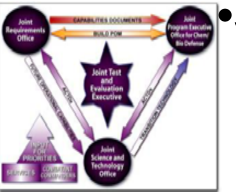
Reduced heat load and physiological burden (Percutaneous)

- Controllable, variable protection
- Microclimate cooling

Complete protection against dusty agent aerosols (Percutaneous)

Test and Evaluation

- Swatch test reference material



Transition Programs

Respiratory Protection

- **Joint Service General Purpose Mask (JSGPM)**
- **Joint Service Aircrew Mask (JSAM)**
- **Next Generation General Purpose Mask (NGGPM)**

Percutaneous Protection

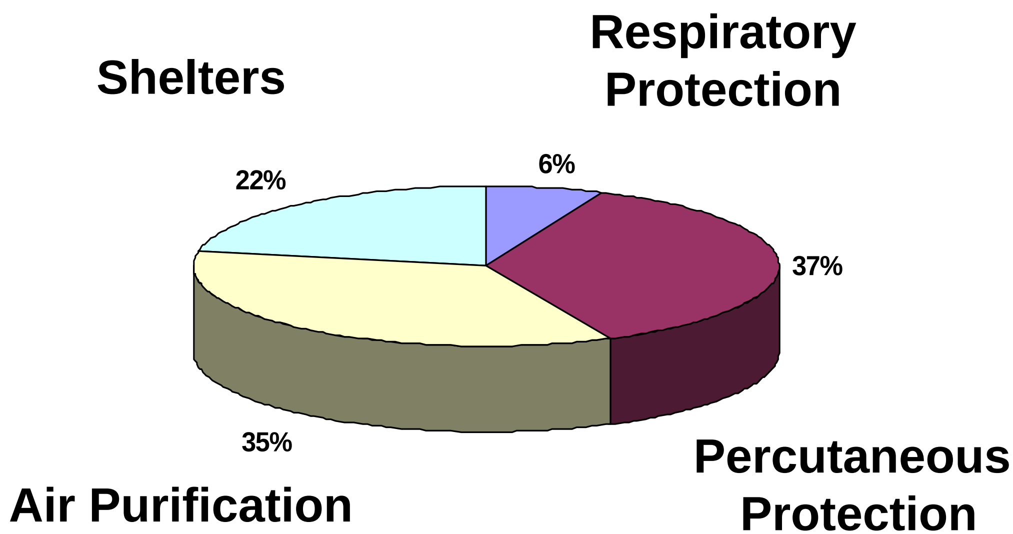
- **Joint Service Lightweight Integrated Suit Technology (JSLIST)**
- **Joint Protective Aircrew Ensemble (JPACE)**
- **Joint Chemical Ensemble (JCE)**

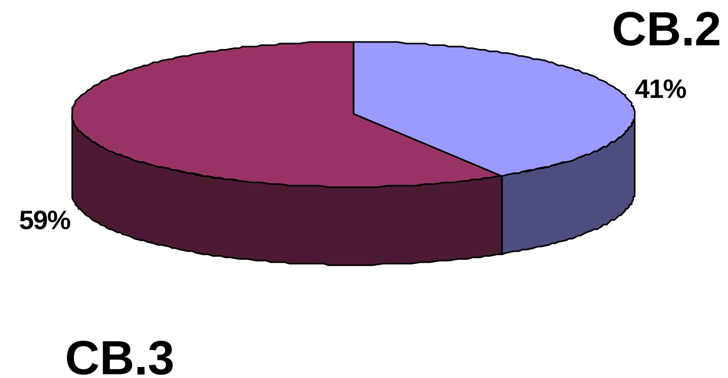
FY06 Core Funding Increases

	FY05($M)	FY06($M)	Increase
CB.1	6.3	15.7	150%
CB.2	62.1	104.3	68%
CB.3	39.9	60.8	53%
Total	108.2	180.8	67%
Detection	33.9	48.9	44%
Mod-Sim	9.1	42.8	372%
Protection	9.6	21.9	130%
Decon	5.2	10.0	91%
Threat Agent Science	31.0	36.6	18%
Basic Rsch/ Transition	19.5	20.7	6%

FY06 *Protection* Funding Summary

- Core Program (including T&E)

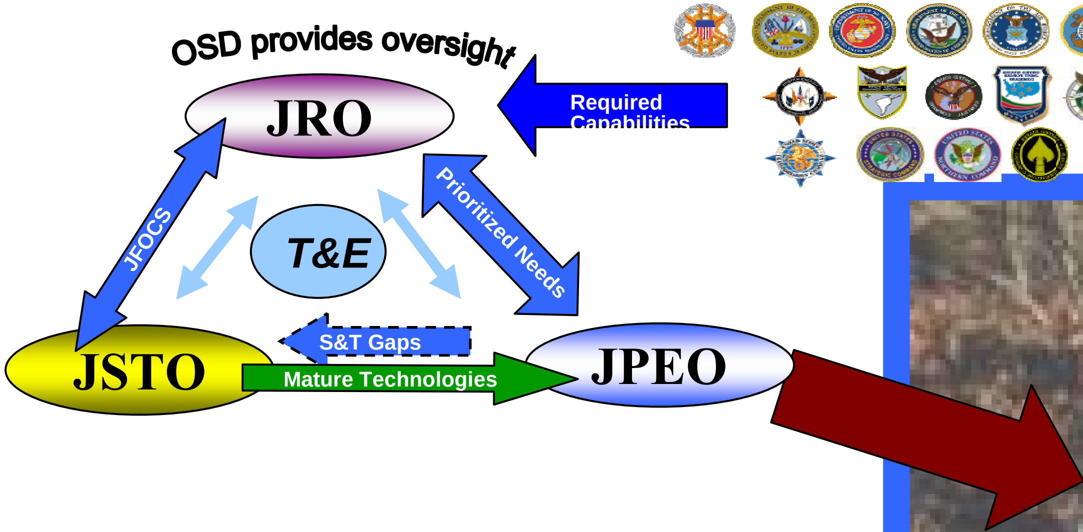




Core Funds by Thrust *Core Funds by Funding Line*

The Bottom Line

- Combatant Commanders
- Services



Individual Protection for Expanding Warfighter Missions

March 8, 2006

PRESENTED TO:
Chemical Biological Individual Protection Conference
Charleston, SC

STEPHEN V. REEVES
Brigadier General, USA
Joint Program Executive Officer
for Chemical and Biological Defense
(703) 681-9600

Introduction

- **Overview of JPEO CBD**
- **Things Shaping What We Do**
- **Key Technology Needs**

Joint Program Executive Office for Chemical and Biological Defense

Mission

The Joint Program Executive Office for Chemical and Biological Defense is Responsible for Research, Development, Acquisition, Fielding, and Life-cycle Support of Chemical, Biological, Radiological, and Nuclear (CBRN) Defense Equipment, Medical Countermeasures, and Installation and Force Protection Supporting the National Military Strategy

Chem/ Bio Defense Program Acquisition Organizations

Defense Acquisition Executive
(USD-ATL)

Executive Agent

Army Acquisition Executive
(ASA-ALT)

Joint Program Executive Officer

Joint Project Managers

Requirements

Joint Requirements Office
J-8

Science & Technology

Defense Threat Reduction Agency - Chem/ Bio Directorate

Test & Evaluation

Test & Evaluation Executive
(DUSA-OR)

OSD Oversight

ATSD (NCB)

DATSD (CB)

Joint Doctrine & Training

Joint Staff

US Army Chemical School

50 USC 1522

What We Do Every Day

- **Support Current Operations**
- **Improve Current Systems**
- **Build the Future**

The Mission

Current Operations | Improve Existing Capabilities | Future Capabilities

Mature/ Maturing Technology | New Technology

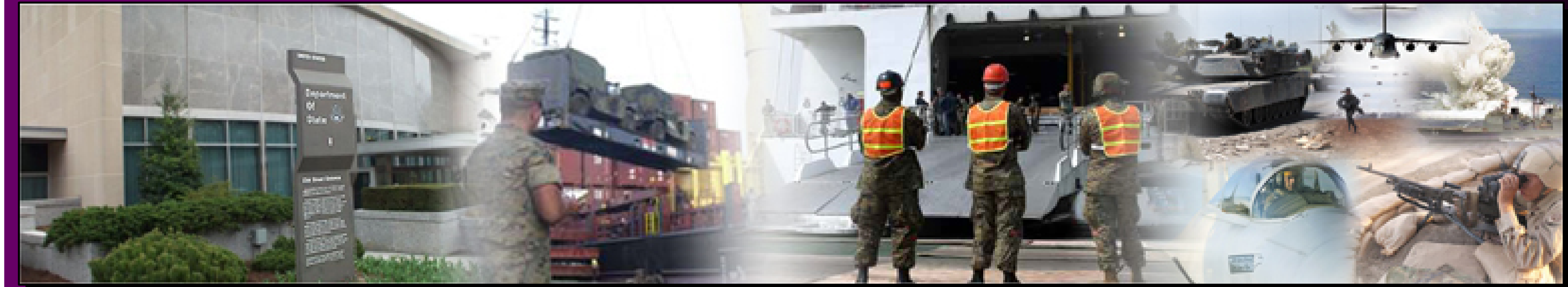
APPLY TECHNOLOGY FOR WARFIGHTING CAPABILITIES

DoD Chemical and Biological Defense

Expanding Roles and Missions

Infrastructure Power Projection Battle Space

"Threats"



"Classic" CBW	Bio-Engineered And "Non-Traditional" Threats	Environmental Threats - Toxic Industrial Chemicals (TICs)/ Toxic Industrial Materials (TIMs)	Environmental/ Medical Surveillance Infectious Diseases

Things Shaping What We Do

- Quadrennial Defense Review – February 2006

- Homeland Defense Strategy – June 2005

- Stability Operations

The 2006 Quadrennial Defense Review

- Applies Lessons from Four Years of War Against Violent Extremists
- Continues the Transformation of the DoD to Meet the Changing World Threat
- Promotes Intergovernmental Cooperation
- Emphasizes Building our Coalition Partner's Military Capabilities to Fight the Global War on Terror

Defense Strategy
Security Environment: 4 Challenges

Higher

Irregular

- Unconventional methods adopted and employed by non-state and state actors to counter stronger state opponents. *(erode our power)*

(e.g., terrorism, insurgency, civil war, and emerging concepts like "unrestricted warfare")

Catastrophic

- Surreptitious acquisition, possession, and possible employment of WMD or methods producing WMD-like effects against vulnerable, high-profile targets by terrorists and rogue states. *(paralyze our power)*

VULNERABILITY

Lower

Traditional

- States employing legacy and advanced military capabilities and recognizable military forces, in long-established, well-known forms of military competition and conflict.

(challenge our power)

(e.g., conventional air, sea, and land forces, and nuclear forces of established nuclear powers)

Higher

Disruptive

- International competitors developing and possessing breakthrough technological capabilities intended to supplant U.S. advantages in particular operational domains.

(capsize our power)

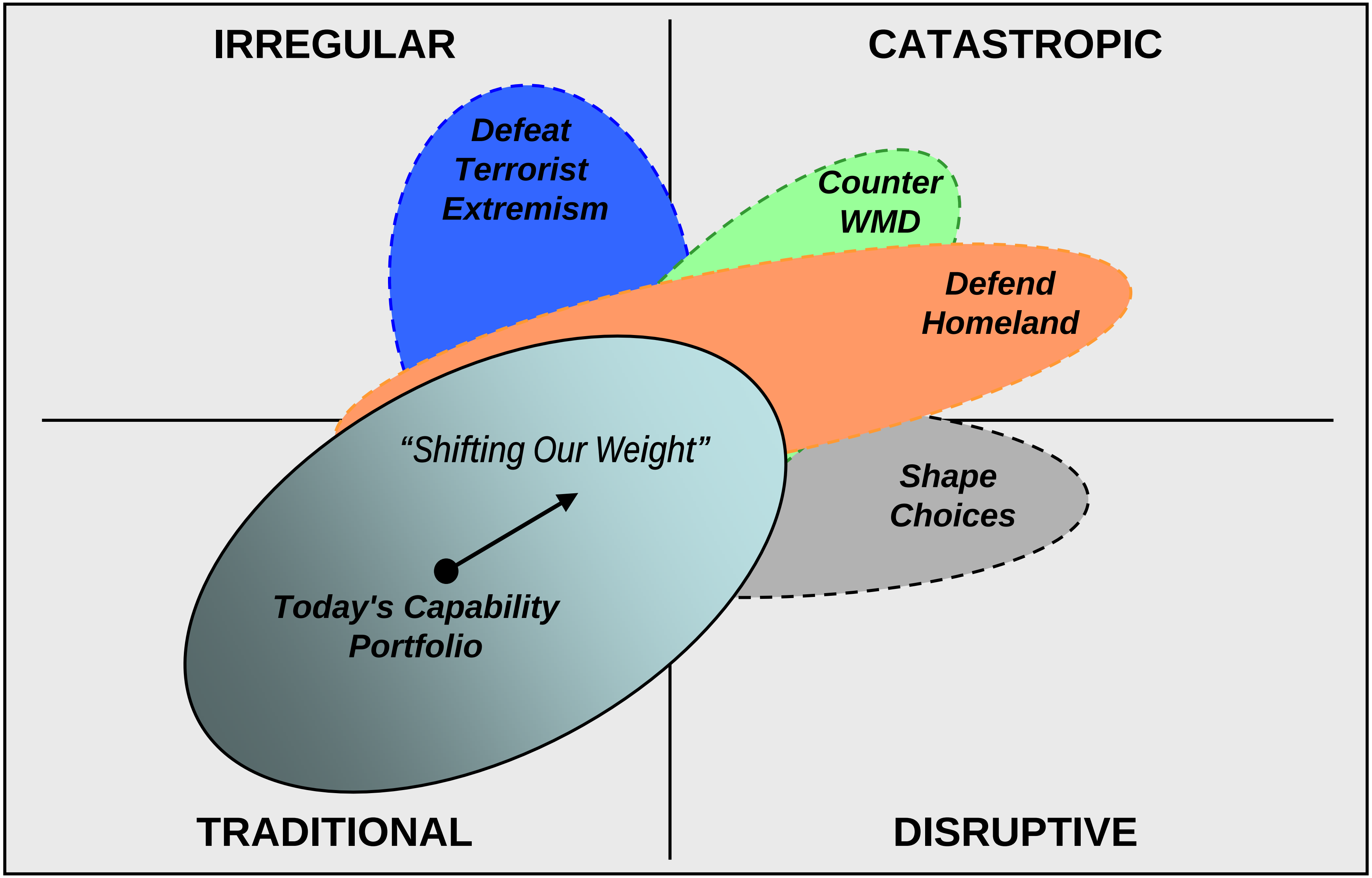
(e.g., sensors, information, bio or cyber war, ultra miniaturization, space, directed-energy, etc)

Lower

LIKELIHOOD

No Hard Boundaries Distinguishing One Category from Another

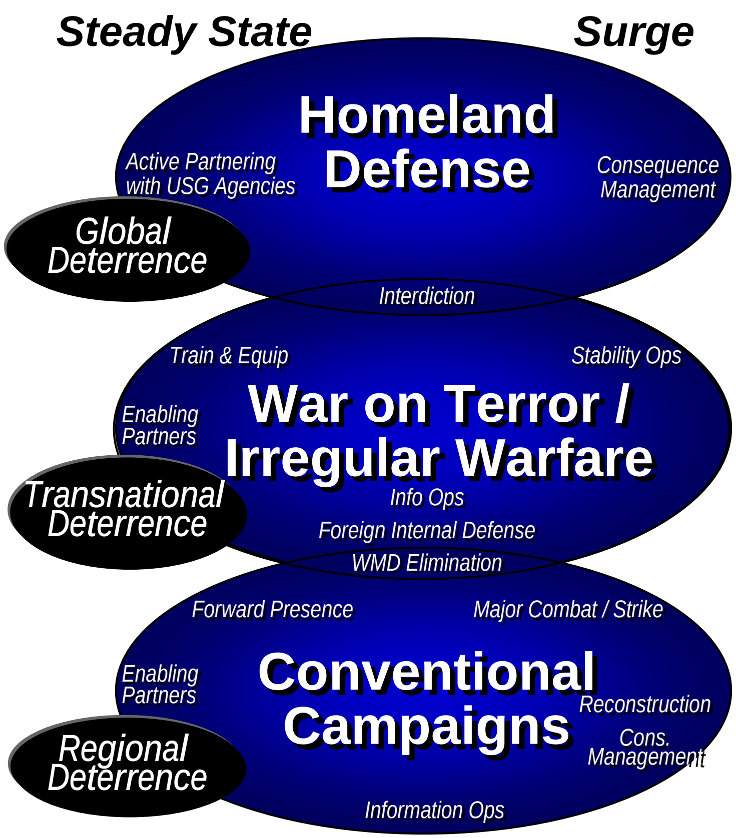
Re-Balancing Future Force Capabilities



Refined Force Planning Construct

Construct for Shaping the Future Force

- Steady-state & surge operations
  - Homeland Defense
  - Sustained Irregular Warfare
  - Conventional Campaigns
- Tailored Deterrence
  - Advanced Military Competitors, Rogue States, Terrorist Networks
  - Strengthened Deterrence Against Opportunistic Aggression/Coercion
- Two-war capacity
  - Varying Levels of Effort
  - Stress-on-the-Force Elasticity



Sizing Variables:

Frequency	Number	Scale / Intensity
Concurrency	Ops Risks	Duration
Policy	Environment	Partner Capabilities

QDR and WMD

- Countering WMD Remains a DoD Priority
- Organizing, Training and Equipping Future Forces Designed to Combat WMD is a Priority
- Funding for Chemical and Biological Defense Programs Has Increased 40% Since 2001 and Will Remain Constant at ~1.4 - 1.6B

Radical Islamists On Using CBRN

- **"use of nuclear, dirty bombs, chemical and biological weapons by martyrs is justified as part of holy war strategy" (al-Qaeda message board, 11 August 2005)**

- **"Attacking Washington Metro with chemical weapons to achieve amazing results" (al-Qaeda message board, 11 August 2005)**

- **"The nuclear war is the solution for destruction of the United States." (Radical Islamist website, 26 December 2002)**

So What?

Fallujah 2004

Chemical Bottles

Potassium Cyanide

Potassium & Sodium Cyanide

Sensitive Site Exploitation Teams

Mission: Identify NBC Weapon Stores and Manufacturing Facilities.

Challenge: Provide “Full Spectrum” Individual Protection and Chemical/ Biological Detection Capabilities.

Capabilities Protecting the Warfighter

JPM IP Programs/Procurements

- **New/ Ongoing Programs:**
  - **Joint Service Lightweight Integrated Suit Technology (JSLIST) Ensemble, Garment, JB1GU, JB2GU, MPS, MULO, AFS**
  - **Joint Protective Aircrew Ensemble (JPACE)**
  - **JSLIST Additional Source Qualification (JASQ)**
  - **Joint Service General Purpose Mask (JSGPM)**
  - **Joint Service Aircrew Mask (JSAM)**
  - **Joint Service Chemical Environmental Survivability Mask (JSCESM)**
  - **M45 Mask**
  - **Joint Service Mask Leakage Tester (JSMLT)**

Upcoming Efforts

PRODUCTION:			
Joint Chemical Ensemble (JCE) *	JPM IP	FY08	$37.6M
JSLIST Spiral	JPM IP	FY09	
JSCESM	JPM IP	FY09	

SCIENCE & TECHNOLOGY:			
Enhanced Respiratory Protection	JSTO/ ECBC	FY06-08	
New Generation Mask	JSTO/ ECBC	FY06-08	

**** Competitive Contract***

Key Technical Challenges

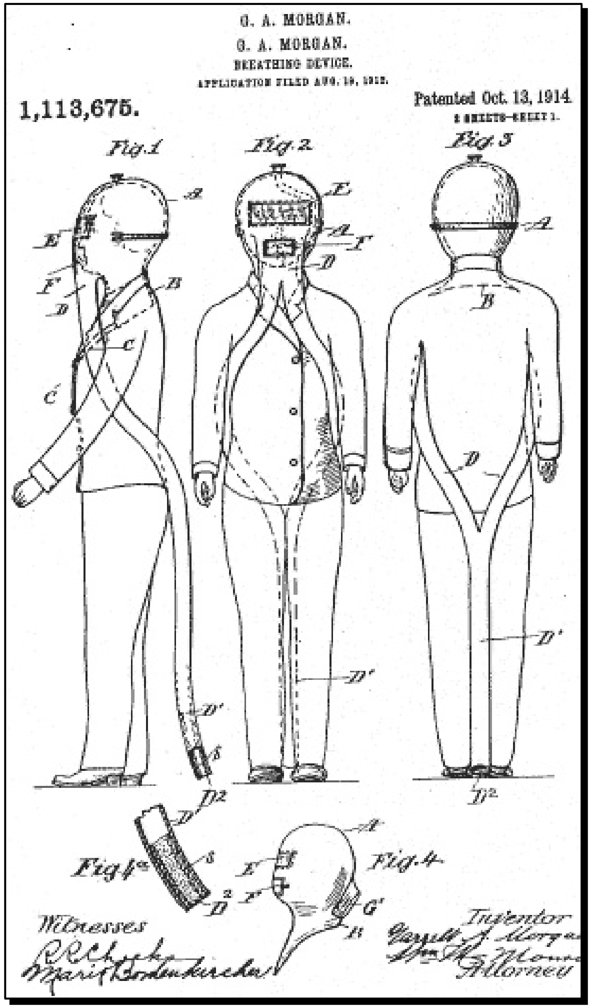
- **Filters:**
  - Longer Lasting
  - Higher Flow Capacity
  - Lower Breathing Resistance
  - Toxic Industrial Chemical Capability
  - Meet New NIOSH CBRN Standards
- **Fabrics:**
  - Lighter
  - Cooler
  - More Resistant to Threats
  - Better Durability and Ruggedness
  - Residual Life Indicators
  - Dual Warfighter/ Responder Certifications

Technology Opportunities

- **Self-Detoxifying Materials:**
  - Lightweight
  - Chem/ Bio Protective
  - Employ Nanofibers, Nanoparticles, and Nanoreactors

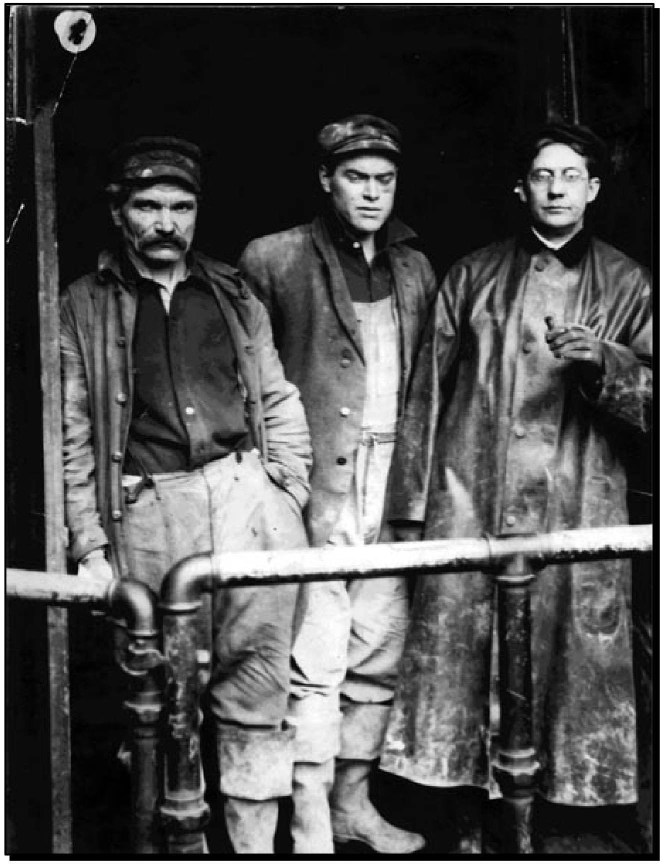
- **End-of-Service-Life Indicators for Filters:**
  - NBC Mask Filters
  - Low-Cost
  - Senses Many Chemical Warfare Agents (CWAs)

Garrett A. Morgan
1875-1963



Inventor, Entrepreneur, Hero

The Water Crib Tunnel Disaster
25 July 1916



Accepted Risk – Produced Results

WMD Threat Perspective

"The greatest threat before humanity today is the possibility of secret and sudden attack with chemical or biological or radiological or nuclear weapons."

President George W. Bush, February 11, 2004

Summary

- **Individual Protection Threats are Real**
- **Training and Equipping Future Forces to Combat WMD is a Priority**
- **Expanding Mission Sets Require New Equipment, New Technologies**

Joint Program Executive Office

Chemical and Biological Defense

JPEO-CBD

Cradle-to-Grave Test and Evaluation Approach

8 March 2006

Fred Schmalkuche
Test Engineer
JPMO - Individual Protection
(703) 432-3504
fred.schmalkuche@usmc.mil

Overview

- **Approach**
  - Revolutionary not Evolutionary
  - Early Involvement
  - Empowerment
- **Process Activities**
  - Training
  - Test Resources Support
  - JEAP Liaison
  - Validation
- **Test Activities**
  - Test Architecture
  - Next Generation Tools

Revolutionary vs Evolutionary

– JPMO-IP looking toward the future

– Engineering (S&T) working in unison with T&E to locate the next generation ensembles
  - Dedicated CAPO at DTRA
  - Thrust Manager assigned to and working in the JPM-IP Office
  - Technology Transition Agreements

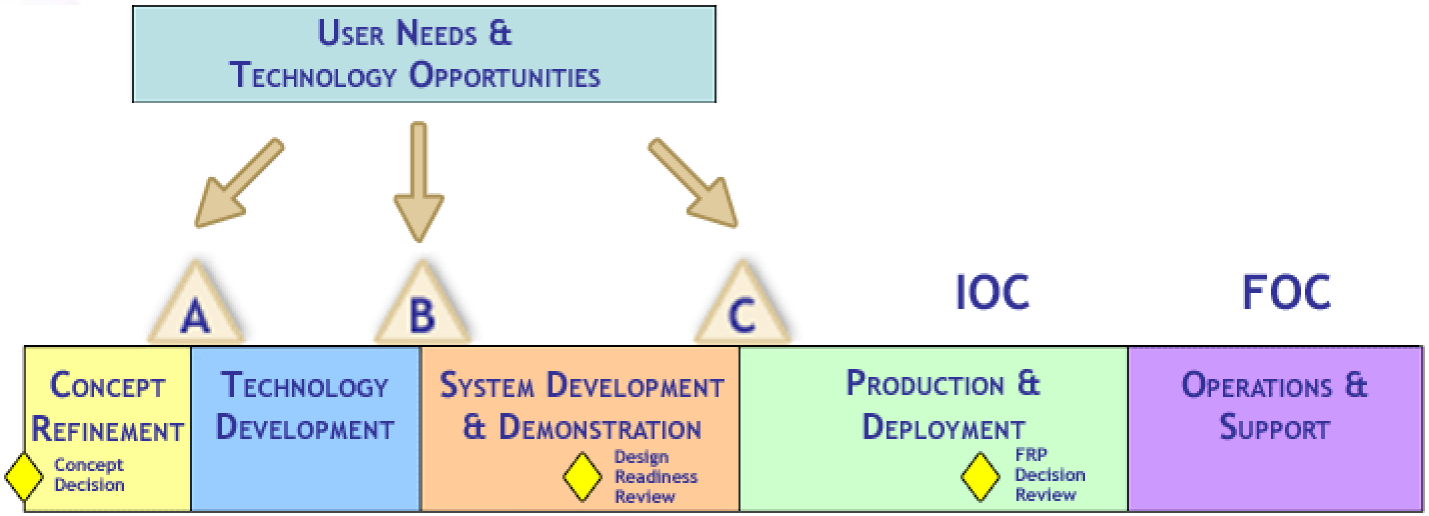
– New Technologies
  - Academia
  - Industry
  - Government

Early Involvement

- **Requirements**
  - Must involve all stakeholders; Joint Requirements Office, Combat Developers, OTA'S, Material Developers, DOT&E (if applicable)
  - Must be Testable, Measurable, Achievable, Meet the needs of the Warfighter
  - Common Mistakes
    - Tie new technology to old
    - Don't take advantage of emerging technology because it does not match existing OMS/MP and COE
  - Examples
    - JSMLT: System failed all 3 KPPs but identified 95.5% of faulty Masks in the field
    - JB2GU: 480 hour wear requirement

Early Involvement

- **T&E Strategy**
  - **Develop T&E Strategy during Concept Refinement phase**
  - **Establish T&E WIPT as soon as material need is identified (before acquisition activities begin.)**
  - **Manage T&E Process “end to end” ensuring test, methodology, and M&S efforts fully assess the system.**



Empowerment

What happens without empowerment?….Nothing

- “With regard to T&E issue resolution, each CBDP system T&E WIPT will resolve as many issues and concerns as possible at the working level and expeditiously escalate those needing resolution at a higher level.” CBDP T&E Executive

- IPTs must consist of empowered members; common stumbling blocks include:
  - Representatives not empowered to speak for parent organization
  - Terms of agreements changed afterward
  - No timely follow-up on actions so no resolution before next IPT meeting

JPM-IP T&E Training

GOAL = Prepare JPM-IP Test Engineers to Become Leaders in the T&E Community

- DAU provides Targeted Training, Consulting, Mentoring
  - MCOTEA, OSD and JPEO-CBD Participation
  - Instructors benefit from student feedback and from observing project team meetings
  - Training briefs and reference materials archived on IDE
- Participation in OTA training
  - Gain understanding of each OTA's perspective and operating procedures
- AWCF certification and continuous learning emphasized

JPEO-CBD

Cross-functional Training

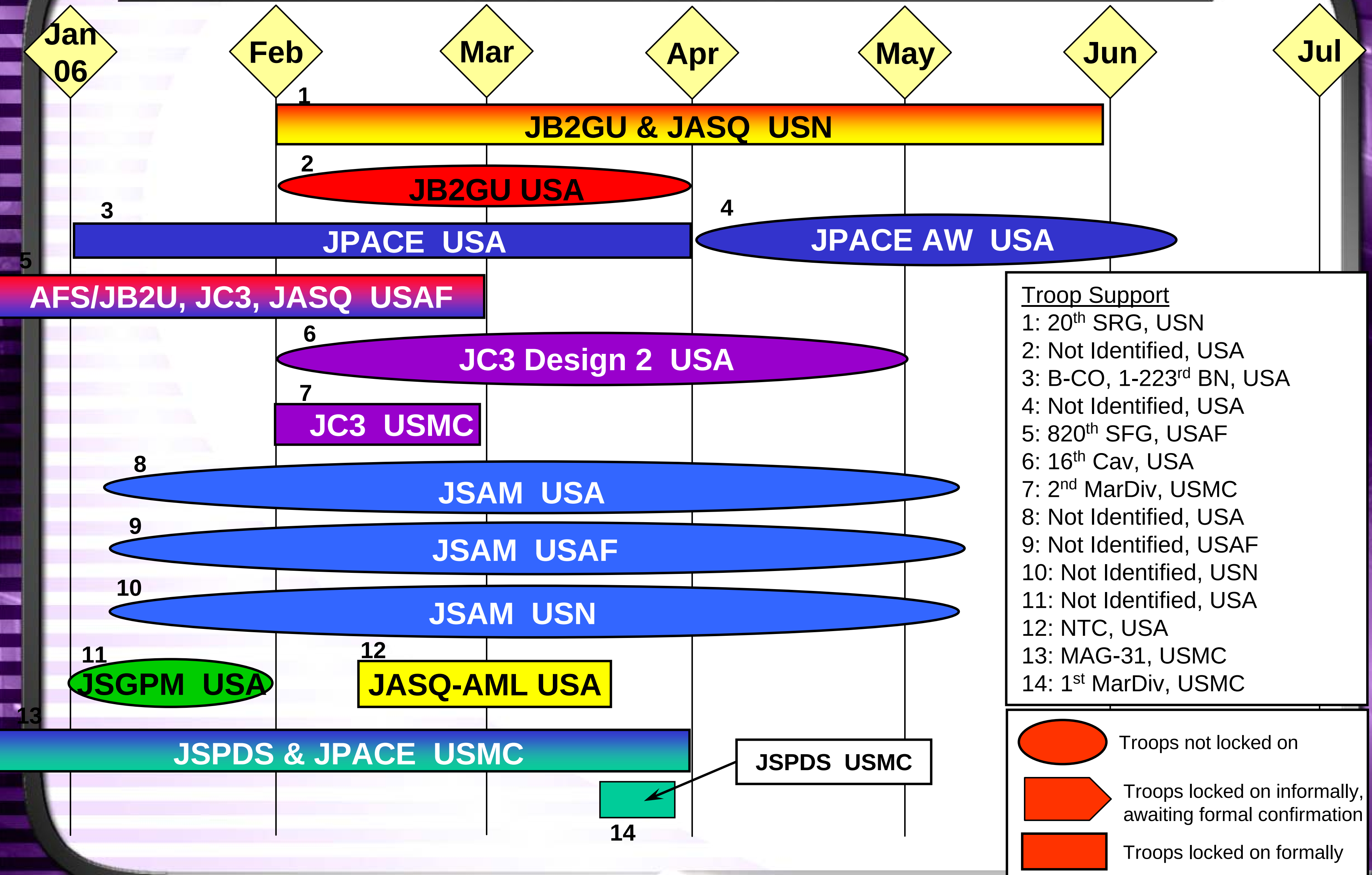
- **Current Developmental Assignments**
  - ECBC Intern
  - Scientist exchange with DPG
  - Test Engineer exchange with AEC

- **Goals**
  - Provide unique OJT for recent hires at ECBC
  - Gain understanding of other T&E roles in acquisition process
  - Foster better working relationships

Test Resources Support

- Obtain test participants, equipment, ammo, ranges and all services necessary to support testing
- Work within Service processes for obtaining troop support
- Assist Services in identifying potential units for support
- Seek alternative sources for test participants when necessary
  - Coast Guard
  - Schoolhouses
  - Training Centers
  - Combine programs when possible to maximize benefit of support
    - JPACE, IFS, JB2GU
    - JASQ Unique, JSPDS
- Be prepared for changes and have back-ups identified
  - High optempo with OIF, OEF and relief efforts

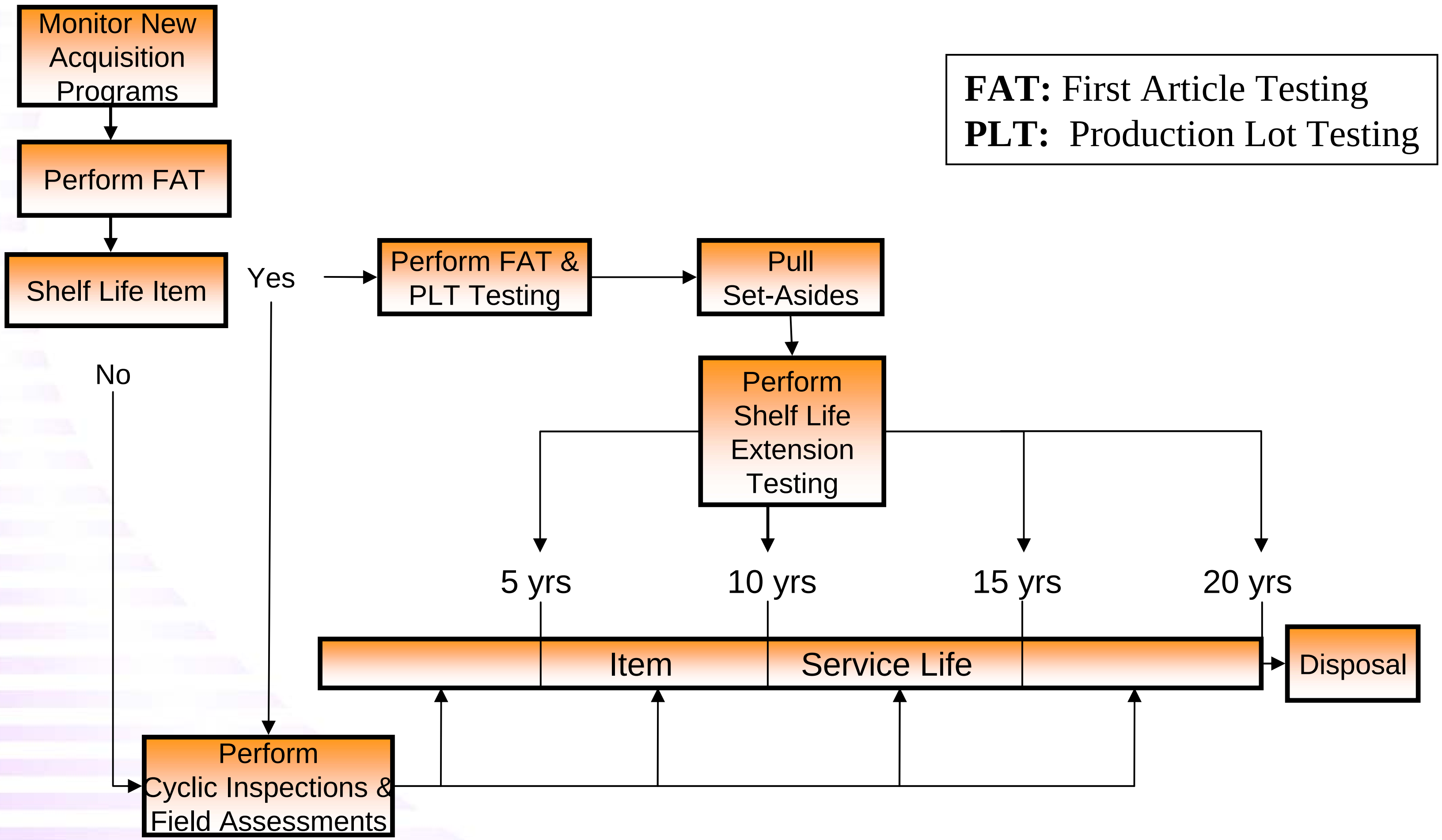
Overarching Test Strategy



JEAP Liaison

- Transition of Acquisition Efforts
  - Work closely with Joint Equipment Assesment Program (JEAP) organization, labs, logistics community
  - Production Lot Testing
  - Traceability
  - Acquisition – Coordinate surveillance requirements
  - Surveillance – Cradle to Grave accountability
    - Involve DPG exchange scientist
  - Requirements/Logistics coordination
    - Incorporating logistics traceability during the Combat Developers documentation process

Surveillance Process
"Cradle to Grave"



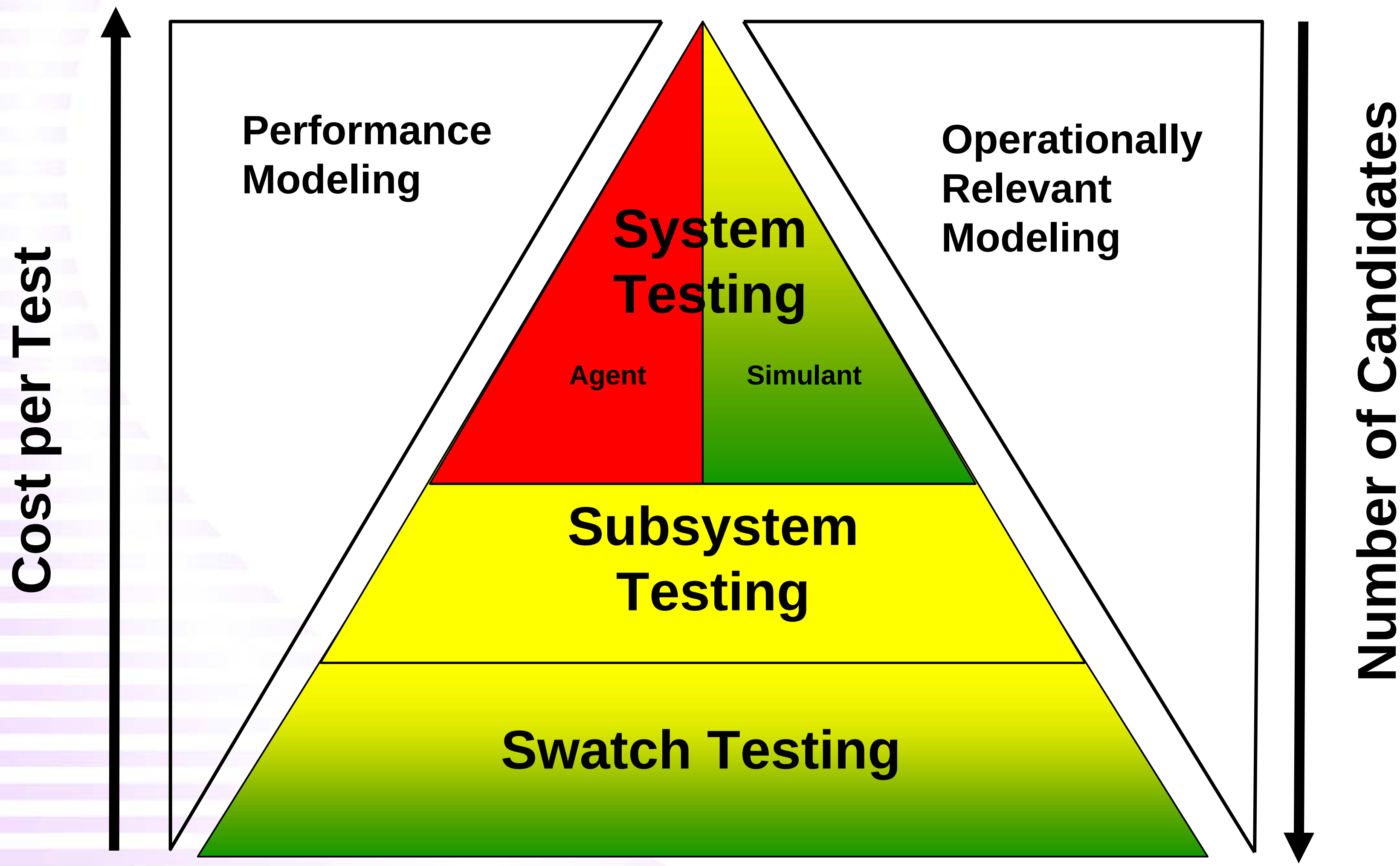
FAT: First Article Testing
PLT: Production Lot Testing

Periods vary depending on the equipment type and assigned Shelf Life Code

Test Method Validation

- Objective
  - Valid data to make sound milestone decisions
  - Intralab and Interlab Validation
- Structure
  - Chair Test Director JPM-IP
  - WGTMVC, OTMVC
  - Full community and SME involvement
- Examples
  - MIST
  - SMARTMAN
  - PATIC

Test Architecture



Next Generation Tools

- Overarching Model
- CBART
- Improved Aerosol
- PETS
- Real-time sampler for MIST
- NTA Chamber

Backups

Acronym List

AEC – Army Evaluation Center
AWCF – Acquisition Workforce Career Field
CAPO – Capability Area Program Officer
CBART – Chemical Biological Agent Resistant Test
CBDP – Chemical and Biological Defense Program
COE – Concept of Employment
DAU – Defense Acquisition University
DOT&E – Director, Operational Test and Evaluation
DPG – Dugway Proving Ground
DTRA – Defense Threat Reduction Agency
ECBC – Edgewood Chemical Biological Center
FAT – First Article Test
IDE – Integrated Data Environment
IFS – Integrated Footware Solution
IPT – Integrated Process Team
JASQ – JSLIST Alternate Source Qualification
JB2GU – JSLIST Block 2 Glove Upgrade
JEAP – Joint Equipment Assessment Program
JPACE – Joint Protective Air Crew Ensemble
JPEO-CBD – Joint Program Executive Office for Chemical and Biological Defense
JPMO-IP – Joint Program Management Office for Individual Protection
JSLIST – Joint Service Lightweight Integrated Suit Technology
JSMLT – Joint Service Mask Leakage Tester
JSPDS – Joint Service Personnel Decon System
M&S – Modeling and Simulation

Acronym List (cont)

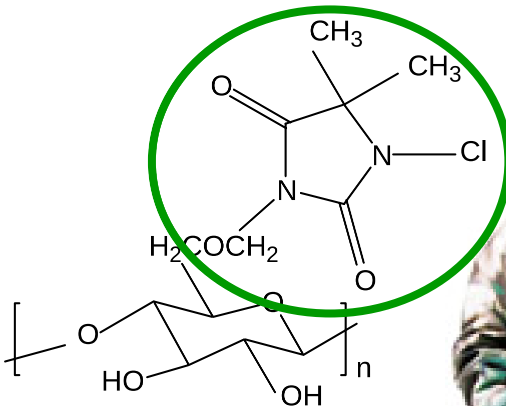
MIST – Man In Simulant Test
MCOTEA – Marine Corps Operational Test and Evaluation Agency
OEF – Operation Enduring Freedom
OIF – Operation Iraqi Freedom
OJT – On the Job Training
OMS/MP – Operational Mode Summary/Mission Profile
OSD – Office of the Secretary of Defense
OTA – Operational Test Agency
OTMVC – Overarching Test Methods Validation Committee
PATIC – Protection Against Toxic Industrial Chemicals
PETS – Protective Ensemble Test System
PLT – Production Lot Test
S&T – Science and Technology
SMARTMAN – Simulant Agent Resistant Test Mannequin
SME – Subject Matter Expert
T&E – Test and Evaluation
TTA – Technology Transition Agreement
WGTMVC – Working Group Test Methods Validation Committee
WIPT – Working Level IPT

Reactive Materials Research for Self-Detoxifying CB Protective Clothing

Heidi Schreuder-Gibson
U.S. Army Natick Soldier Center
Natick, MA

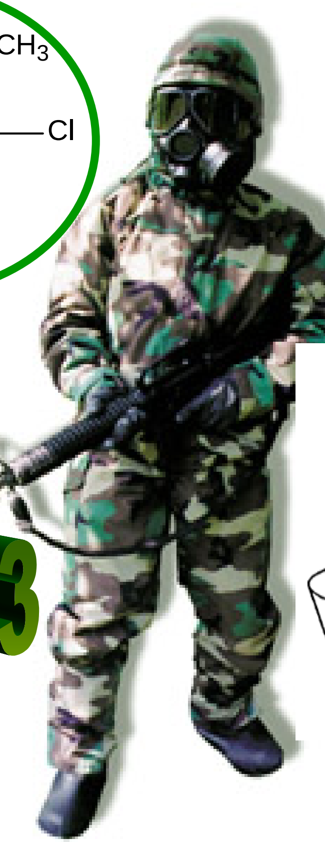
Concept

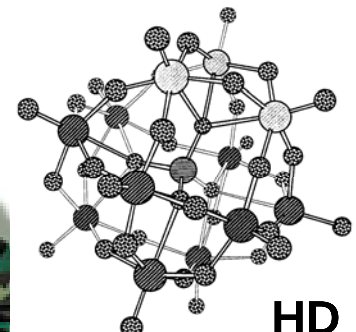
Place reactive materials in fabrics that detoxify Contaminants on clothing within hours of exposure.



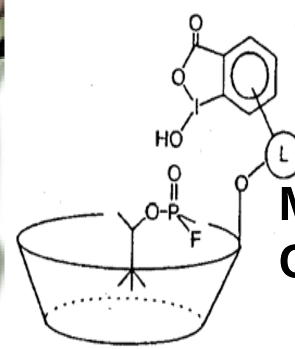
CHLORAMINE

Bactericide, Agent Decon



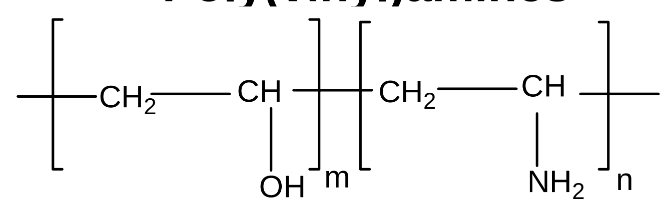


HD Catalyst



Modified Cyclodextrins

Poly(vinyl)amines



Approach

Chloramides & Quats -Shell Fabric

Bio, HD, VX

Sporicide and Agent Decon, Water Repellancy

POM Catalysts – Liner Materials

HD Carbon Surfaces

Polymer Film Surfaces

Nanoparticles – Attached to Fabrics,

HD, VX Blended into Fibers

Particulate Absorbants

Reactive Permselective Membranes - Liners

G, VX

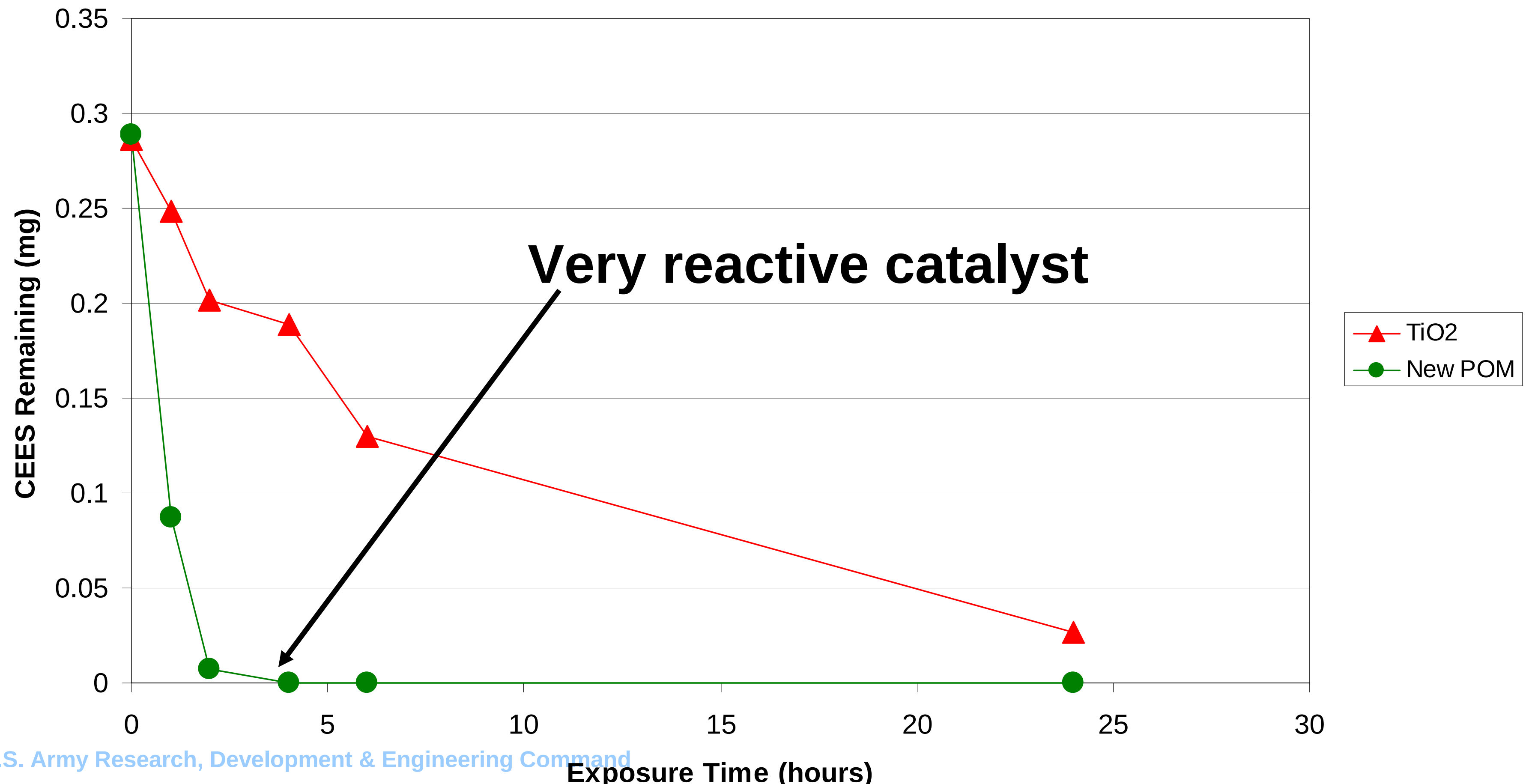
Nanoparticle Reaction Rate Studies

Depletion of 2-CEES

- In Solution
- In Vapor

Solution Depletion of 2-CEES

Nanoparticle TiO_2 vs POM Catalyst

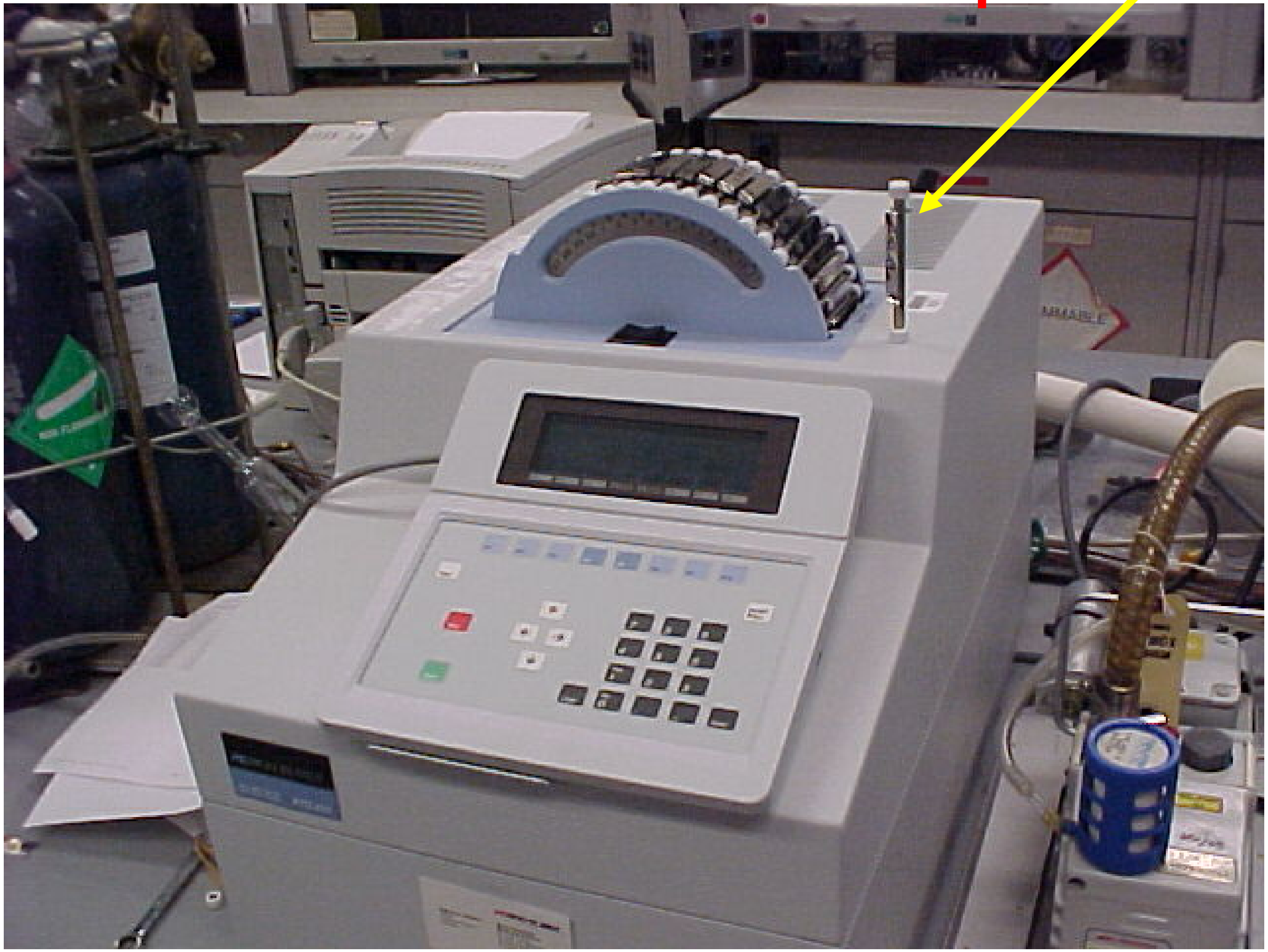


Equilibrium Vapor Adsorption Measurements

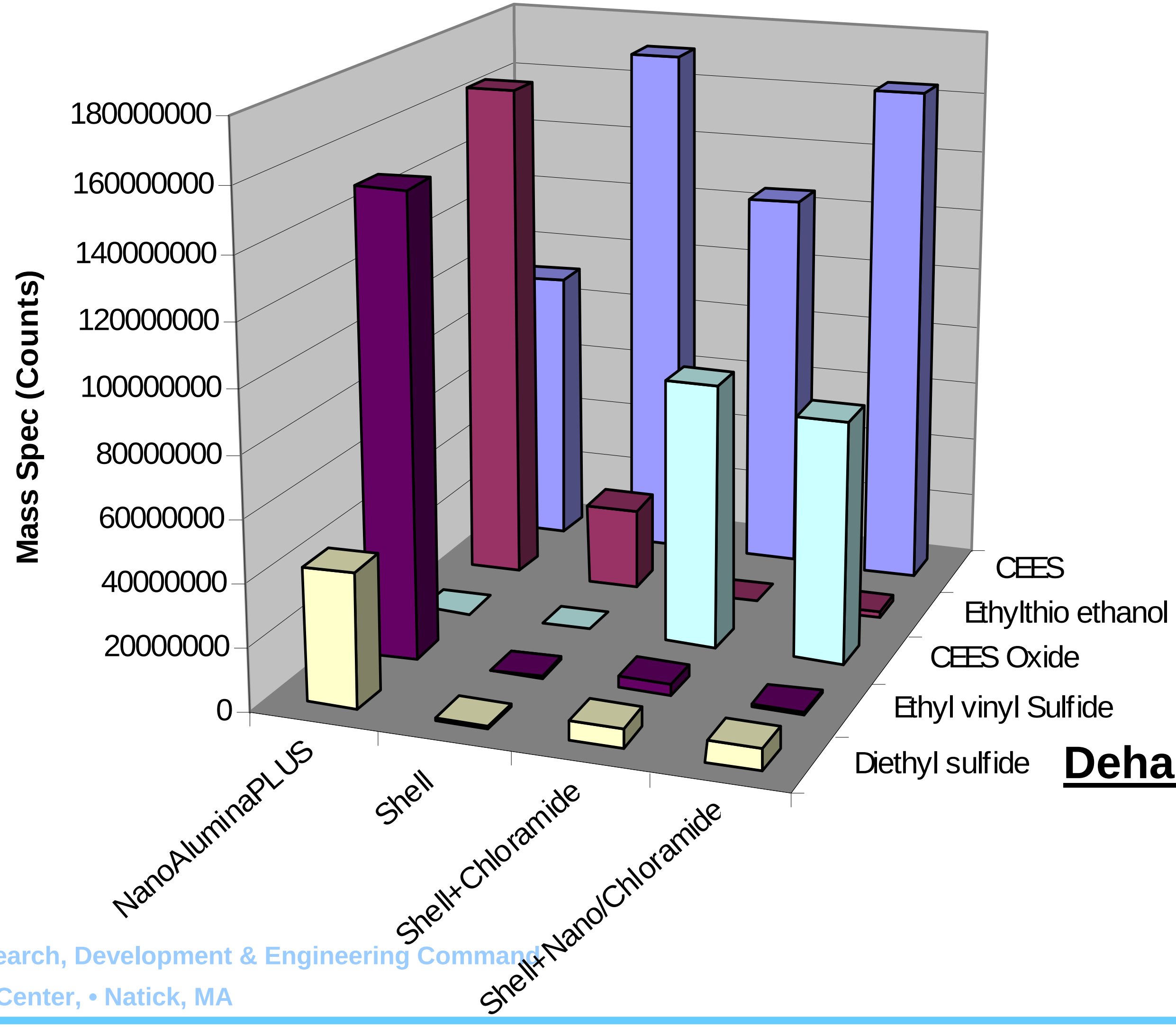
ADSORBANT	% CEES Vapor Uptake
Carbon Spheres	56
NanoAl_2O_3 - PLUS	99
NanoAl_2O_3	10
NanoTiO_2	17

Thermal Desorption GC/MS

Sample in Tube



Depletion of CEES Formation of Products

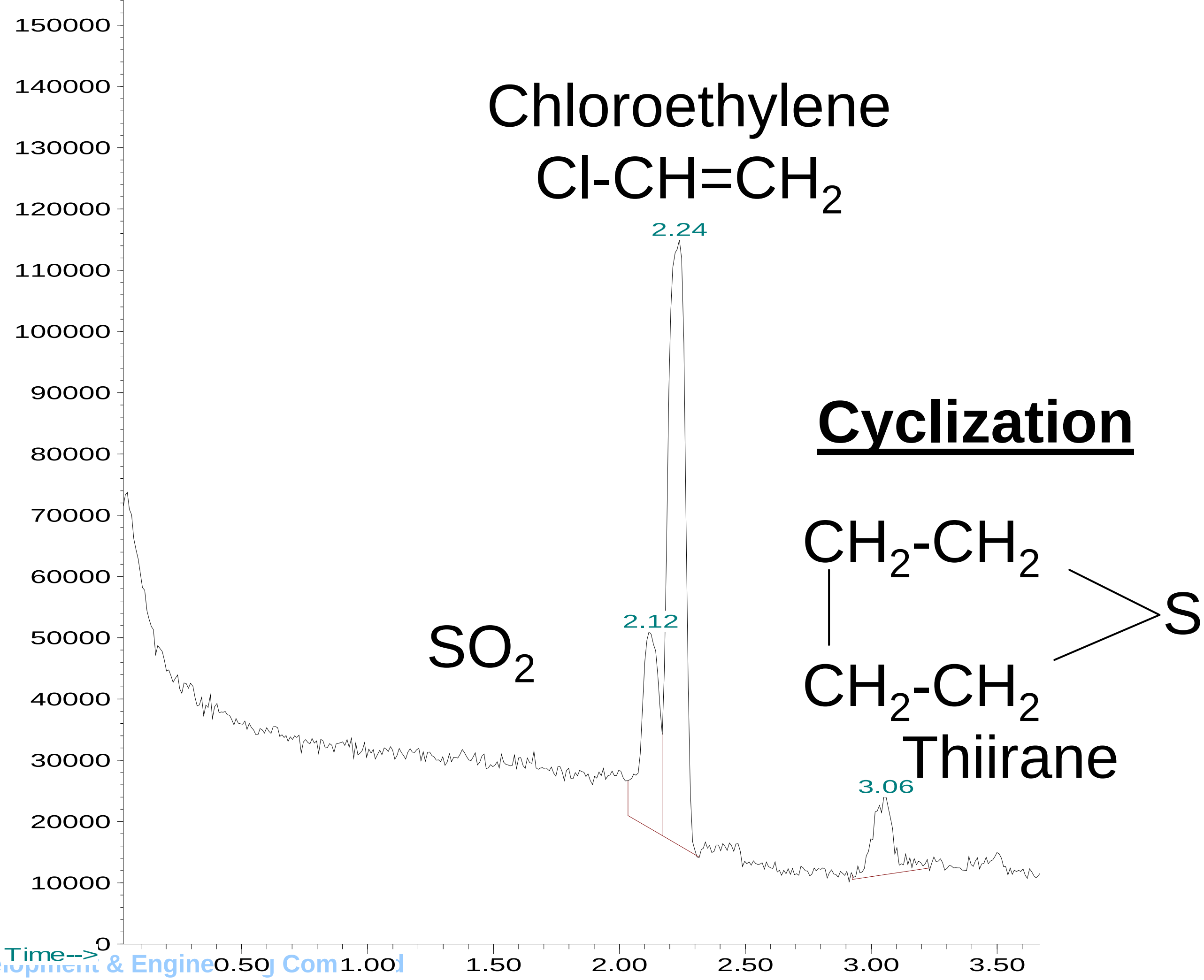


Oxidation

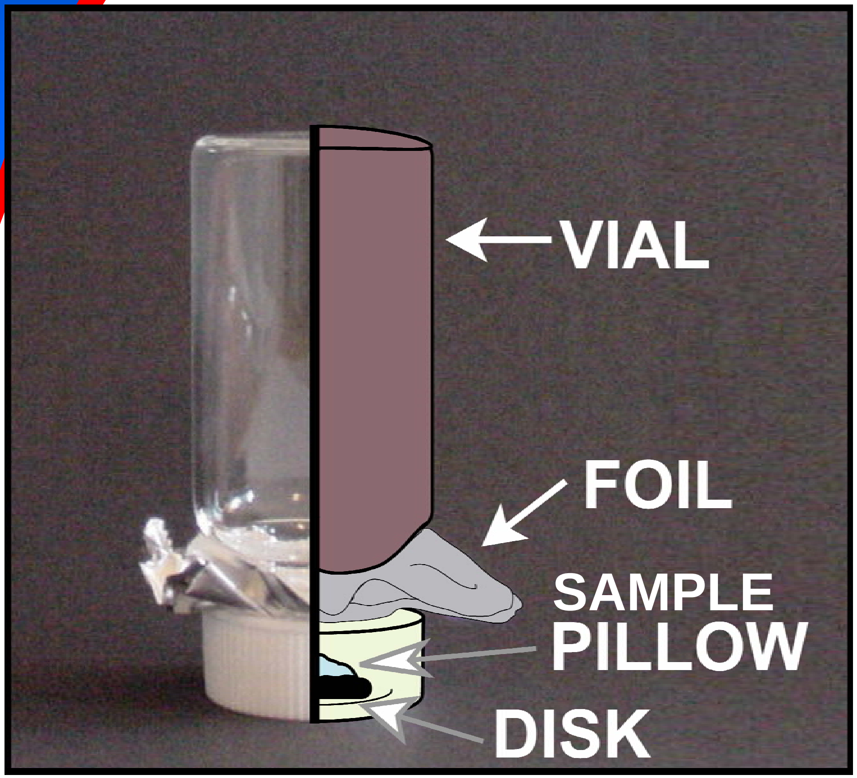
(CEES-OH)
(CEES=O)

Dehalogenation

Some Products from Oxidation Reactions of 2-CEES



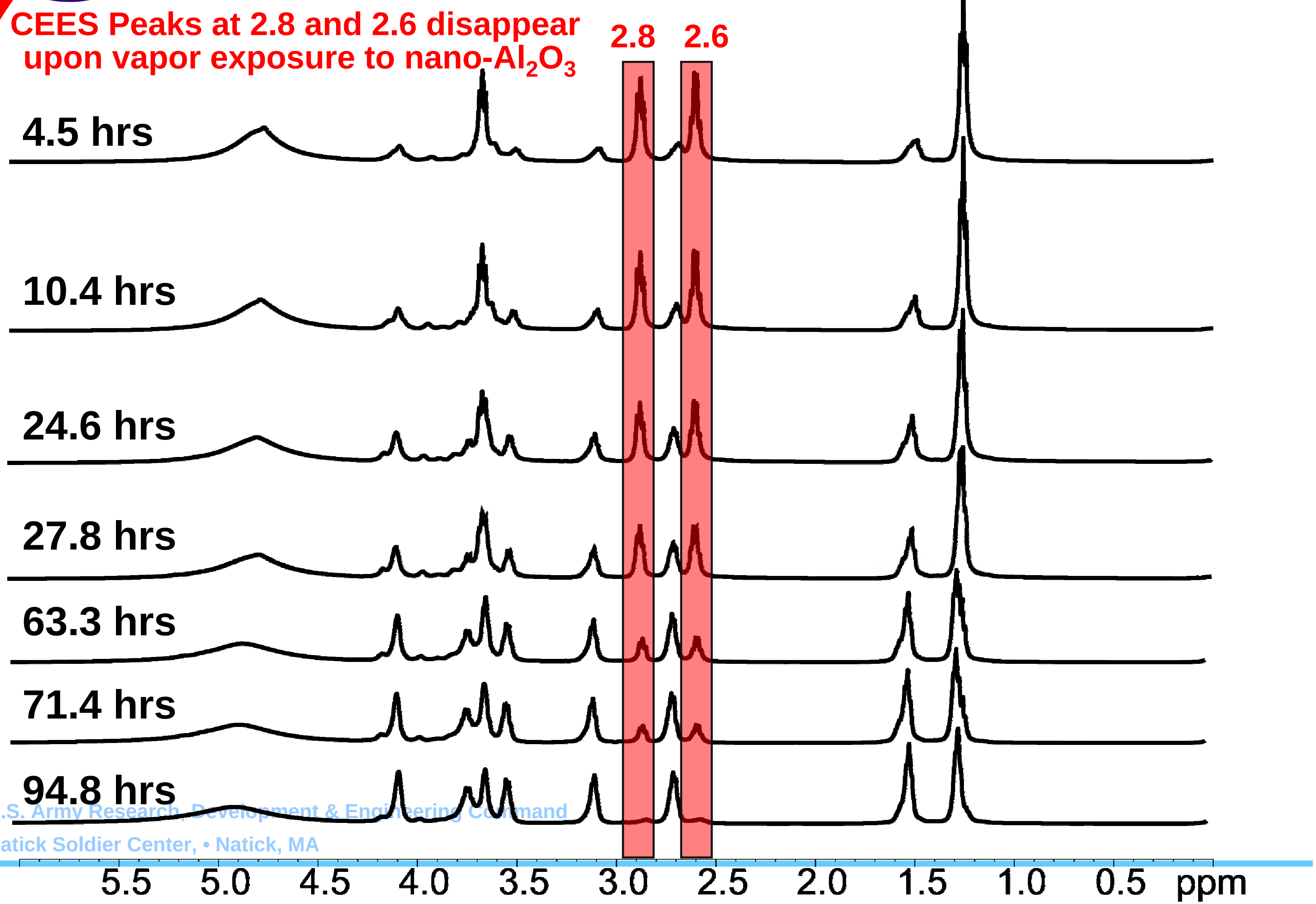
NMR (HRMAS)
Sample preparation



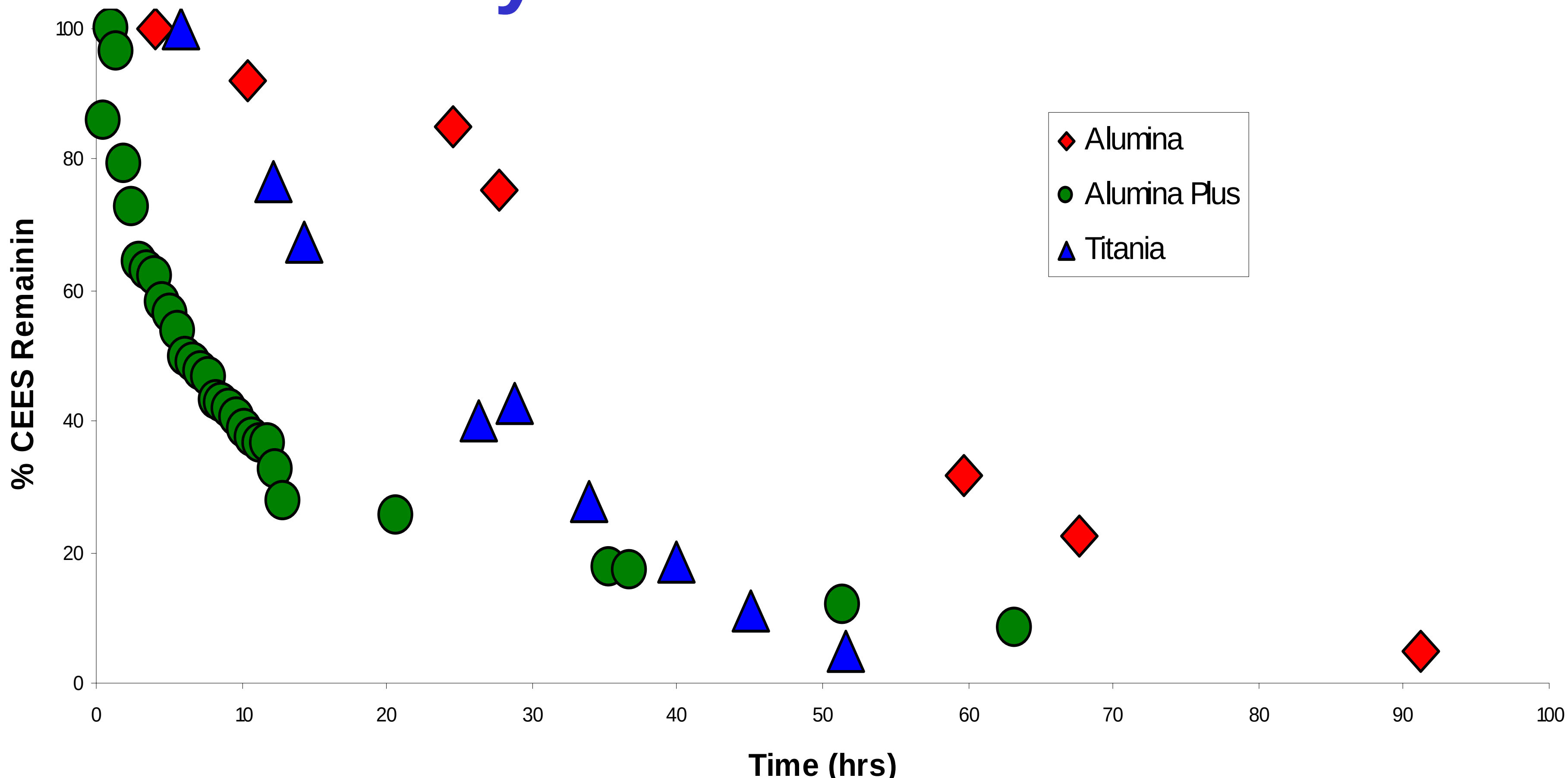
Vapor chamber for exposing catalyst to vaporous agent/simulant

4 mm HRMAS rotor for examining small volumes of sample (< 100 µl)

^1H 1D Spectra Reaction Kinetics



Normalized 2-CEES Degradation Kinetics By Solid State NMR



Rate of CEES Vapor Depletion in HRMAS NMR Studies

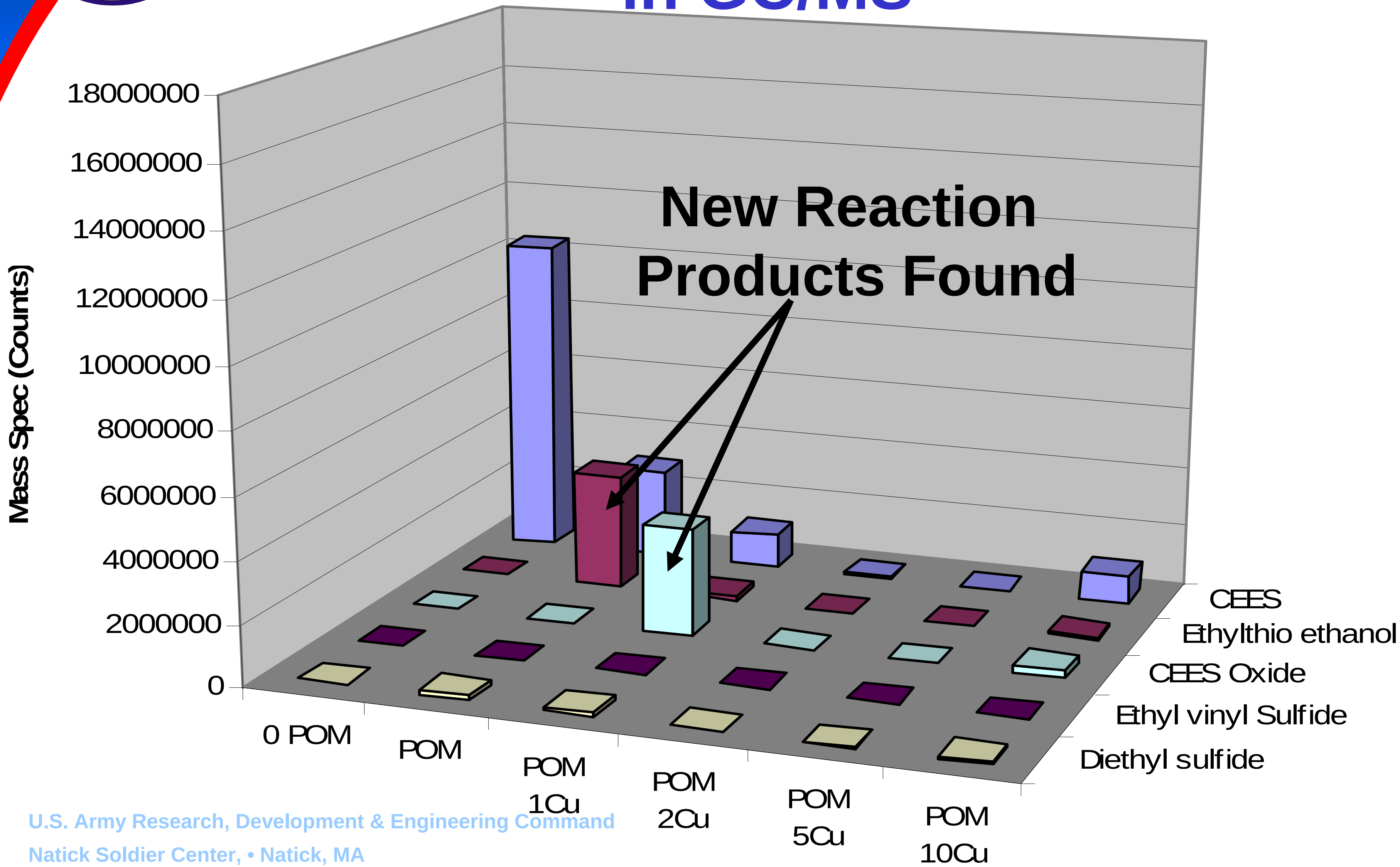
	Rate % CEES/hr	Activity mgCEES/24hr / mgNanoparticle
NanoAl_2O_3	0.83	0.020
NanoTiO_2	2.3	0.094
NanoAl_2O_3-PLUS	3.1	**0.74***

***30 g/m^2 of nanoAl_2O_3-PLUS needed to meet current protection requirements. 100 g/m^2 of nanoTiO_2 needed.**

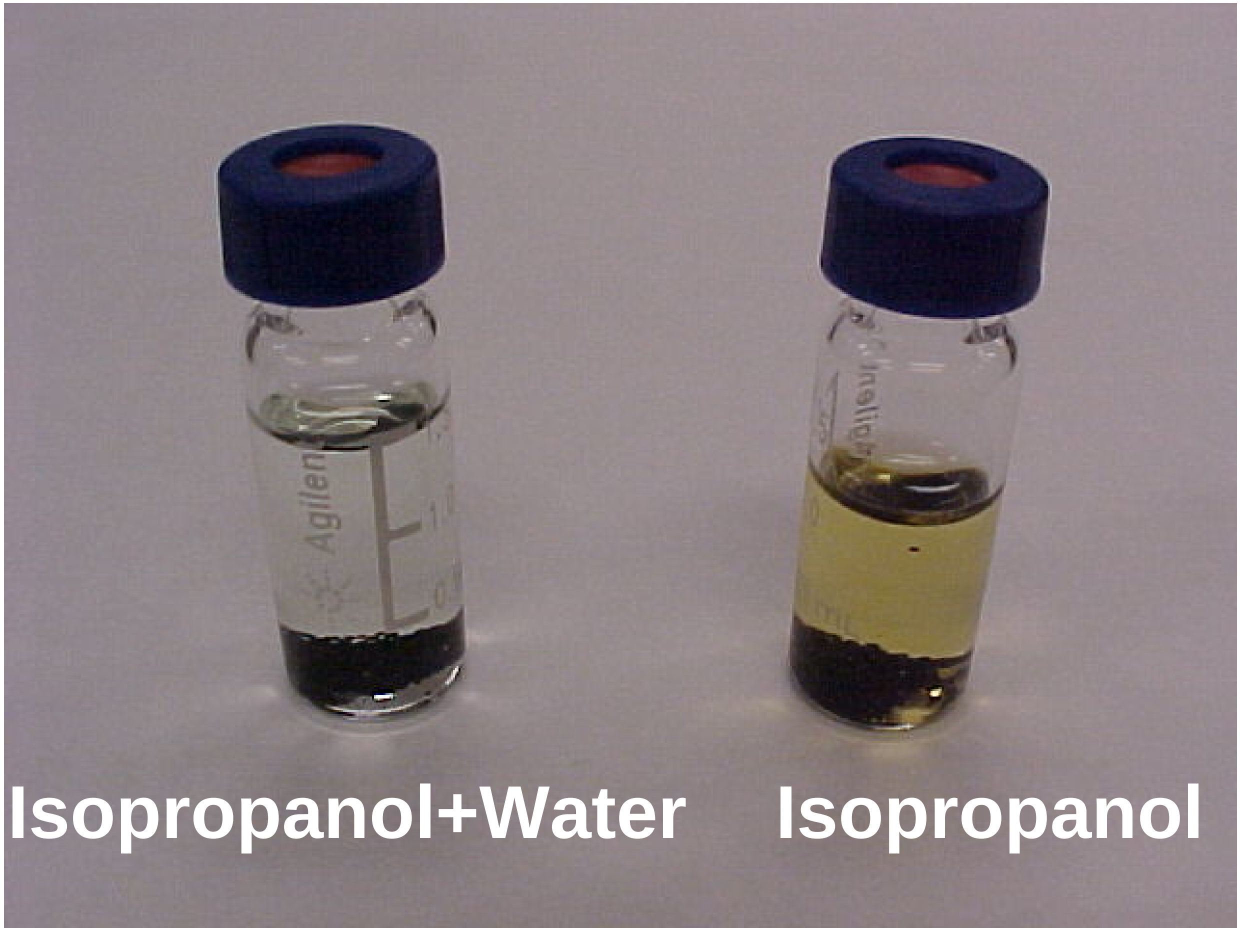
POM Catalyst Reactions with 2-CEES

- POM on Carbon Surface
- Effect of Copper Content

POM/Carbon Reduces 2-CEES in GC/MS

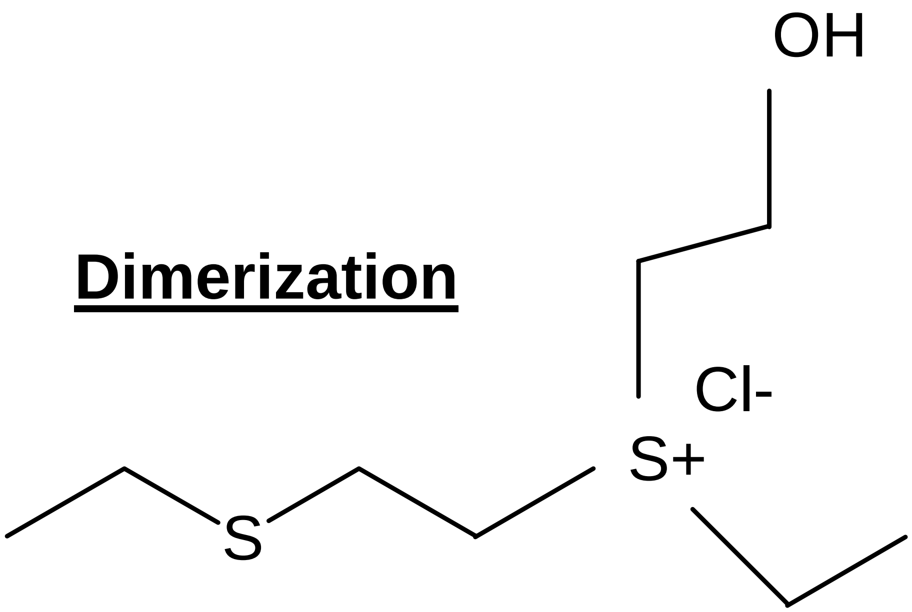


Reaction Product from Carbon/POM + 2-CEES



Dimer of 2-CEES from Oxidation Reaction

Dimerization



CEES
Vapor Diffusion Studies

Thick vs Thin Supported
Selectively Permeable Films

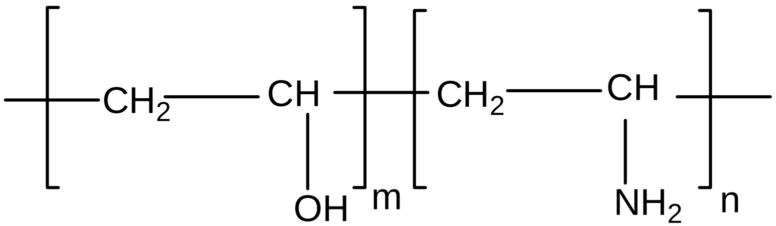
Reactive

PVAM (polyvinyl amine-co-vinyl alcohol)

Non-Reactive

Nafion, Membrane C, Membrane T

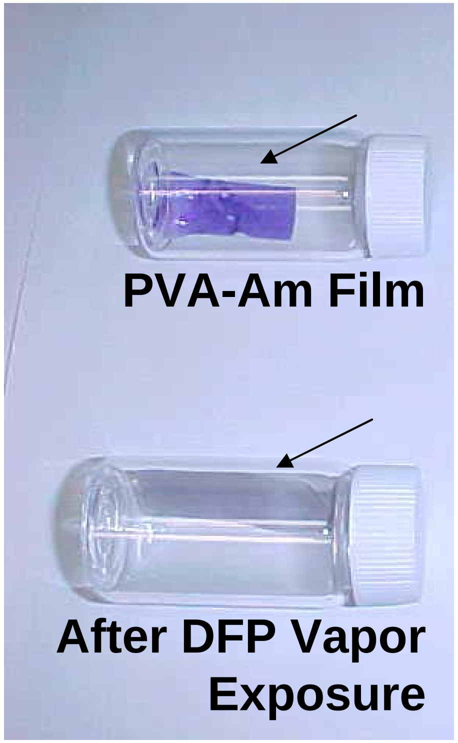
Reactive Selectively Permeable Membranes



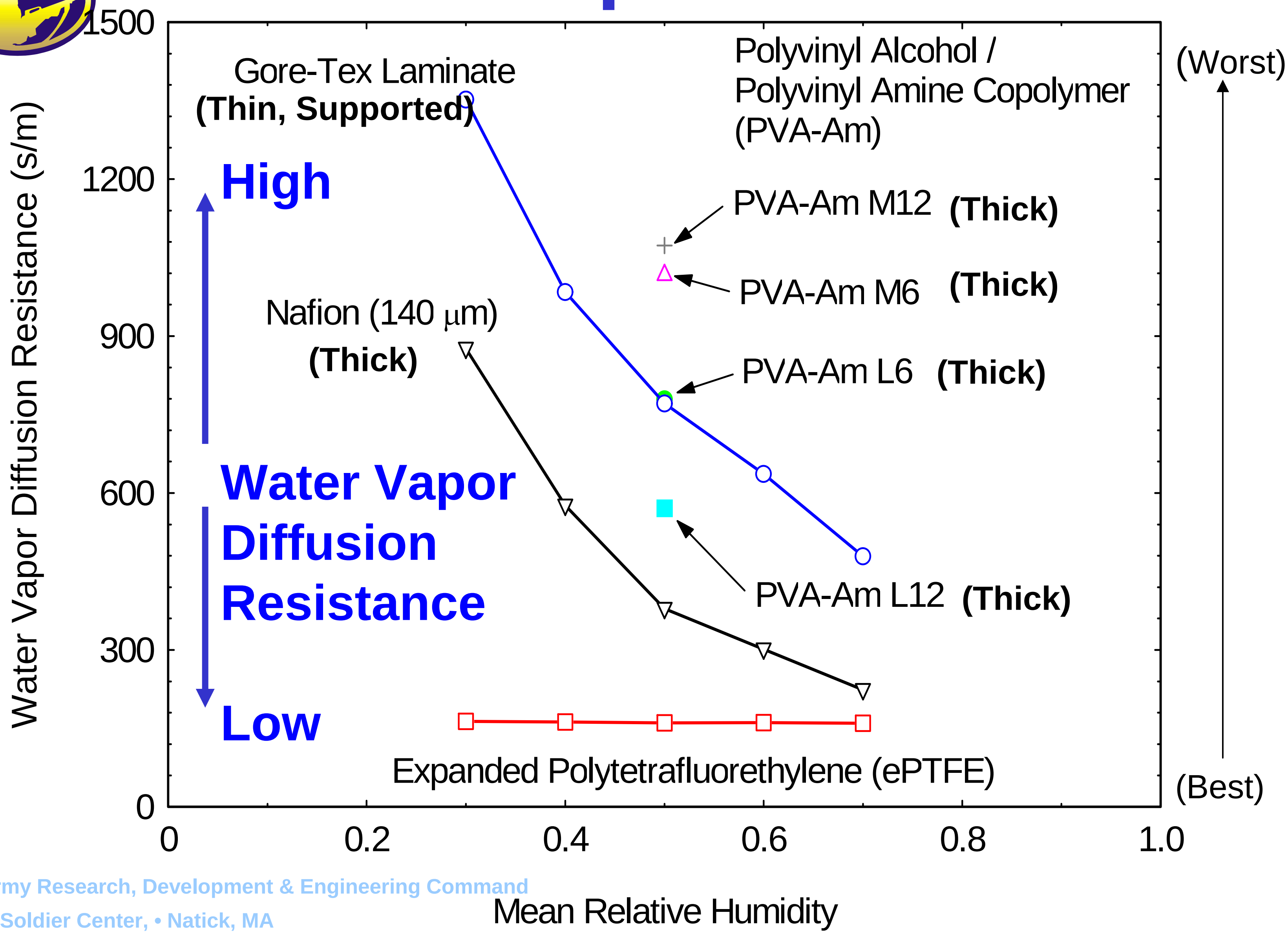
Polyvinyl alcohol-co-amine, PVA-Am

PVA-Am Film Hydrolyzes DFP, G-agent Simulant

(Seen by pH indicator).

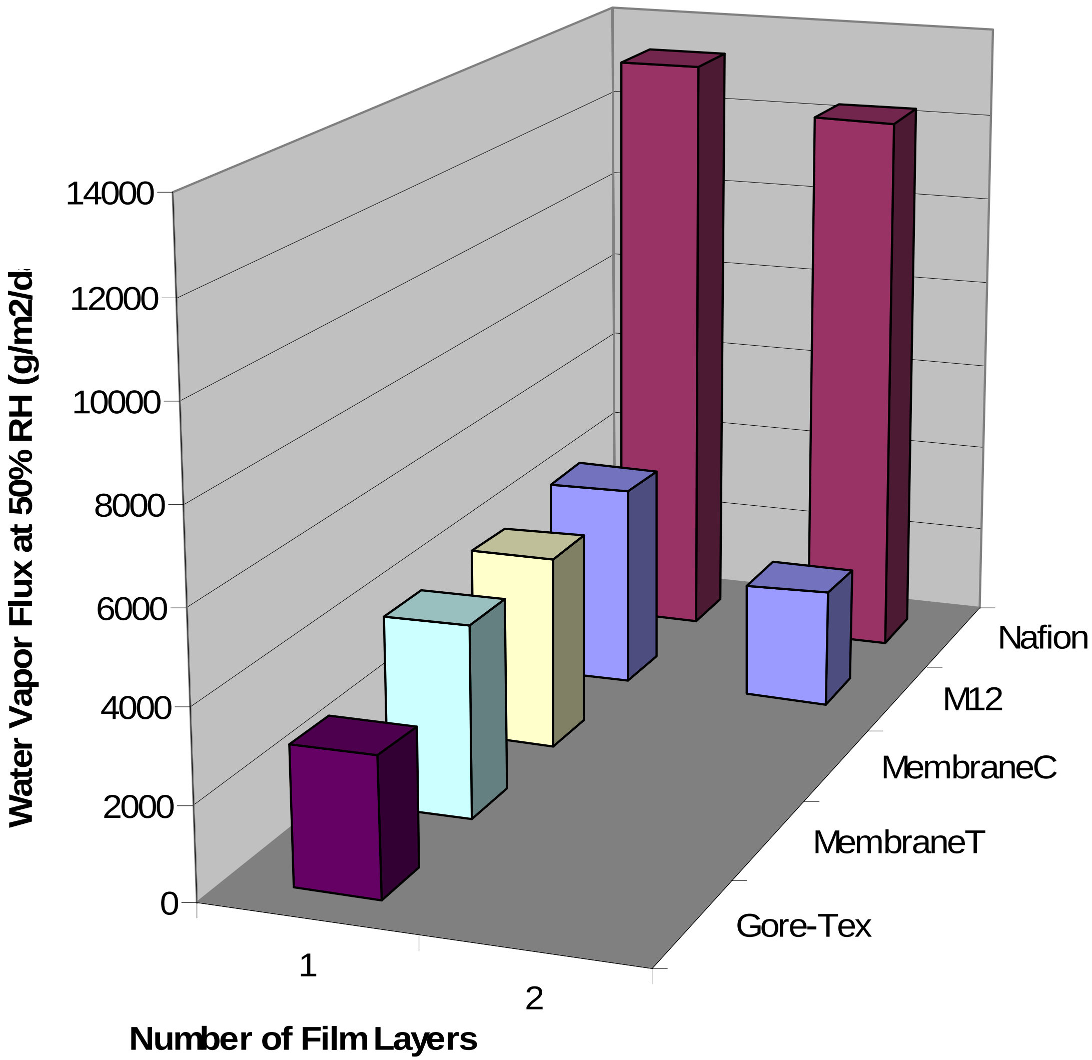


Water Vapor Diffusion



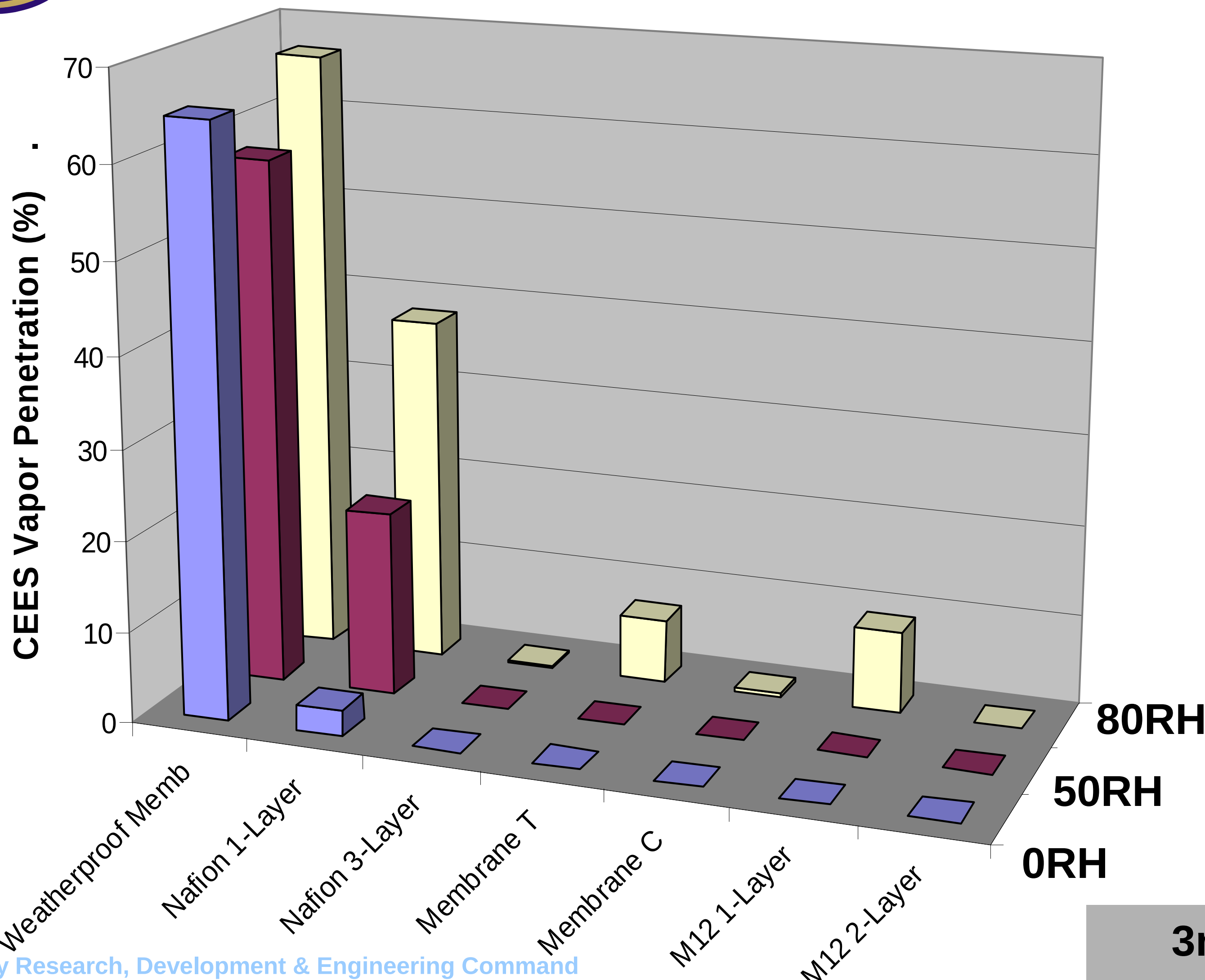
Water Vapor Diffusion

Thin, Supported Films



CEES Vapor Diffusion

Thin, Supported Films



3mg CEES applied

Conclusions

Chloramide-treated fabrics break down 2-CEES in solution and in vapor challenge tests.

One of the major by-products was the nontoxic sulfoxide. Other by-products include dimers.

Chloramides bound to nanoparticles of alumina were reactive, but not as active as the chloramides alone.

Conclusions

NanoAl_2O_3-PLUS more adsorptive than activated carbon.

NMR found that NanoAl_2O_3-PLUS depleted 2-CEES at a rate of 0.74 mgCEES/mgNanoparticle/day.

A fabric weight of 1-33 grams per square meter of NanoAl_2O_3-PLUS needed to meet the 1mg/cm2/day protection requirement for clothing systems.

100 gsm of nanoTiO_2 would be needed for protective fabrics to meet Chemical Protection requirements.

Conclusions

Carbon-bound POMs faster than free POM in the decomposition of 2-CEES.

Carbon-bound POMs can be optimized with Cu to increase depletion of 2-CEES by 7x.

Copper-containing POMs completely neutralize 2-CEES in 30 min. Produce CEES-oxide (sulfoxide) product.

Conclusions

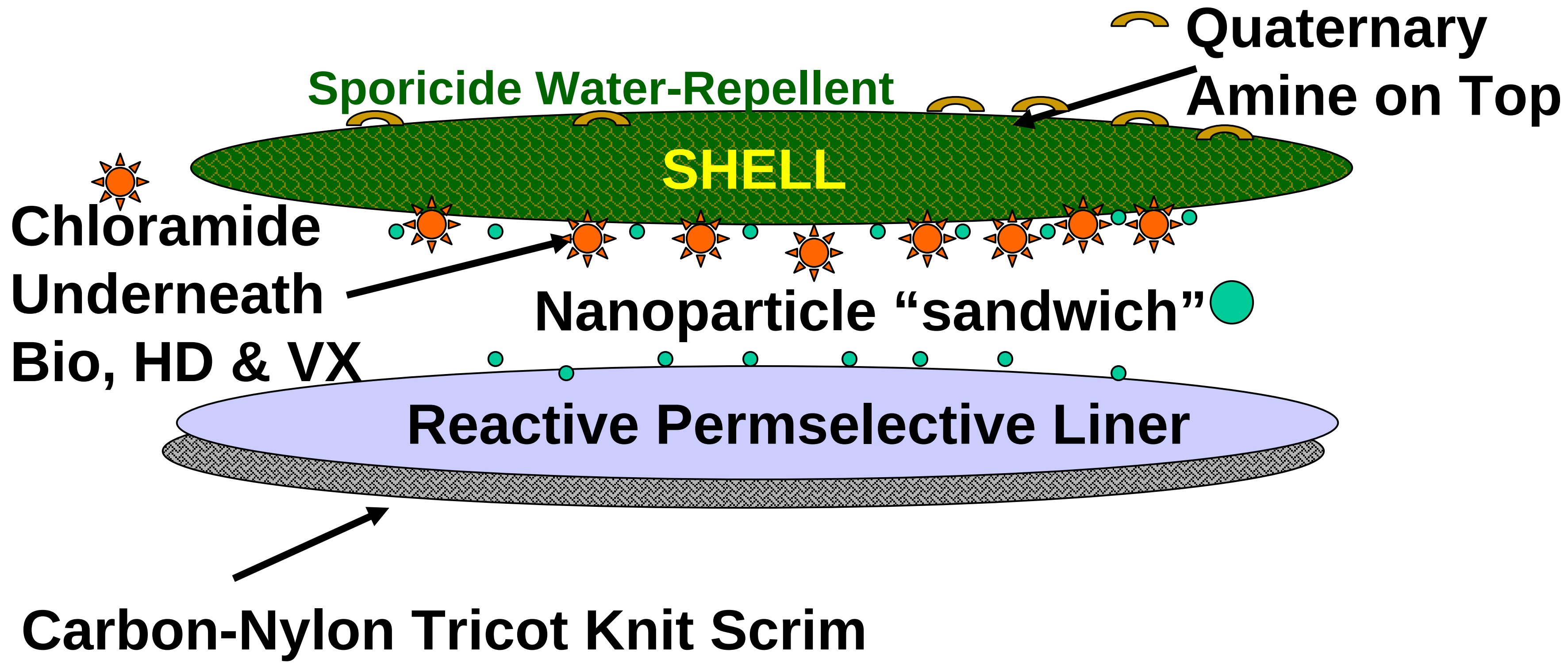
Thin supported PVAM films have high water vapor permeation, similar to commerical permselective membranes C and T.

Thin supported Nafion has the highest water vapor permeation.

Thin supported Nafion and MembraneC allow CEES penetration above 50RH

Thin supported PVAM films and MembraneT block CEES below 80RH.

Reactive Fabric System Design



Acknowledgements

Professor Craig Hill and Dr. Nelya Okun, Emory University for POM Catalysts

Gentex Corporation for spherical carbon

Reactive Materials Team at Tyndall AFB For Chloramides & Test Data

Edgewood NMR Group for MAS Results

Erkol, Ltd. for PVAM Polymers

Phil Gibson, Joel Carlson, John Walker at Natick

The Joint Service Mask Leakage Tester: Helping to Ensure Protective Mask Readiness

Jeremy Scott

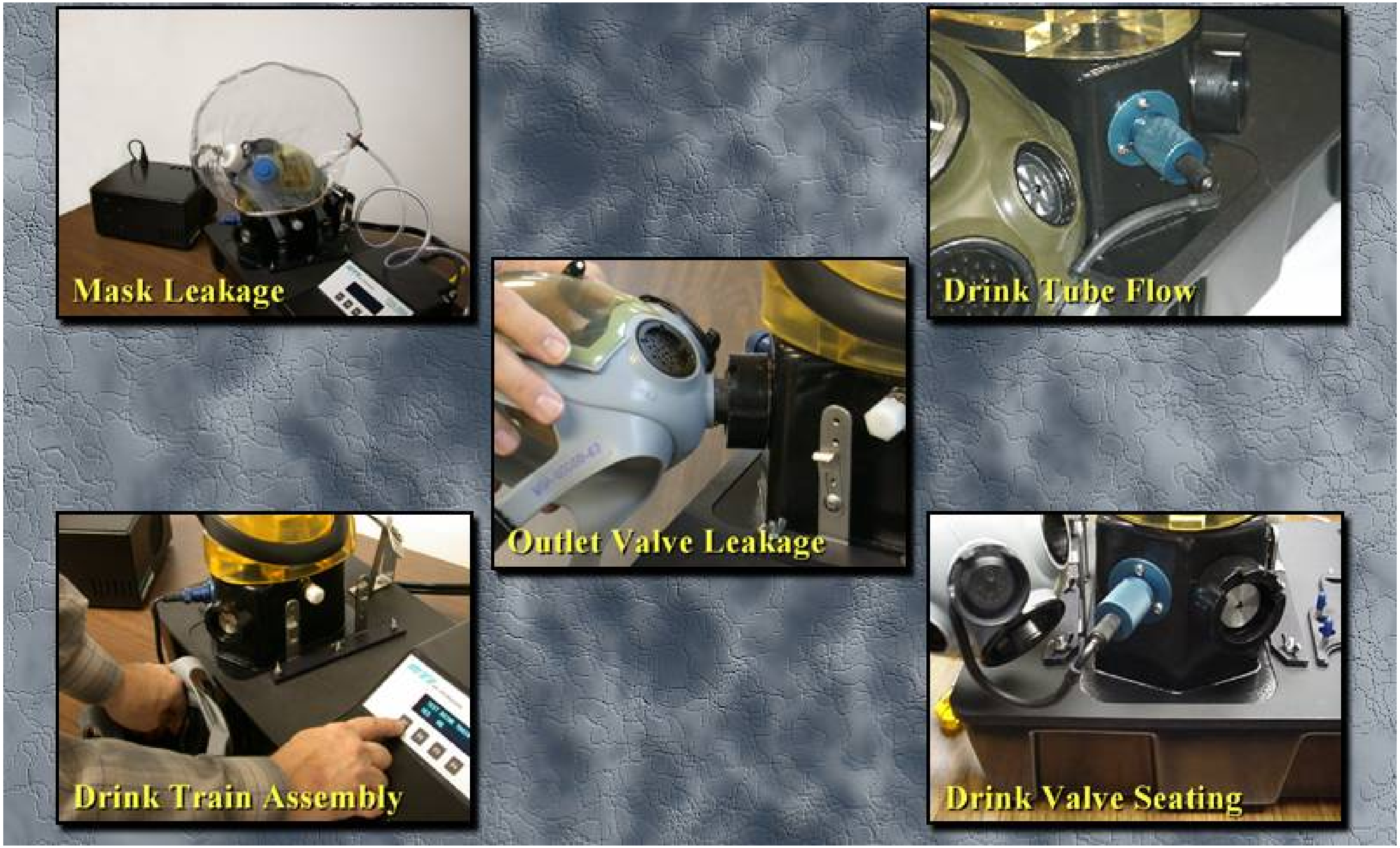
Program Manager - JSMLT

9 March 2006

JSMLT – The Basics

- A portable tool to aid the warfighter to determine leakage and fit of protective masks
  - Used to maintain masks in a high state of readiness
  - Reinforces a unit's PMCS program
- Concept of Operations
  - Garrison and deployed operations
  - Peacetime, wartime, military operations other than war, garrison training and field exercises
  - Shore and afloat forces
  - Supports NBC capabilities in low, medium and high threat areas

JSMLT – Capabilities



JSMLT – Capabilities

JSMLT – Capabilities

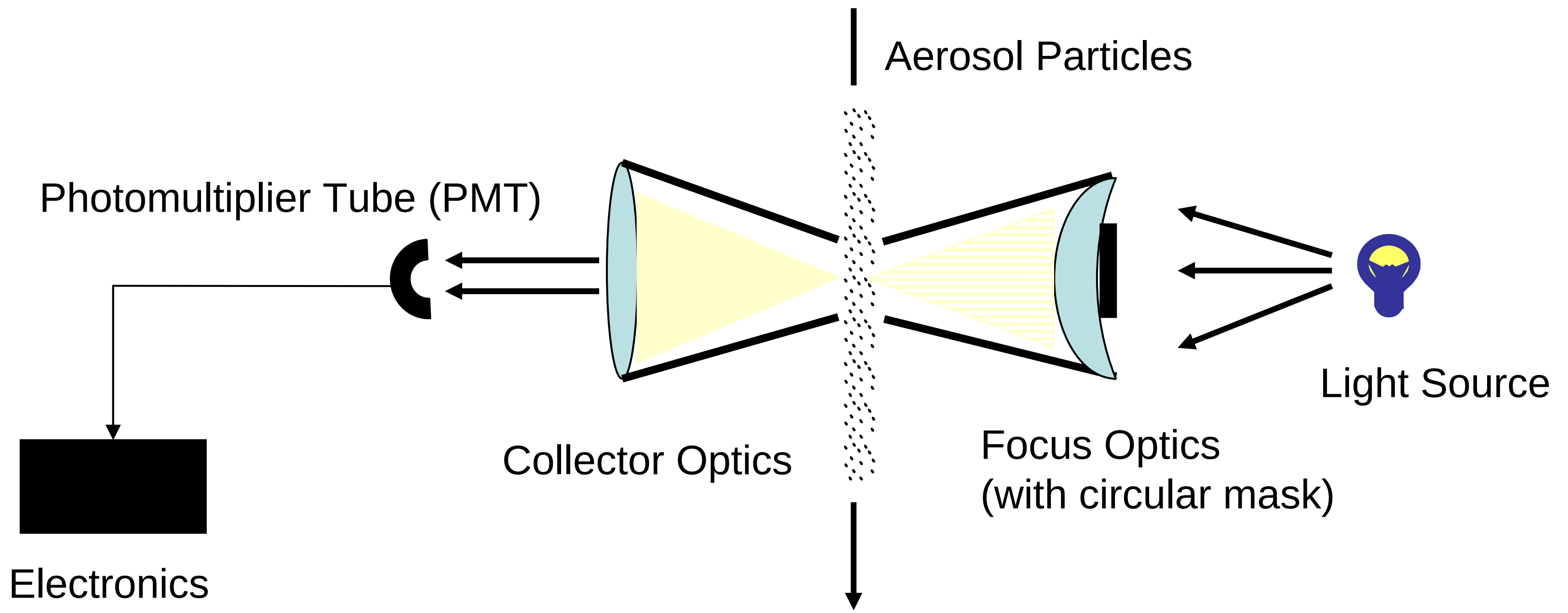
- Fielded Systems Will Provide Testing Capability For:
  - M40A1 Masks
  - M42A2 Masks
  - M45 Masks
  - MCU-2A/P Masks
  - Joint Service General Purpose Mask (JSGPM)
  - Joint Service Aviator Mask (JSAM)
  - Many other protective masks

JSMLT – Mask Leakage Testing

- Mask placed on the headform
- Aerosol released under shroud over the protective mask
  - Poly-Dispersed (0.2 - 0.5μ)
- Aerosol penetrates any existing leaks due to negative pressure applied under the mask
- Penetrating Aerosol Particles are Detected by Light Scattering Photometry
- Percent Penetration Is Calculated

JSMLT – Light Scattering Photometry

- The aerosol particles that have penetrated the mask pass into the light scattering chamber
- The particles scatter the light that passes through the intersection of the cones
- The PMT converts the scattered light into an electrical signal



JSMLT vs. Current Capabilities

- **Five devices currently required to determine function and fit**
  - – **M14 Mask Leakage Tester**
  - – **M4A1 Outlet Valve Leakage Tester**
  - – **Q179 Drink Tube Air Flow Resistance Tester**
  - – **Q204 Drink Tube Assembly Leakage Tester**
  - – **M41 Protection Assessment Test System**
    - **Only deployable system on list**
    - **Cannot identify defective or unserviceable components**

(Trailer or fixed site)

From this…..

to this.

JSMLT vs. Current Capabilities

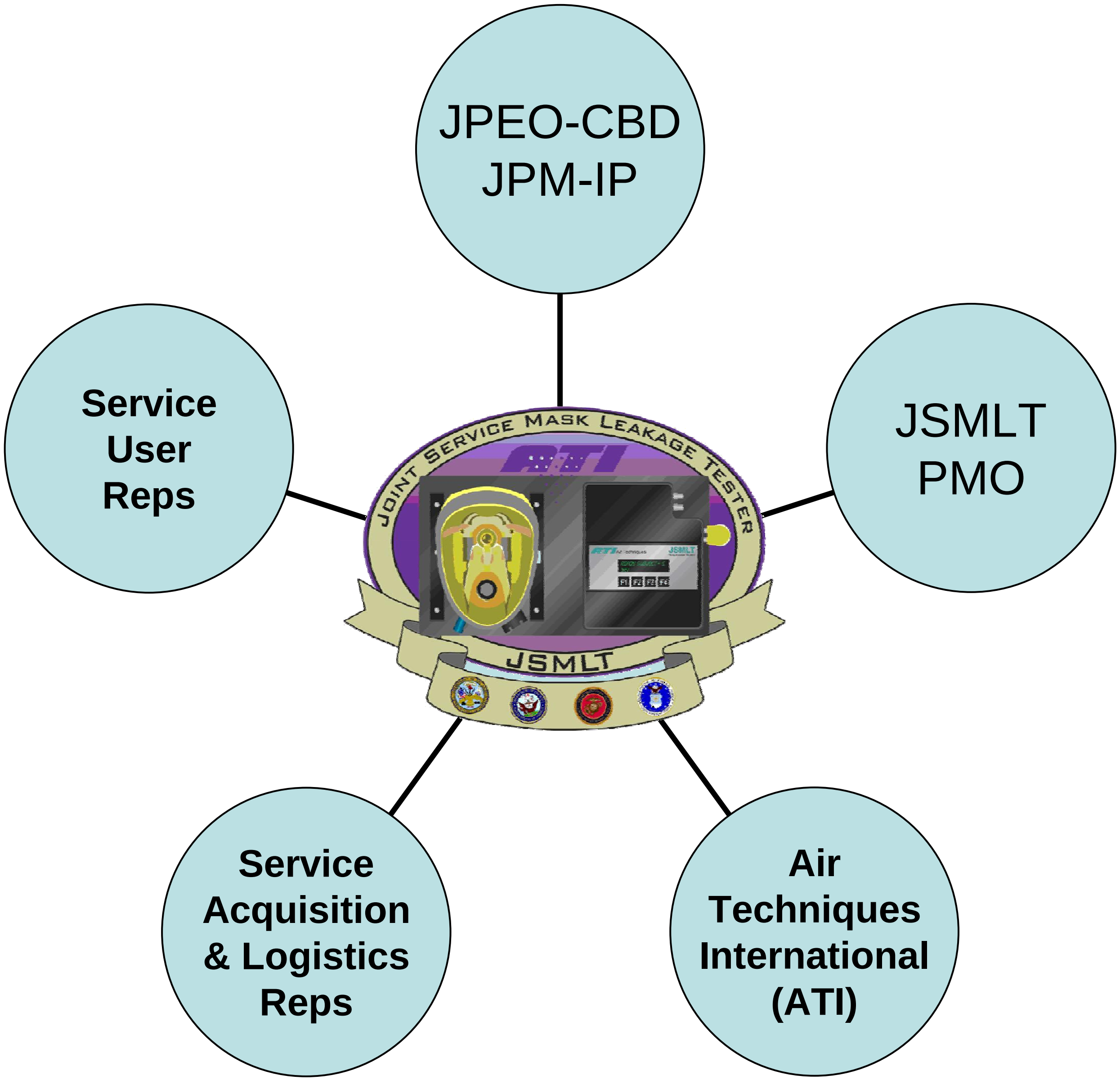
- Current Mask Testing Efforts
  - Mask Serviceability
    - Visual Inspection
    - Qualitative, Low accuracy, Low precision
  - Fit Testing
    - Qualitative Methods
      - Negative Pressure Check
    - Quantitative Method
      - M41 PATS (Not widely used by USAF and USMC)
  - Current surveillance efforts
    - Continue to identify a large percentage of critical defects
    - Cannot conduct 100% inspections

- Bottom Line: JSMLT significantly improves ability to detect and repair critical leaks in protective masks
  - >50% not identified through visual inspection
  - 4.5% not identified in JSMLT operational testing

JSMLT – Benefit to the Warfighter

- Issues with Mask Readiness Have Persisted
  - Leaking Facepieces
  - Torn/Dirty Outlet Valve Disks
  - Incorrectly Installed/Damaged Voicemitters
  - Damaged Drink Systems
- Preventative Maintenance, Checks, and Services (PMCS) Alone Are Insufficient
- JSMLT Will Provide the Warfighter with a Means of Verifying PMCS Has Been Performed Correctly
- Services that Will Use the JSMLT:
  - U.S. Marine Corps
  - U.S. Navy
  - U.S. Air Force
  - U.S. Coast Guard (DHS)

JSMLT - Partnering with Industry and the Joint Services



JSMLT – ATI Background

- **Based in Owings Mills, Maryland**
- **Started in 1961 to produce the M14 Gas Mask Leakage Tester**
- **Provided test equipment for the M17, M40 Series, and MCU-2A/P Protective Masks**
- **Provider of Support to the Joint Equipment Assessment Program (JEAP)**
- **An organization committed to quality through ISO 9001 and a Configuration Management program designed for JSMLT**

JSMLT – Recent and Upcoming Program Achievements

- Milestone C/FRP Decision – May 05
- FRP Contract Awarded - 7 Sep 05
  - JSMLT Production Has Commenced
- First Unit Equipped – 3QFY06

QUESTIONS???

Jeremy Scott

PM JSMLT

Comm: 410-436-5664

DSN: 584-5664

Jeremy.jon.scott@us.army.mil

Joint Requirements Office for Chemical, Biological, and Nuclear Defense

MAJ W. Scott Smedley

8 March 2006

Individual Protection Conference

Charleston, South Carolina

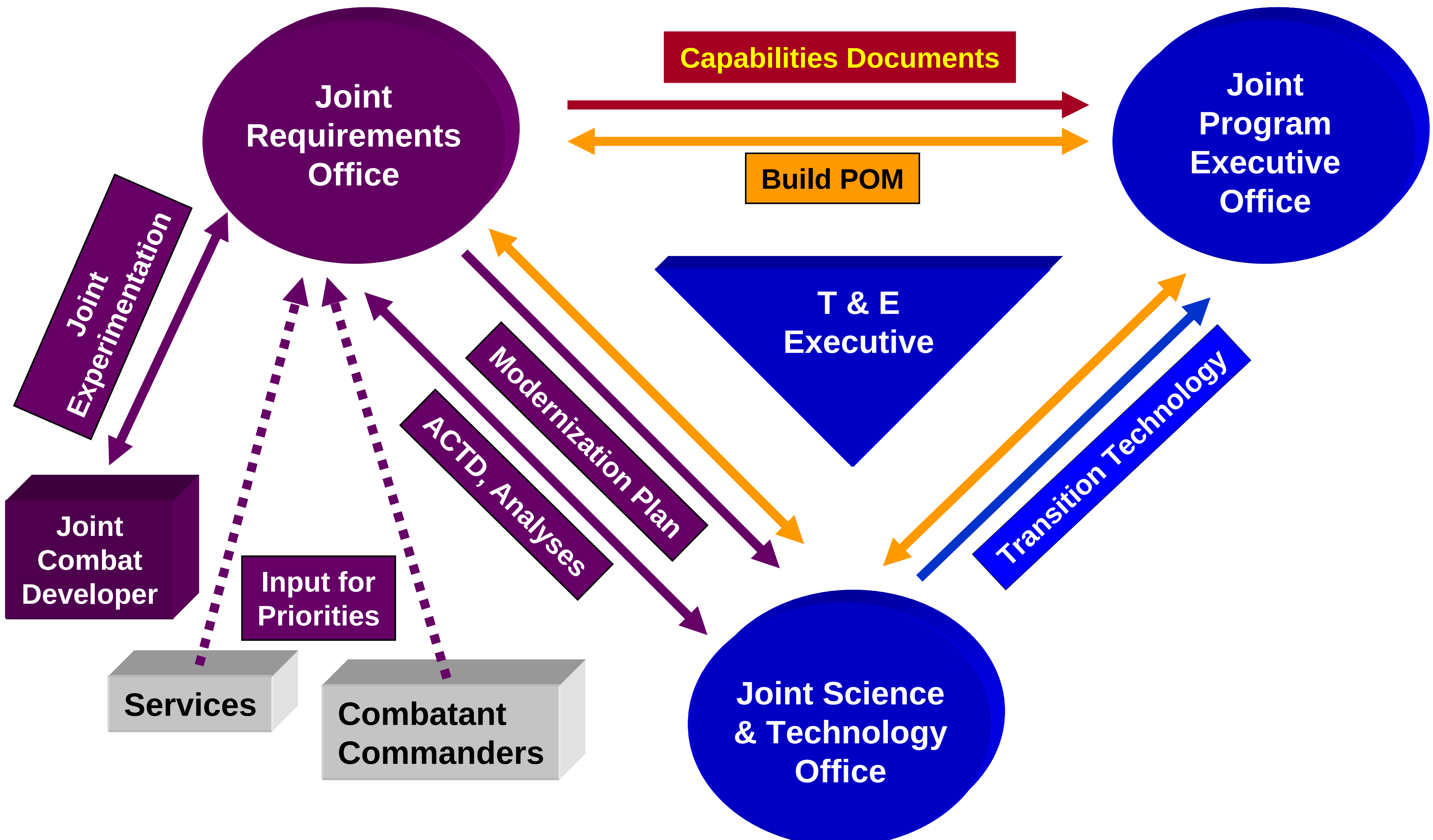
Agenda

- **Background**
- **Baseline Capabilities Assessment**
- **Capabilities Based Assessment and the Joint Capabilities Integration and Development System**
- **Way Ahead**

JRO – CBRN Defense Charter

- Single office within DOD responsible for the planning, coordination, and oversight of joint CBRN defense operational requirements
  - Develop and maintain the CBRN Defense Integrating Concept and the CBRND Modernization Plan
  - Represent the Services and Combatant Commanders in the requirements generation process and act as their proponent for coordinating and integrating CBRND operational capabilities
  - Develop DOD CBD POM with acquisition community support
  - Facilitate the development of joint doctrine and training and sponsor the development of multi-service doctrine
- CJCS' single source of expertise to address all issues involving CBRND, within passive defense, consequence management, force protection, and homeland security

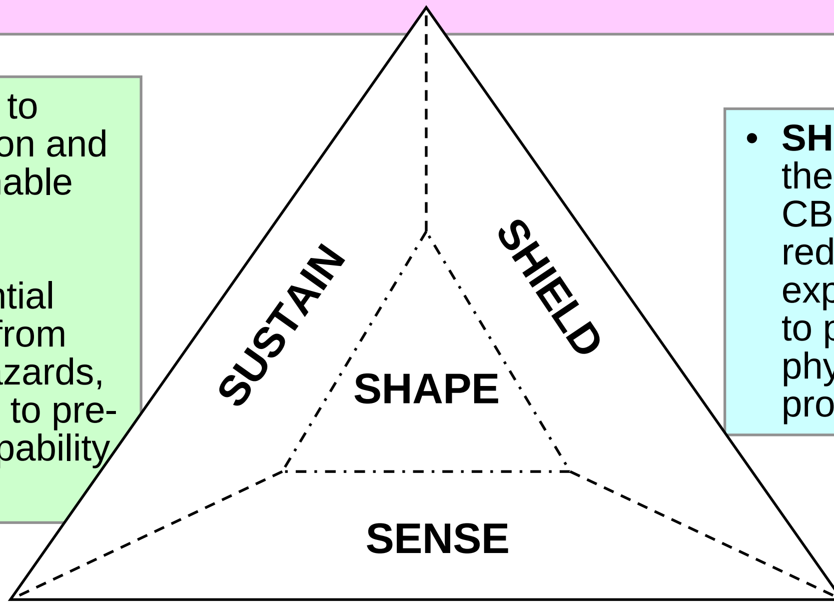
Required Capabilities, S&T, and Acquisition



Joint CBRN Defense Functional Concept

- **SHAPE –** Provides the ability to characterize the CBRN hazard to the force commander - develop a clear understanding of the current and predicted CBRN situation; collect and assimilate info from sensors, intelligence, medical, etc., in near real time to inform personnel, provide actual and potential impacts of CBRN hazards; envision critical SENSE, SHIELD and SUSTAIN end states (preparation for operations); visualize the sequence of events that moves the force from its current state to those end states.

- **SUSTAIN –** The ability to conduct decontamination and medical actions that enable the quick restoration of combat power, maintain/recover essential functions that are free from the effects of CBRN hazards, and facilitate the return to pre-incident operational capability as soon as possible.

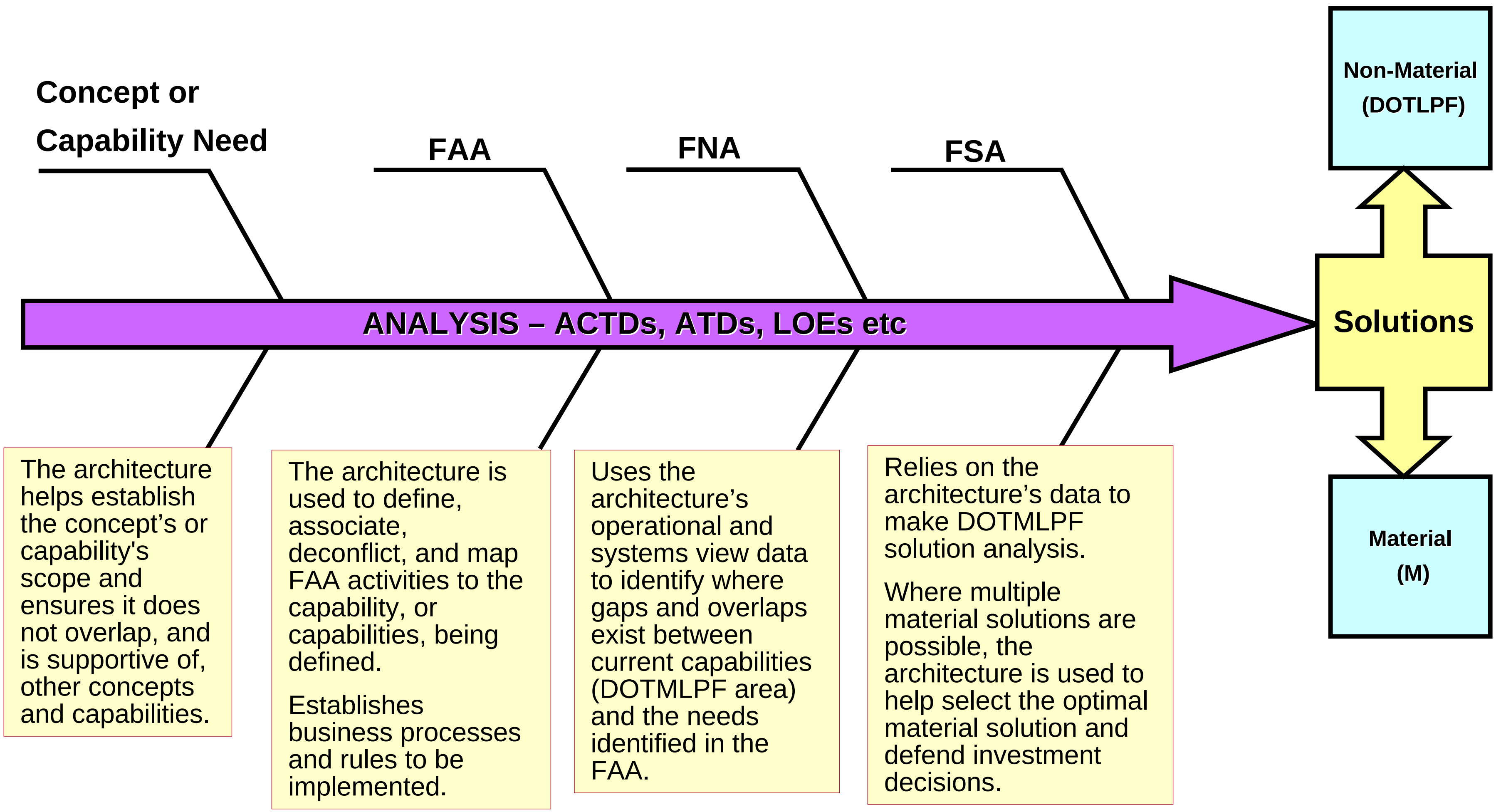


- **SHIELD –**The capability to shield the force from harm caused by CBRN hazards by preventing or reducing individual and collective exposures, applying prophylaxis to prevent or mitigate negative physiological effects, and protecting critical equipment

- **SENSE –** The capability to continually provide the information about the CBRN situation at a time and place by detecting, identifying, and quantifying CBRN hazards in air, water, on land, on personnel, equipment or facilities. This capability includes detecting, identifying, and quantifying those CBRN hazards in all physical states (solid, liquid, gas).

Process Integration

Using Architecture to Support JCIDS



CBRN Baseline Capability Assessment Concept

BCA 1-39

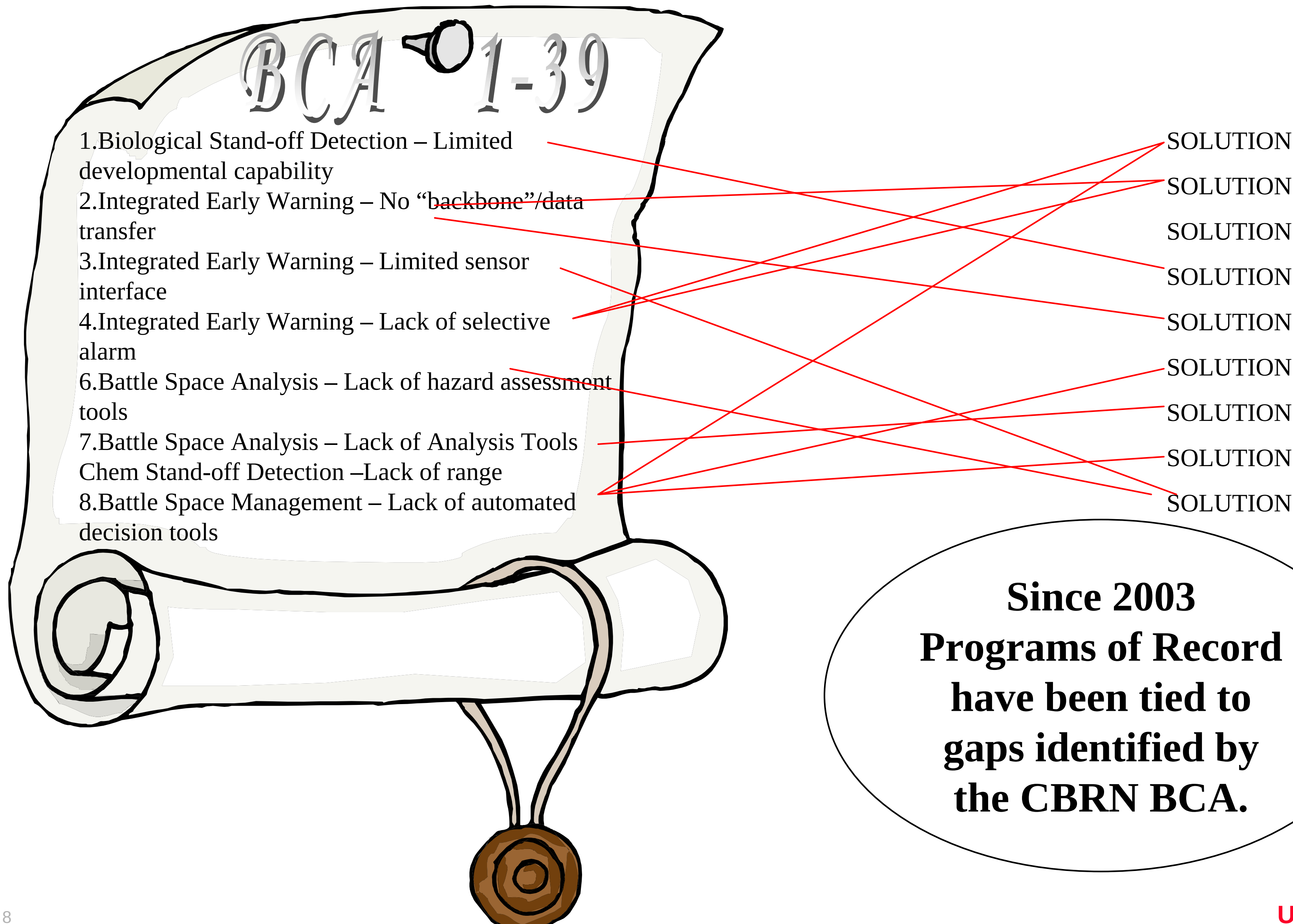
1.Biological Stand-off Detection – Limited developmental capability
2.Integrated Early Warning – No “backbone”/data transfer
3.Integrated Early Warning – Limited sensor interface
4.Integrated Early Warning – Lack of selective alarm
6.Battle Space Analysis – Lack of hazard assessment tools
7.Battle Space Analysis – Lack of Analysis Tools
Chem Stand-off Detection –Lack of range
8.Battle Space Management – Lack of automated decision tools

Why:

- **Annual Requirement (JROCM, Jul 2002)**
- **Sets the basis for analysis toward Chairman’s Program Assessment (CPA)**

Direct the JRO-CBRN Defense to propose to the JROC issues for inclusion in the FY 06-11 planning guidance priorities that are based on the capability gaps identified in this assessment

Tying the BCA to Programs of Record



Since 2003 Programs of Record have been tied to gaps identified by the CBRN BCA.

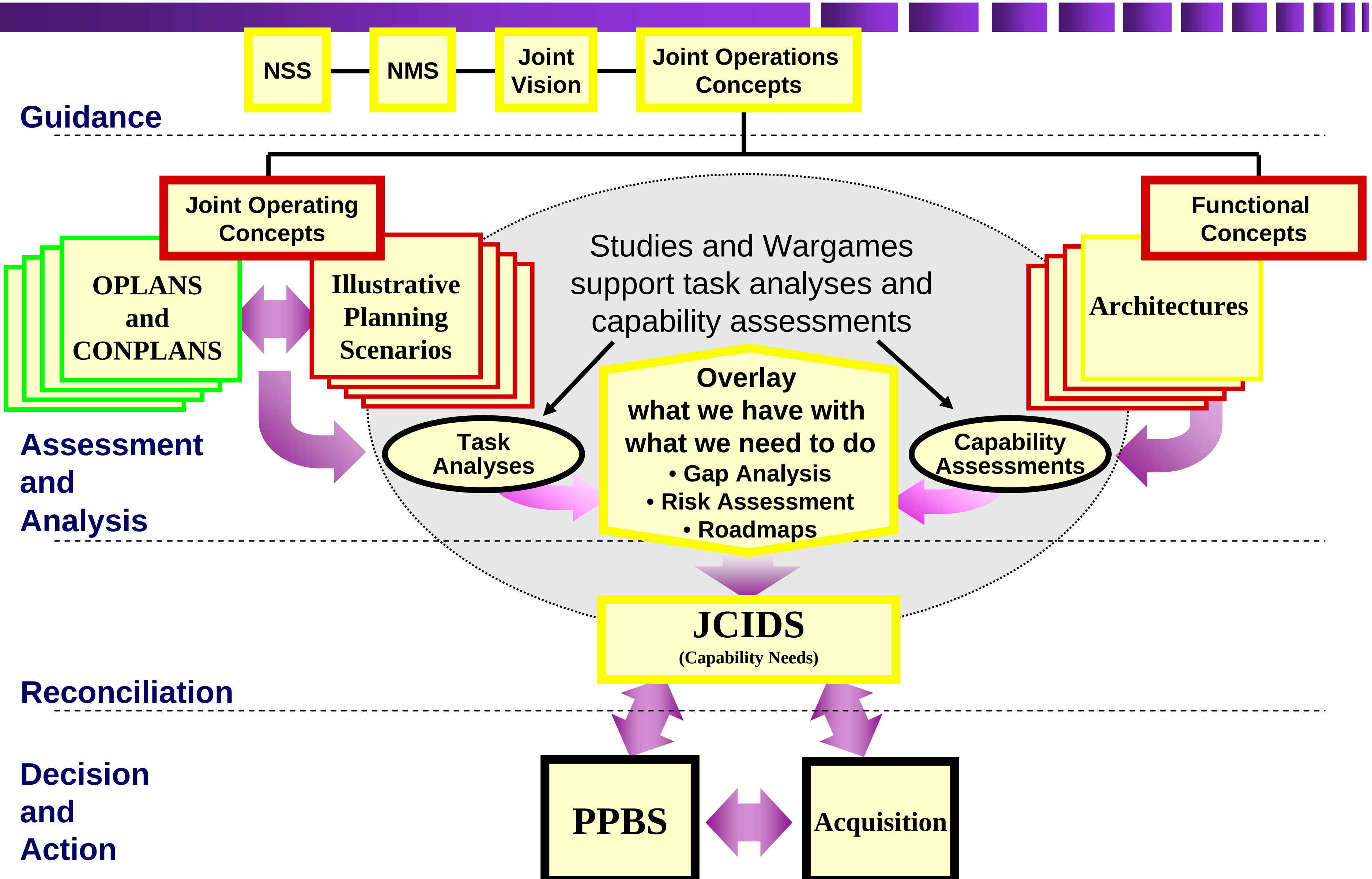
JCIDS Capabilities Baseline Assessment Supersedes BCAs

JCIDS Guidance

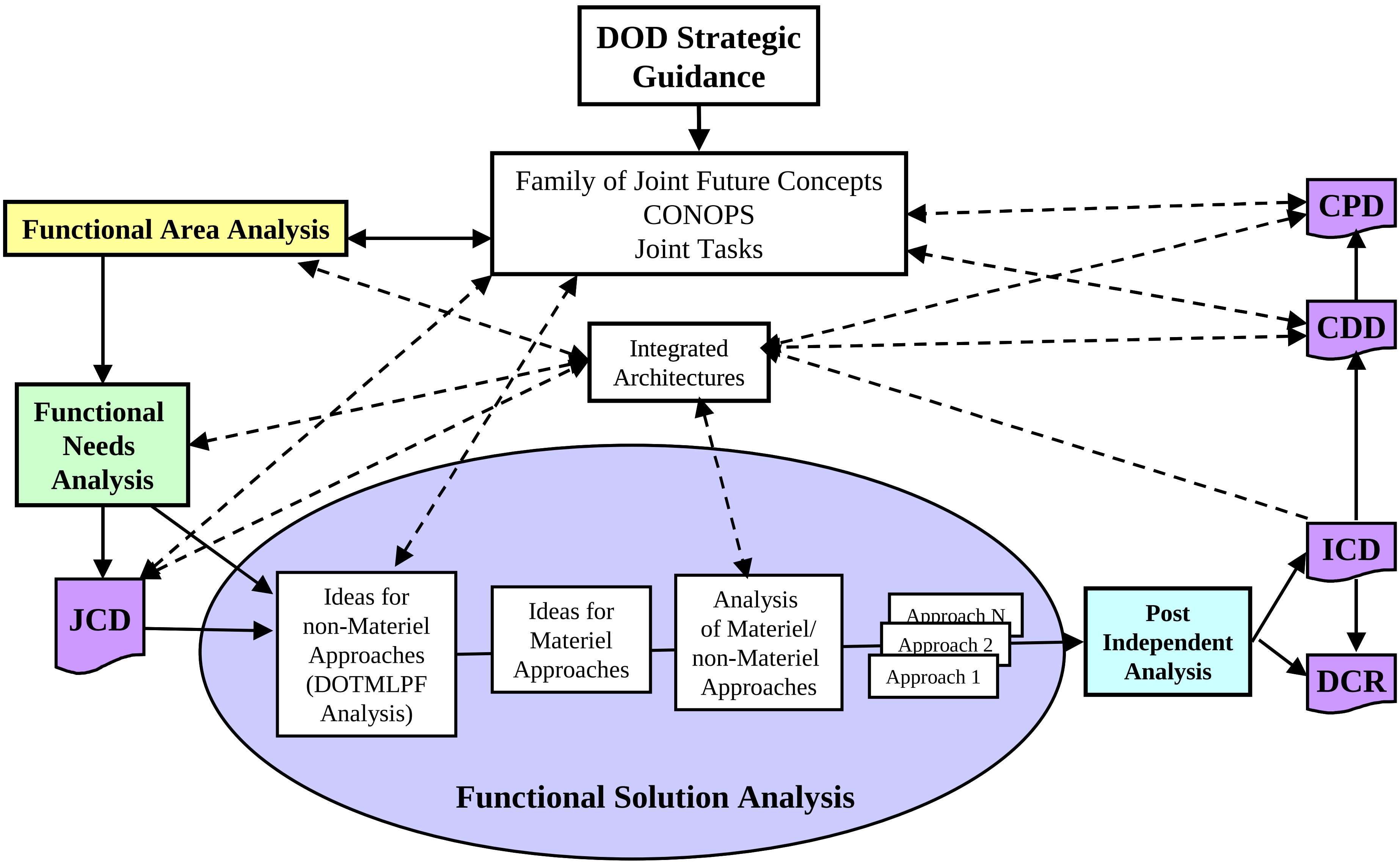
- CJCSI 3170.01E
- CJCSM 3170.01B

The CBRN BCA served it’s purpose well, but now the JCIDS process mandates CBAs.

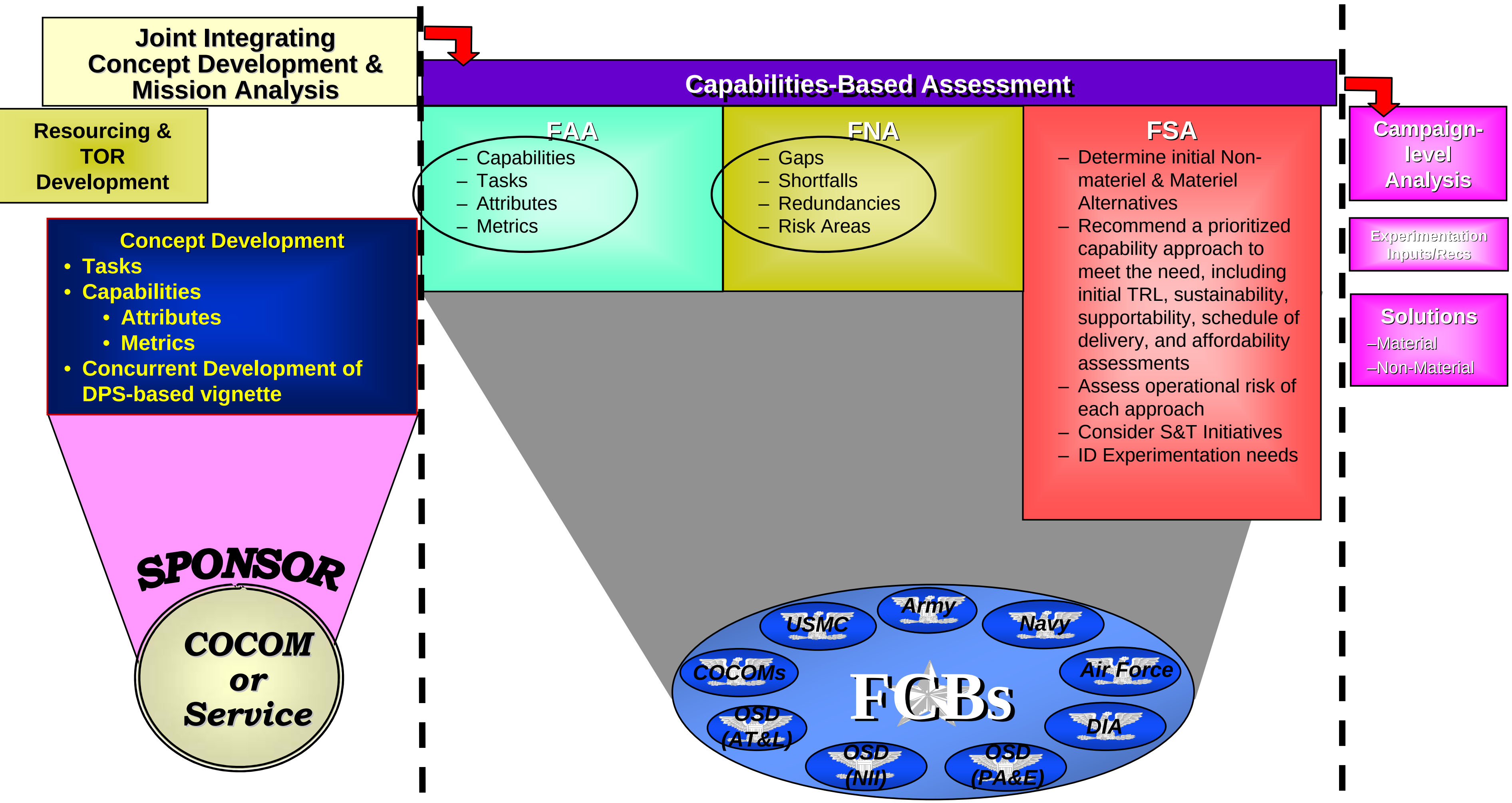
Top-Down Capabilities-Based Process



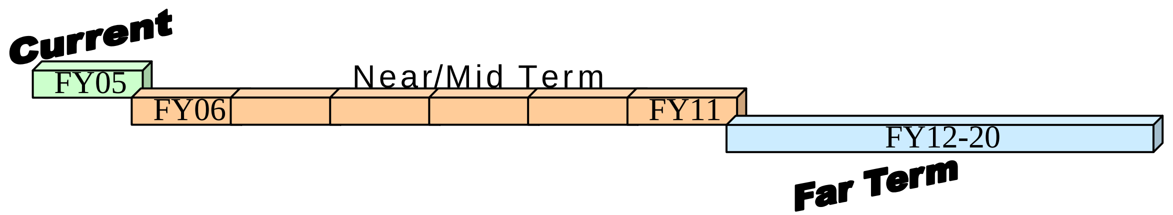
Capabilities Based Analysis and JCIDS



The JROC Capability-Based Assessment Process



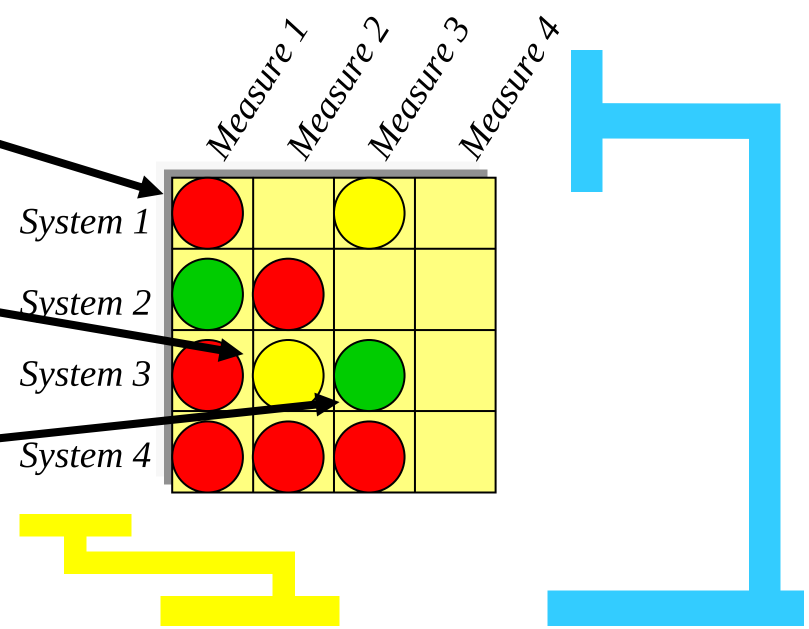
FNA Ratings and Analysis Timeframe



<u>Red</u> indicates little or no capability to perform the task to the designated standard(s).

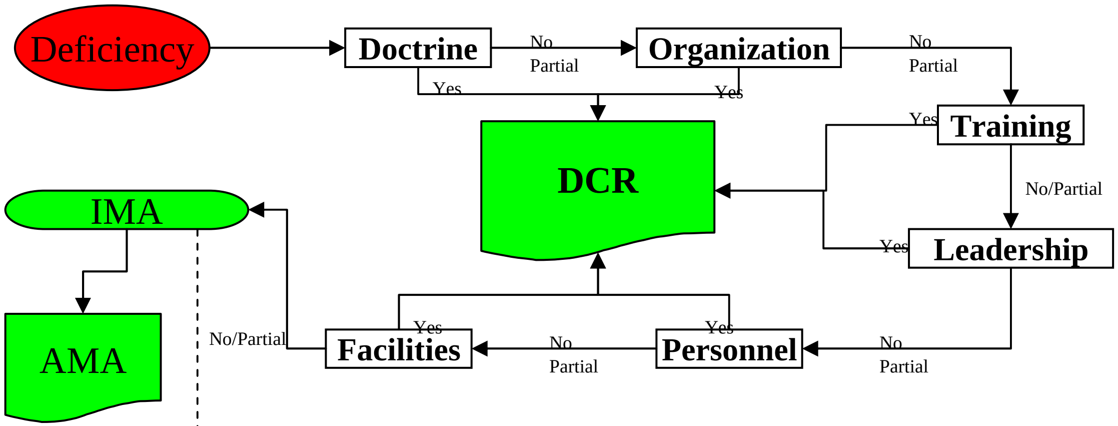
<u>Yellow</u> indicates a partial capability to perform the task to designated standard(s).

<u>Green</u> indicates a full capability to perform the task to the designated standard(s).



Compares what we have with what we need to do

FSA DOTLPF Filter for Deficiencies



Once a capability gap is exposed the primary means to repair that gap is the DOTLPF analysis.

DCR – DOTMLPF Change Recommendation
IMA – Ideas for Materiel Approaches
AMA – Analysis of Materiel Approaches

An IMA submitted through research, SMEs, and working groups is used to identify materiel approaches to provide the required capabilities. Does not define which specific systems or system components should be used.

TASENS 2. Sense the atmosphere for biological hazards.

Idea for Material Approach (IMA) / Identified Gap	Mass Spectrometry	Immunoassay	Genetic	Tissue Based	Flame Photometry	Colorimetric	Raman Spectrometry	Spectroscopy
Gap 1	X	X						X
Gap 2			X	X		X		
Gap 3	X						X	
Gap 4		X			X		X	
Gap 5	X		X					X

Notional

Results From the Analysis

FNA Executive Summary

	SNSENS	STSENS	OPSENS	TASENS	SNSHA	STSHA	OPSHA	TASHA	SNSHLD	STSHLD	OPSHLD	TASHLD	SNSUST	STSUST	OPSUST	TASUST		OVERALL
Current	Y	Y	Y	Y	Y	Y	Y	Y	R	Y	Y	Y	R	Y	Y	Y		Y
Near/Mid	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	R	Y	Y	Y		Y
Far	Y	Y	G	Y	G	G	G	Y	Y	Y	Y	Y	Y	G	G	Y		Y
Task Qty	17	9	10	17	14	11	12	32	12	11	14	14	12	14	14	30		243

Upper level assessments are a product of the assessments of many pieces and a single measure can effect the overall

Olde Way

39 BCA Gaps in 19 Core Capabilities

Qty	Sense: Detection
1	Biological Stand-off Detection
2	Chemical Stand-off Detection
4	Chemical Point Detection
1	Biological Point Detection
1	CBRN Recon
1	Radiological Point Detection

Qty	Shield: Protection
2	Mobile Collective Protection
3	Medical Prophylaxes
2	Respiratory Protection
3	Percutaneous Protection

Qty	Shape: Battlespace Awareness
3	Integrated Early Warning
2	Battle Space Analysis
2	Battle Space Management

Qty	Sustain: Restoration
2	Individual Decontamination
1	Sensitive Equipment Decon
2	Equipment Decon
2	Medical Therapeutics
2	Fixed Site Decon
3	Diagnostics

New Way

362 CBA Gaps in 19 Core Capabilities

Qty	Sense: Detection
4	Biological Stand-off Detection
10	Chemical Stand-off Detection
29	Chemical Point Detection
19	Biological Point Detection
N/A	CBRN Recon
21	Radiological Point Detection

Qty	Shield: Protection
41	Mobile / Fixed Collective Protection
21	Medical Prophylaxes
22	Respiratory Protection
30	Percutaneous Protection

Qty	Shape: Battlespace Awareness
21	Integrated Early Warning
27	Battle Space Analysis
34	Battle Space Management

Qty	Sustain: Restoration
20	Individual Decontamination
5	Sensitive Equipment Decon
33	Equipment Decon
17	Medical Therapeutics
18	Fixed Site Decon
20	Diagnostics

Way Ahead

- **Match Programs of Record to capability gaps**
- **Assess the ability of the program of record to meet the necessary standards indicated in the metrics**
- **Complete a roadmap for CBRN Passive Defense**
- **Use this analysis and roadmap to build the Program Objective Memorandum**

Contact Information

W. Scott Smedley, Major, US Army
8000 Joint Staff Pentagon
Washington, DC 20318
703-602-0871/0863
William.smedley@js.pentagon.mil
SIPR: william.smedley@js.pentagon.smil.mil

Test Infrastructure Upgrades

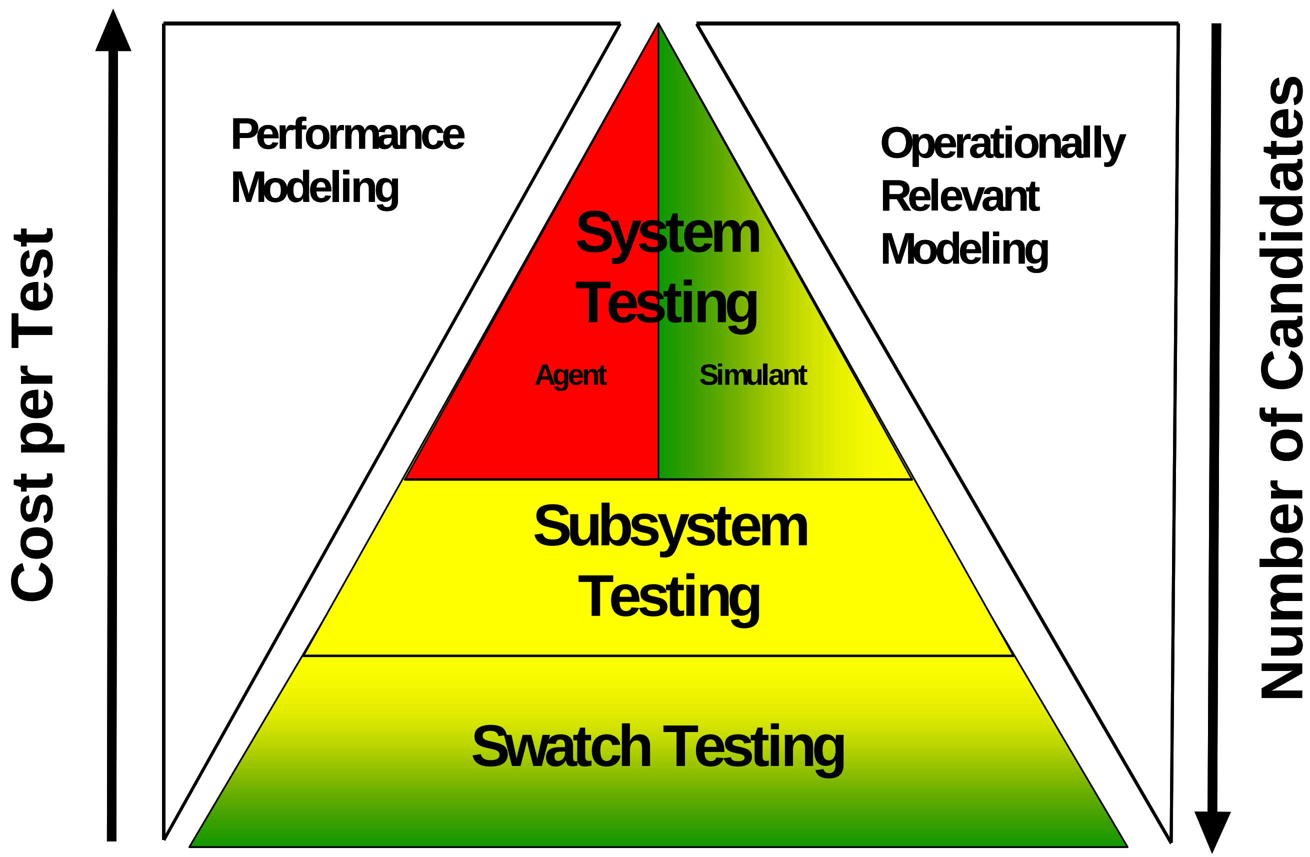
Chem Bio Individual Protection Conference 2006

Gene Stark Ph.D.
Dugway Proving Ground
March 9, 2006

Agenda

- Current Testing Protocol
- Improved Swatch Testing
  – Chemical Biological Agent Resistance Test (CBART)
  – Real Time analysis
- Improved System Testing
  – Real Time analysis of Man In Simulant Testing (MIST)
  – Improved Aerosol Testing
  – IPE Human Body Grid System
  – IPE Airflow Mapping
  – Protective Ensemble Test System (PETS)
- Conclusion

Evaluation Pyramid



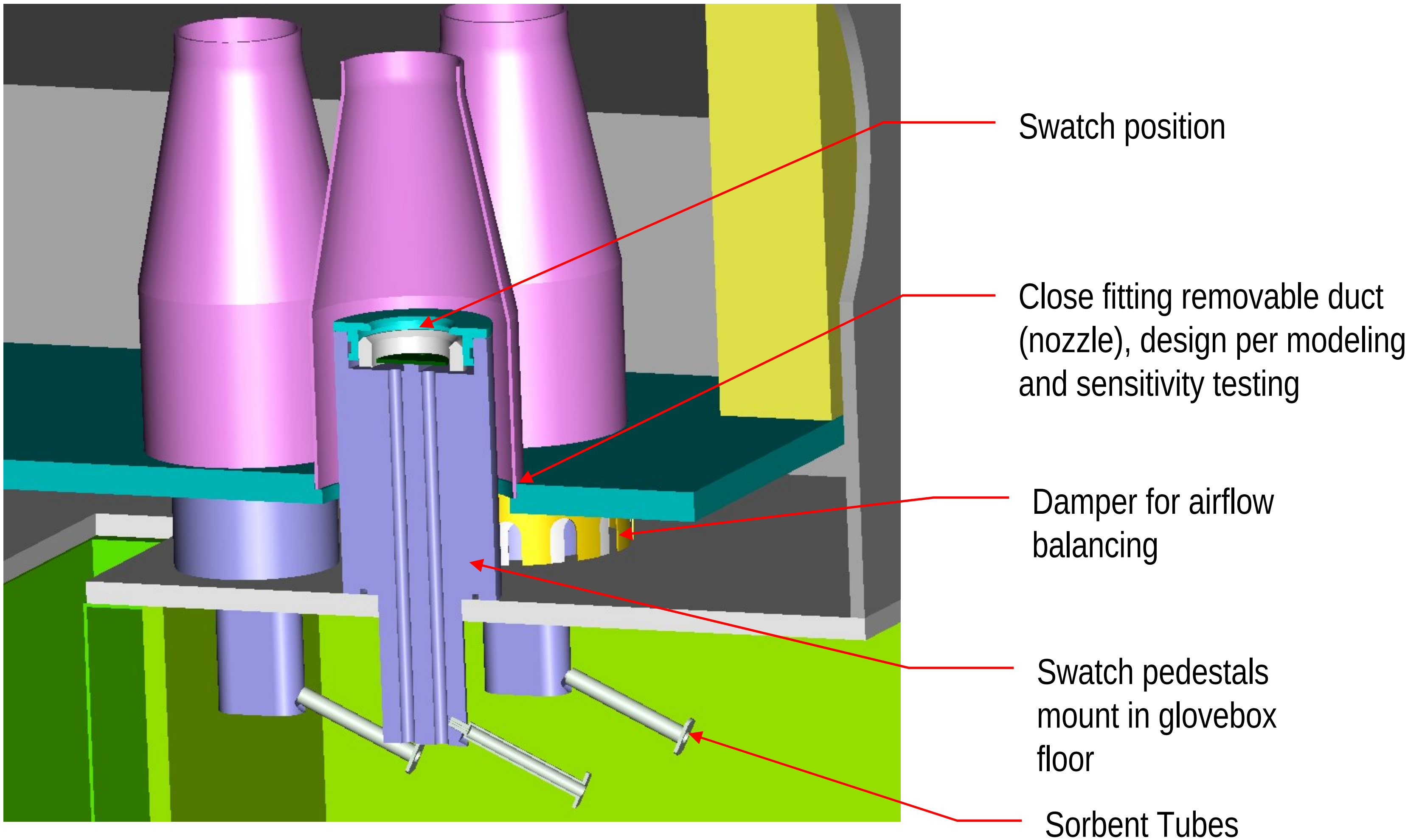
Swatch Testing Improvements

Increased Standardization—permeable fabrics tested differently than impermeable materials

	CBART	AVLAG
Test Types	Material Performance	Dual, Static & Convective flow
Flow Source	Wind Speed	Pressure Controlled
Types of data	1	3
Impingement Flow	Set @ wind speed-- No variability	Variable, based on swatch permeability
Config. Mgmt.	Built-in	None
	Single Test	Multiple Tests

Variable flow eliminated

CBART
(Chem/Bio Agent Resistance Test)
Conceptual Design



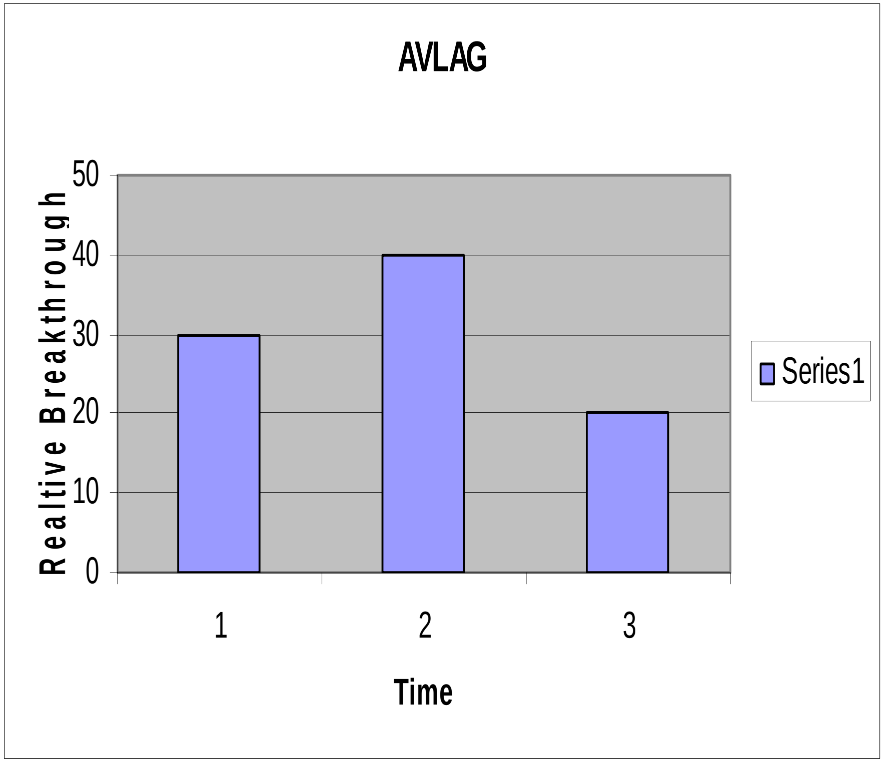
CBART

- Key Contributors
  - DPG, ECBC, SBCCOM, NSC, DTRA, DUSA-OR, JPEO, AEC, Natick, Battelle, Creare
- Limited JSTO funding this year
- Issues
  - Verification and validation of new fixture
  - Control parameters
  - Configuration Management

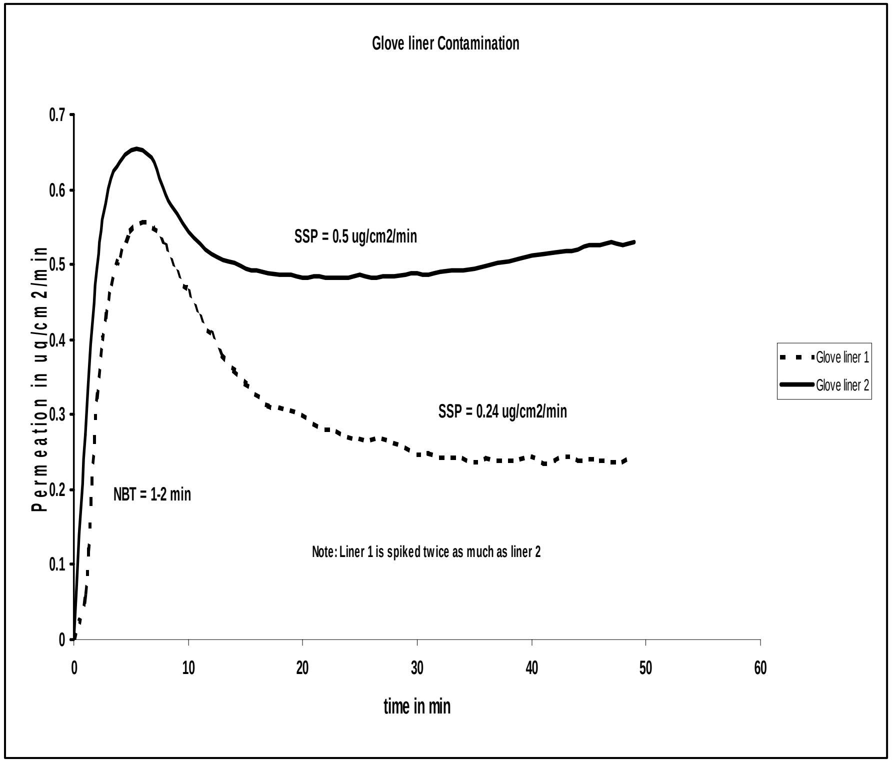
Swatch Real-Time Analysis

- Swatch testing has almost exclusively used bubbler samplers.
  - MINCAMS (>$30K each)
- Three bubblers per 24 hours gives 3 data points per sample/trial.
- Initial breakthrough time and steady state data unavailable.

Background

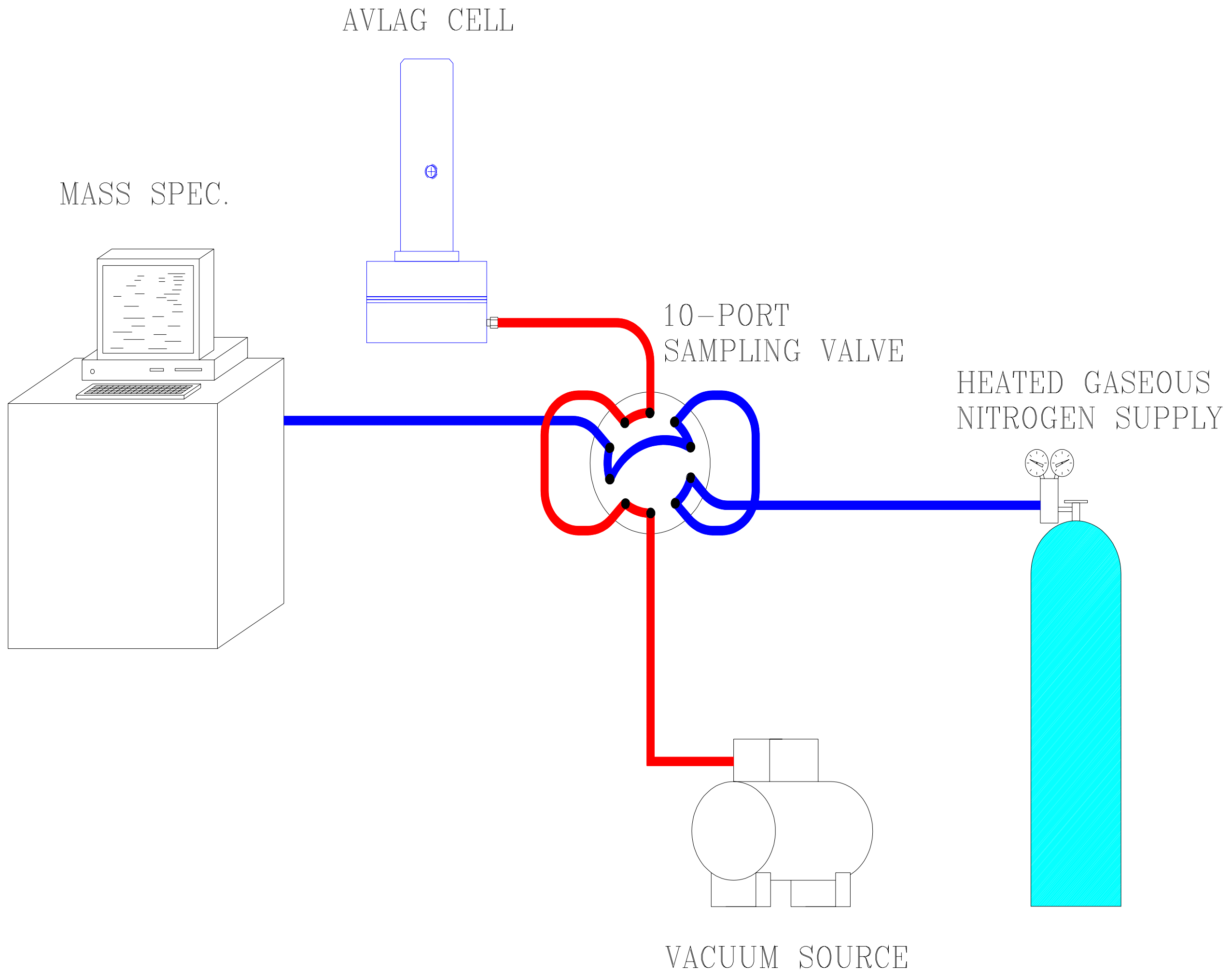


AVLAG
Realtive Breakthrough
50
40
30
20
10
0
1
2
3
Time
Series1



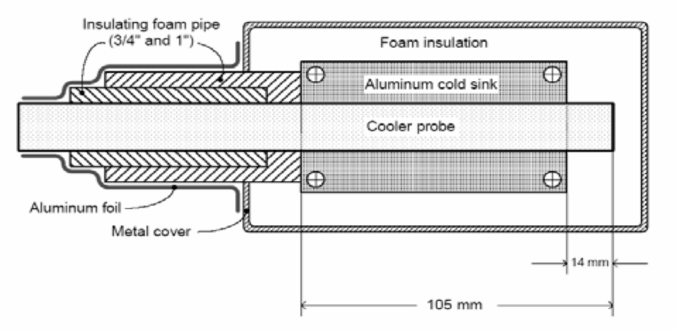
Glove liner Contamination
Permeation in ug/cm2/min
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
10
20
30
40
50
60
time in min
SSP = 0.5 ug/cm2/min
SSP = 0.24 ug/cm2/min
NBT = 1-2 min
Note: Liner 1 is spiked twice as much as liner 2
Glove liner 1
Glove liner 2

Proposed Solution



Gradient Temperature Cyrogenic Pre-concentrator (GTCP)

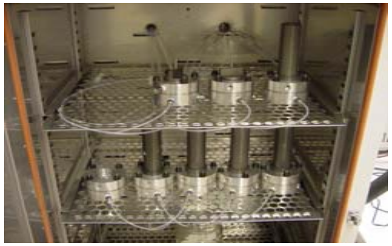
- GTCP ready to be integrated and tested with switching system (SS) and tested with agents.



The GTCP uses a two-stage refrigeration system, and eliminating problems typically associated with humidity concentration.

Cryofocusing Preconcentrator

Test chamber houses 10 AVLAG test cells. Using sequential switching, analyte from the permeate side of the test cell is transferred to the cryogenic prefocusing unit.

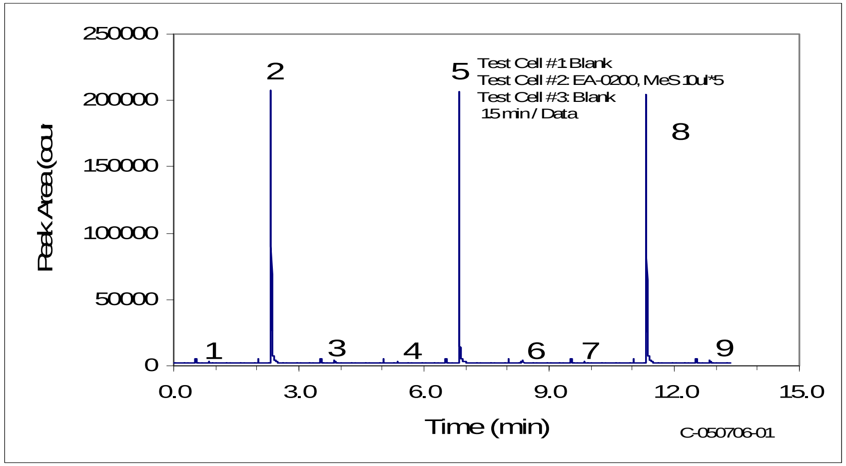


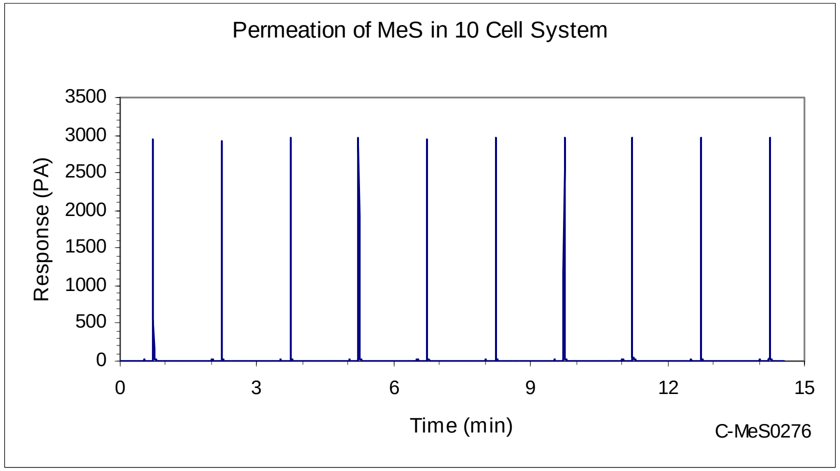
Test Chamber

Developed at SOUTH DAKOTA SCHOOL OF MINES & TECHNOLOGY

Status of Switching System (SS)

- SS ready to be integrated and tested with GTCP. Has been tested successfully with 10 cups.

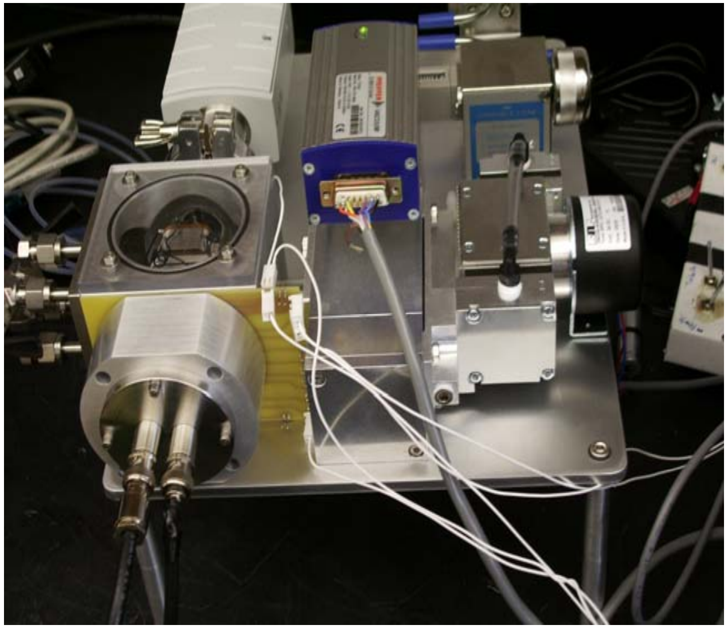


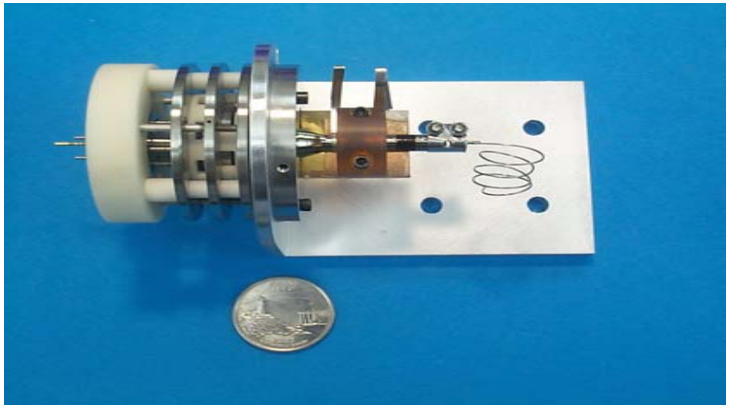


Sequential Switching using Fabric Swatches and Equal Amounts of Methyl Salicylate, with all Samples Spiked, then with Blanks to Demonstrate No Significant Carry-over

Miniature GC-MS

- GCMS has undergone dilute agent, TICs, and simulant testing at DPG.
- GCMS software fully developed beyond critical design.
- Seeing at least 1amu.
- Volume of toroidal trap a factor of x400 more trapping volume.
- Ready to be integrated onto the GTCP.
- Dugway will receive prototype this Spring.



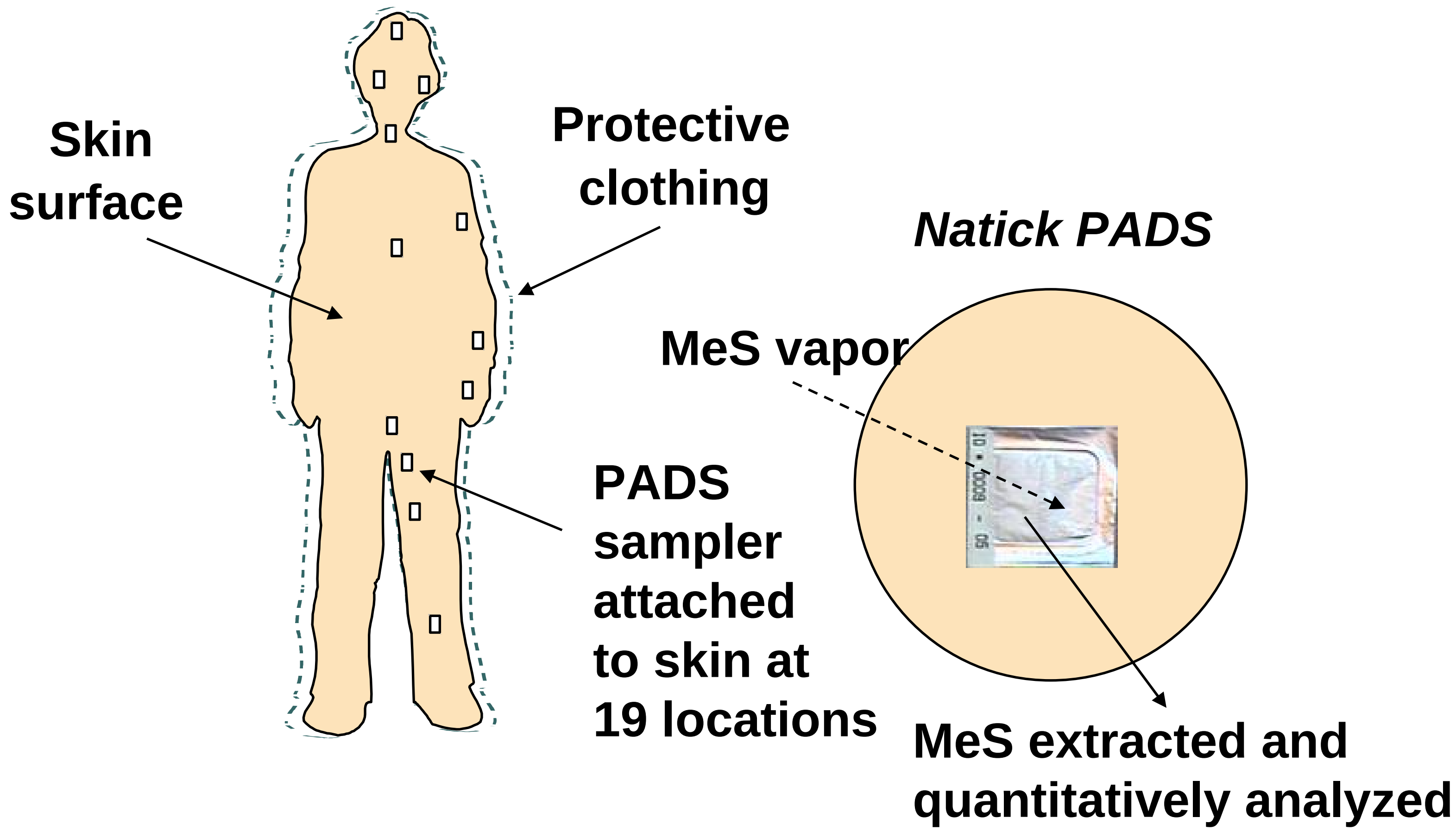


Developed at Brigham Young University

Swatch Real-Time Analysis

- Key Personnel
  - Nathan Lee/Dugway (Project Management)
  - Teri Corbin/ South Dakota School of Mines and Technology (Principle Scientist)
  - Milton Lee/Brigham Young University (Senior Scientist)
- JSTO funded beginning this year
- DTRA and Army Research Labs previously funded
- Issues
  - Verification and validation of 10 cup sample switching
  - Efficient separation of humidity from analyte
  - Swatch fixture available at Dugway and Battelle

Current MIST Sampling Procedure

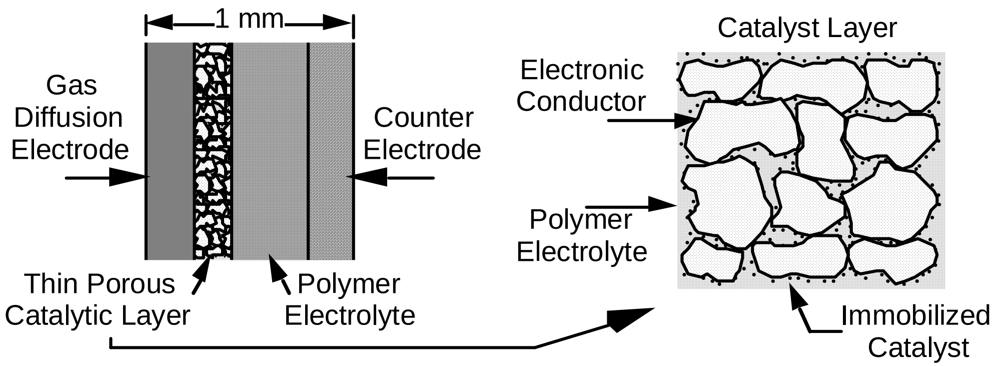


Real-Time MIST Sensor Requirements

- Size: 3 cm x 3 cm
- Concentration range: 10 ng/cm^2 to 100 mg/cm^2
- Wear duration: 2 hours
- Detect and clear time: 1 to 5 min
- Wireless
- Cost under $1000
- Selective to MeS
- Reject water/sweat
- Will be used for agent and robots later
- Technology selection in 5 months, operations capability in 1.5 years.

Potential MIST samplers

– Los Alamos National Laboratory (LANL) developed electrochemical fuel cell that has demonstrated sensitivity and selectivity for Methyl Salicylate.



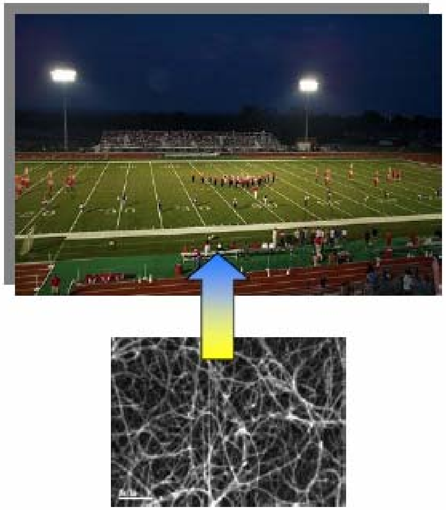
Electrochemical Fuel Cell Structure

Potential MIST samplers (cont.)

– NASA Center for Nanotechnology developed sensor array from single walled carbon nanotubes that has demonstrated sensitivity and selectivity for multiple chemicals.

Large surface area → large adsorption rates for gases and vapors → changes some measurable properties of the nanomaterial → basis for sensing

- Dielectric
- Capacitance
- Conductance

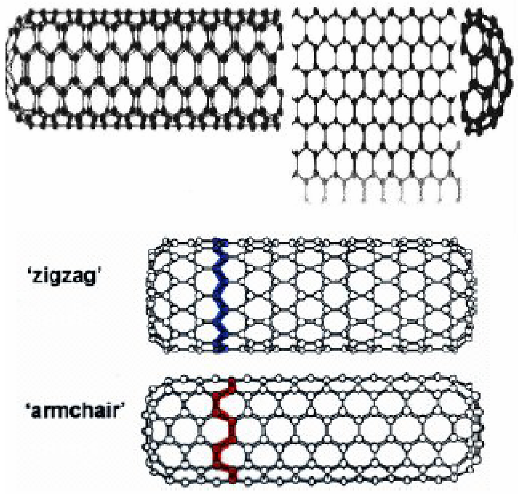


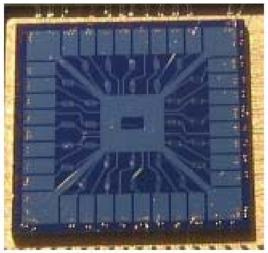
4 grams

Ames Research Center

Potential MIST samplers (cont.)

Nanomaterial + Chip (micro) ⟶ Macro sensing system





Array Chip

- Sensor array
- Chip < 1 cm^2
- Disposable or capable of integration

Operation:

1. The relative change of current or resistance is correlated to the concentration of analyte.
2. Array device "learns" the response pattern in the *training* mode.
3. Unknowns are then classified in the *identification* mode.

Ames Research Center

Real-Time MIST sampler

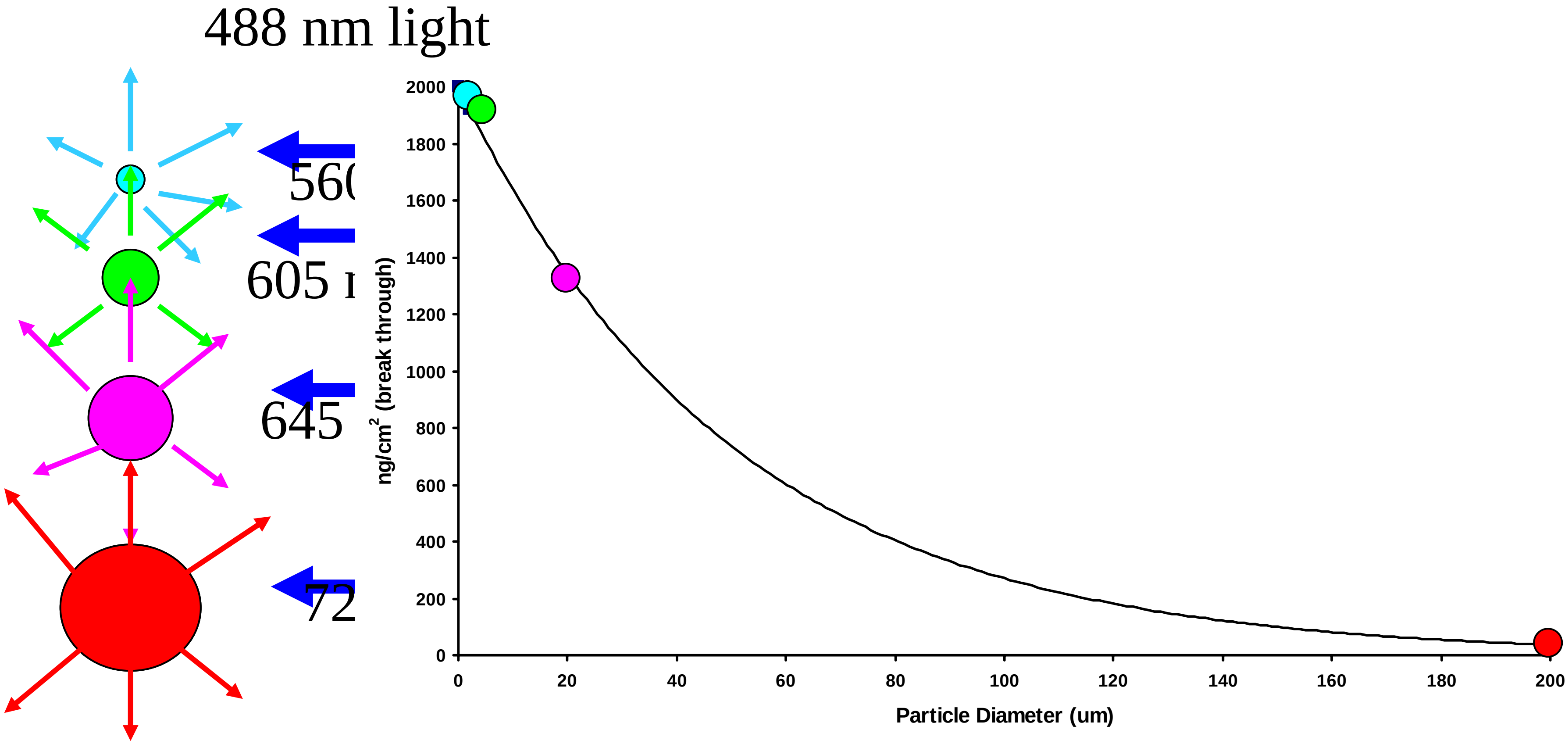
- Key Personnel
  – Andrew Neafsey, Jim Hanzelka – Dugway
  – Jon Kaufman – NAVAIRSYSCOM
  – Pam Gordon – AMTI
  – Alex Rodriguez – RDECOM
  – Karen Burke – RDECOM
  – Mike Vanfahenstock - Battelle
- JSTO funded beginning this year
- Issues
  – Verification and validation of technology
  – Attachment of sampler to body

Improved Aerosol System Testing

- Current aerosol testing utilizes 1-10 micron range particles
  - Exact size of penetrating particle unknown.
    - Solution: Selectively tag particle sizes of interest.
- Analytical procedure is laborious
  - Skin Rinsing to extract samples
    - Solution: Whole body aerosol scanner.

RTI Center for Aerosol testing in North Carolina
Photo courtesy of Jim Hanley

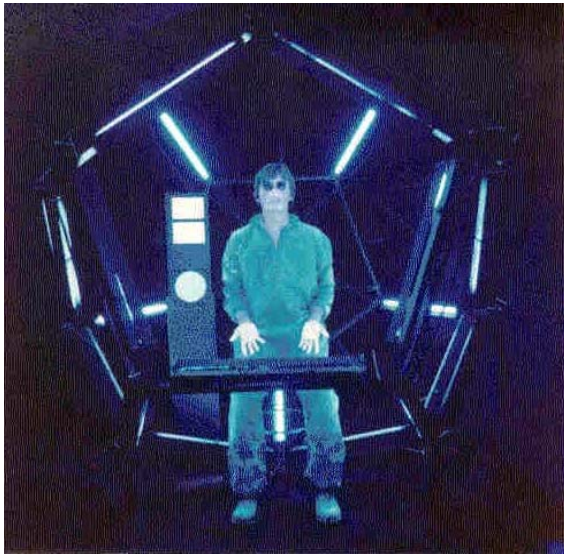
Basic Theory



Whole Body Aerosol Scanner

- The United Kingdom’s Safe Training Systems has developed a whole body scanner that quantifies fluorescent tagged aerosols particles.

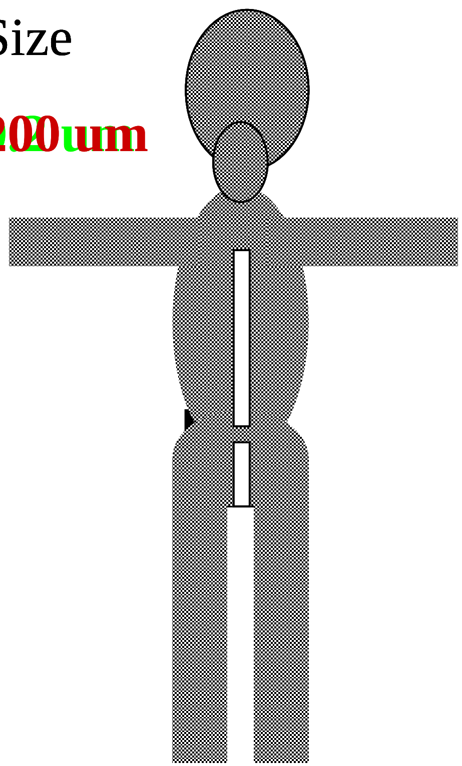
- PD-TESS has committed $500K to purchase one.



Example Display

Size

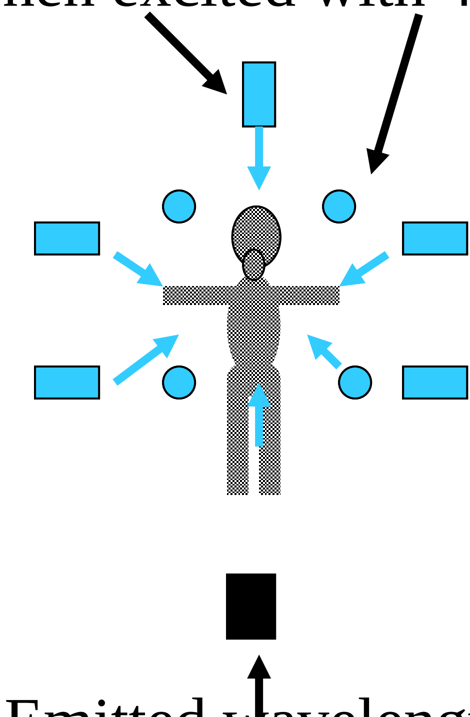
200um



Wavelength 560 720
Avg density 1952 1992
Profile ng/cm2 White - 20 White - 50 Yellow – 200 Black - 2000

Filtered Source 488 nm

When excited with 488 nm



Emitted wavelength are imaged

Filtered Camera

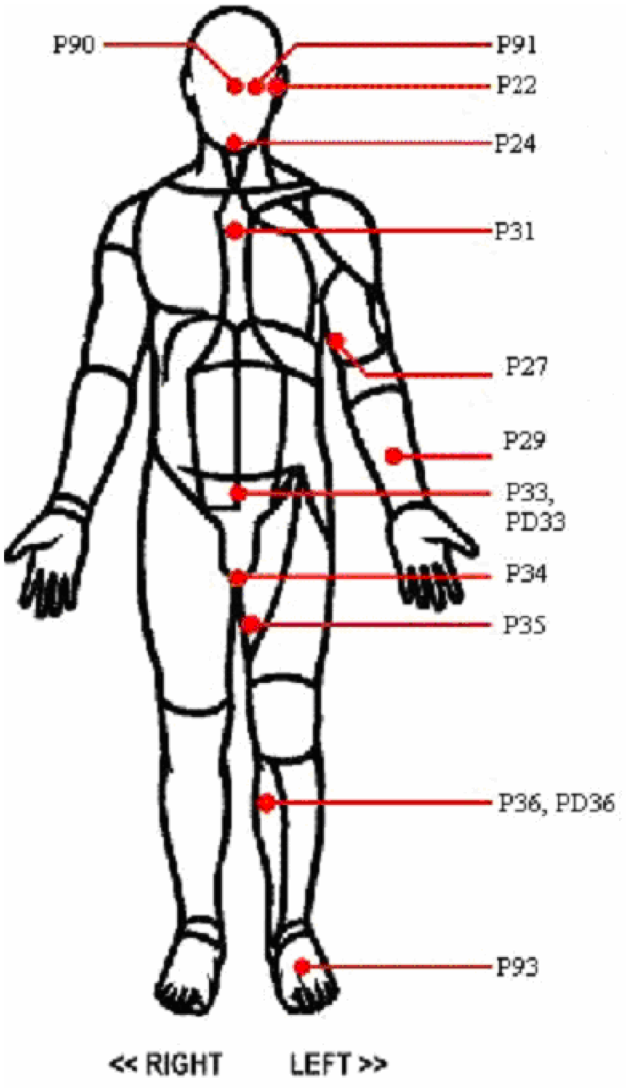
560, 605, 645, 720 nm

Aerosol Testing Improvements

- Personnel
  - James Hanzelka, Andrew Neafsey, Brad Rowland – Dugway
  - Jonathan Kaufmann – NAWC
  - James Hanley – RTI
  - Other members of the HWRW and nanoparticle working groups
- PD-TESS funded
- Issues
  - Particle tagging
  - Can be made mobile

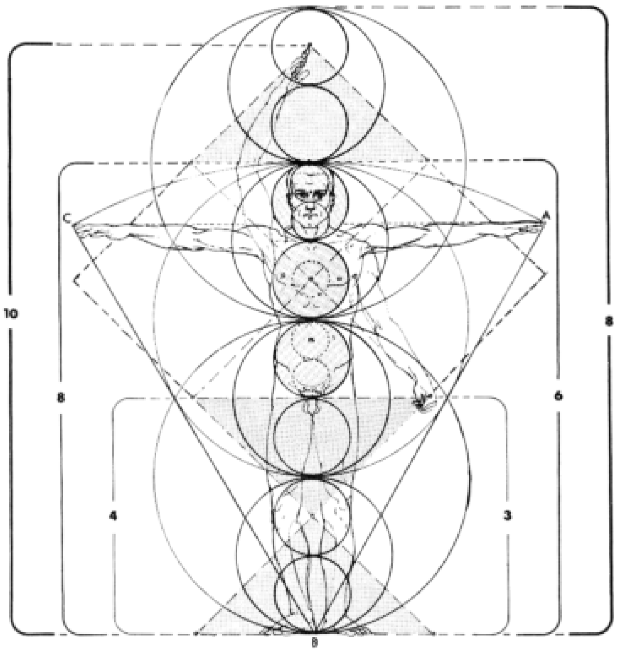
IPE Test Grid
Project Objectives

- Goal of program is to develop a standard method for marking the location of sampling on the body and successive layers of clothing for two purposes
  - Ensure repetitive placement of sampling for MIST, Aerosol and Swatch testing.
  - Provide a basis to relate data from MIST, Aerosol and Swatch testing (critical for overarching model effort).
- Use polar coordinates related to anthropometric landmarks.
- Joint effort between Natick Soldier Center and Dugway.



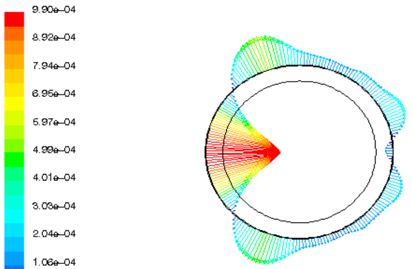
IPE Test Grid
Program Overview

- Key Personnel
  - Jim Hanzelka/Dugway – Project Management
  - Steven Paquette/Natick – NSC Anthropology Coordinator
  - Dan Blodgett/Dugway – Lead Statistician
- PD-TESS funded beginning this year
- Issues
  - Verification and validation of sampling sites to match current locations used for MIST and Aerosol Testing
  - Ease of use

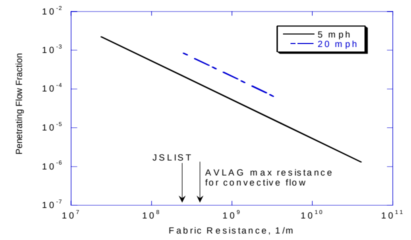


IPE Airflow Mapping

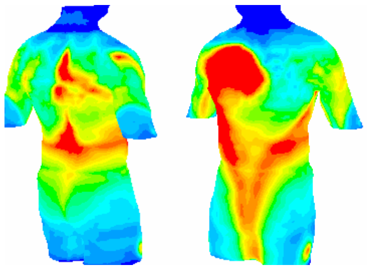
- Establish a validated model that describes the correlation between airflow and agent penetration through materials, interfaces and filters.
- Develop a grid for MIST sensor placement to reflect agent flows underneath suit.
- Standardize sensor placement
- Establish fundamental parameters that will be used in the Overarching IPE model.



Velocity Vectors Through Clothing Surface



Fraction of Flow Penetrating Garment



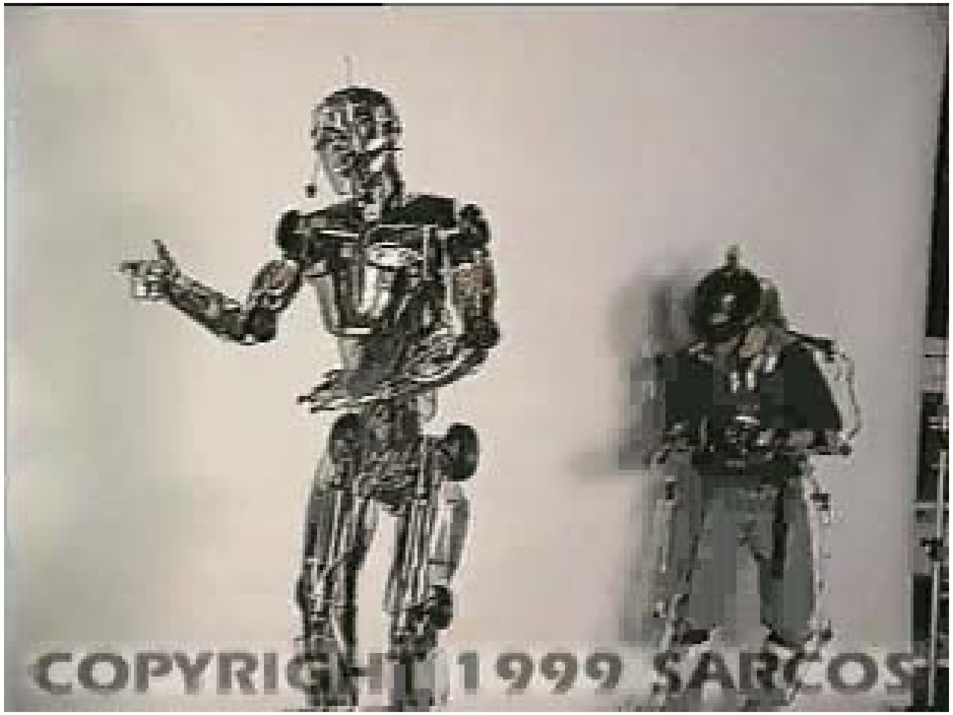
- –Solve 3-D Mass/Momentum/Energy Equations for Airflow and Agent
- –Volume-Averaged Porous Media Approach, Variable Properties
- –Extend Commercial FLUENT® or Other modeling Software for Vapor/Liquid Physics in Fabric
- –Activated Carbon Model

IPE Airflow Mapping

- Key Personnel
  - – Nathan Lee/Dugway (Project Management)
  - – Phil Gibson/Natick (Principle Investigator)
  - – Jim Barry/Creare (Senior Scientist)
- JSTO funded beginning this year
- Issues
  - – Verification and validation of model
  - – Control parameters

Protective Ensemble Test System (PETS) Objectives

- PETS will utilize a live agent facility that will incorporate robotic mannequins and support equipment for testing entire IPE ensembles under realistic use conditions.
- Design facility to accommodate various agents, simulants and environmental conditions.
- Design instrumentation to acquire real time data.
- Establish optimal sampling locations for test sampling.
- Verification and validation of live agent model, software and processes.



PETS

- Key Contributors
  - Dugway, ECBC, JPM-IP, Battelle, DTRA, DUSA-OR
- PD-TESS funded beginning this year
- Issues
  - Free standing or attached umbilical cord
  - Under-suit sampling locations
  - Analytical methods
  - Liquid, aerosol, vapor challenge test methods
  - Chamber Decontamination
  - Model and evaluation strategy

Conclusion

- Improved swatch testing protocols are needed to test next generation materials.
  - Chemical Biological Agent Resistance Test (CBART)
  - Real Time analysis
- Improved system testing needed to better characterize IPE performance.
  - Real Time analysis of Man In Simulant Testing
  - Improved Aerosol Testing
  - XYZ Grid System
  - Airflow Mapping
  - Protective Ensemble Test System

MICROCLIMATE COOLING

Chemical Biological Individual Protection Conference

7-9 March 2006

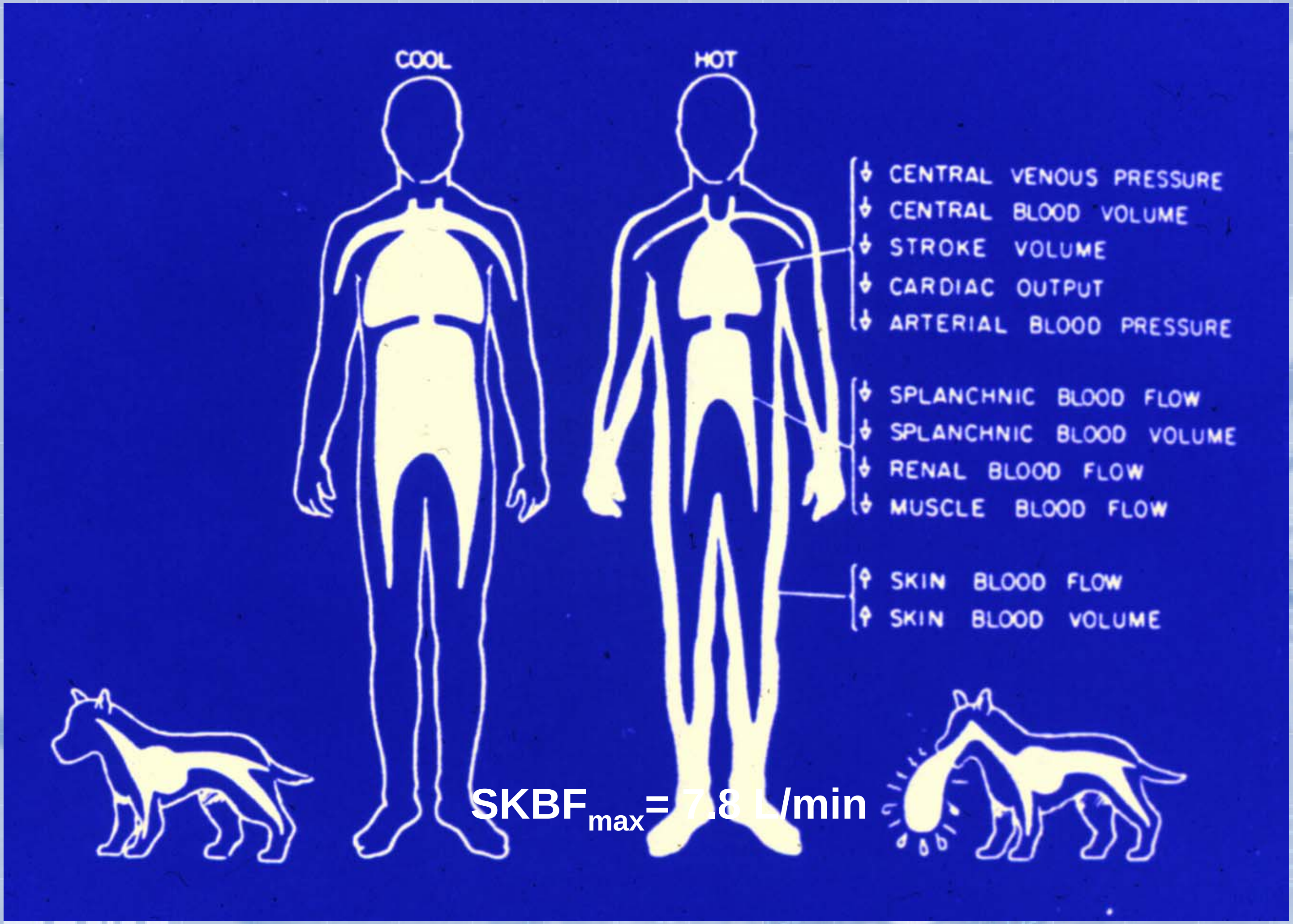
U.S. Army Natick Soldier Center
Individual Protection Directorate

Walter Teal
508 233-6096
walter.teal@natick.army.mil

Warfighter Microclimate Cooling
The Need

A Warfighter working at a moderate activity level, in MOPP IV in a warm/hot environment will succumb to heat stress in 60-90 minutes.

Blood Distribution in the Heat

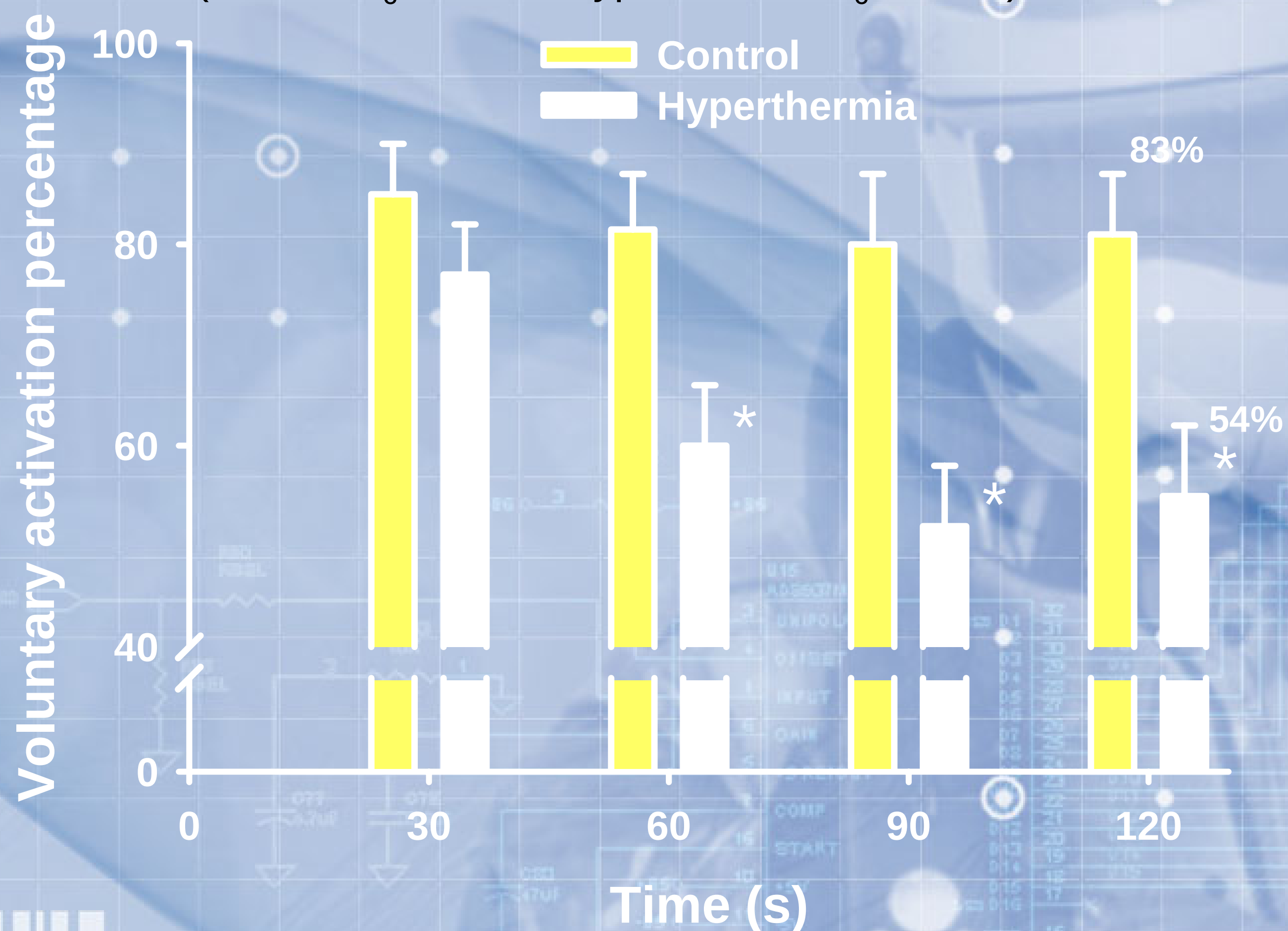


$SKBF_{max}$= 7.8 L/min

Rowell Human Circulation 1986

Hyperthermia Reduces Voluntary Muscle Force Activation

Exercise to exhaustion (60%VO_{2max}) in hot or temperate;
sustained MVC knee, voluntary activation by electrical stimulation to nervus femoris
(Control T_c = 38ºC; Hyperthermia T_c = 40ºC)



* Significantly lower than control (P<0.05)

Nybo & Nielson JAP 2001

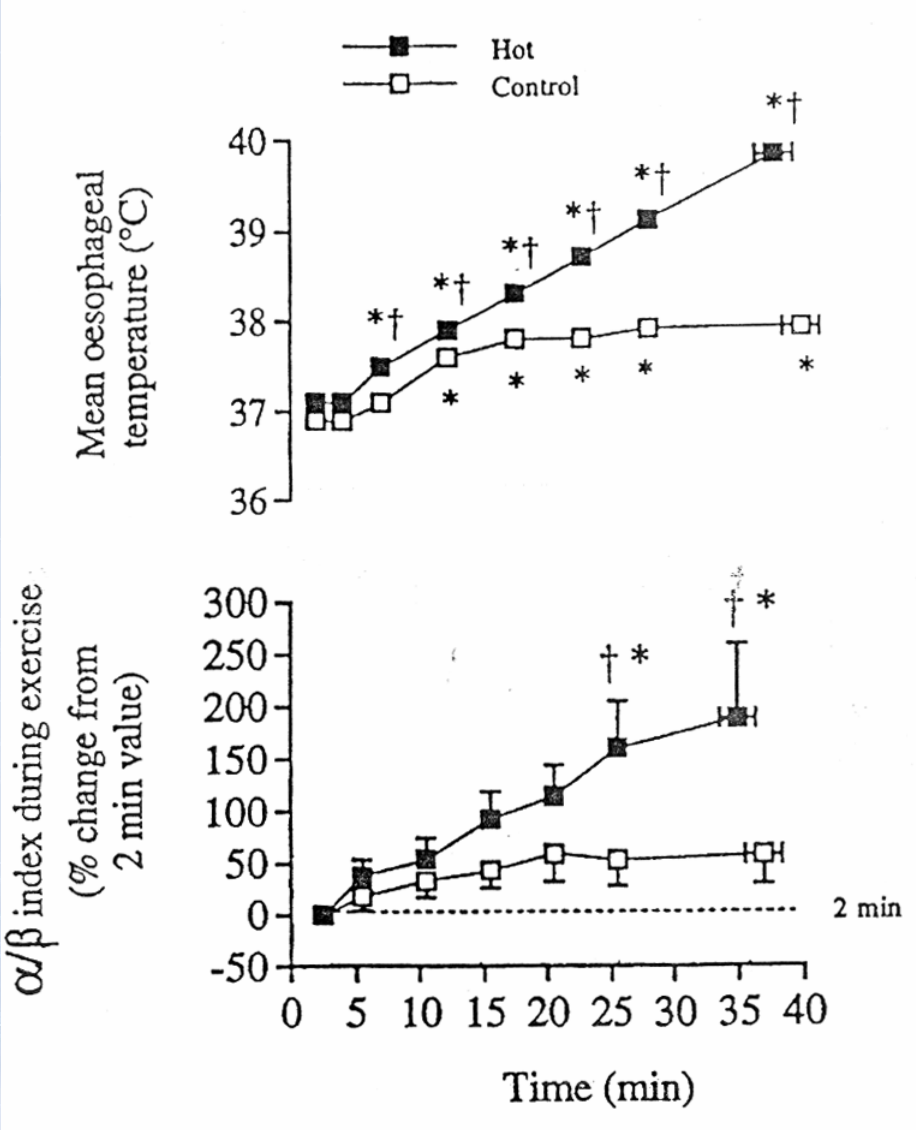
Hyperthermia Reduces Brain EEG Activity

Exercise (60% VO_{2max}) to Exhaustion in hot & temperate climates.

Frontal Brain EEG activity related to drowsiness (↑ α freq &↓ β freq).

Heat Stress induced lower β freq & α/β index was highly correlated with T_{es} (r^2 = 0.98)

Nielsen et al., <u>Pflug. Arch</u>. 2001

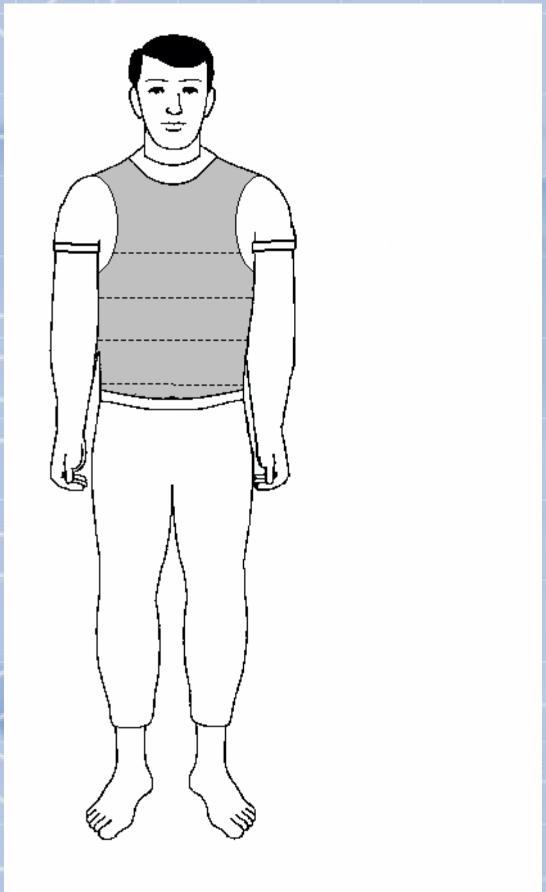


Microclimate Cooling Benefits

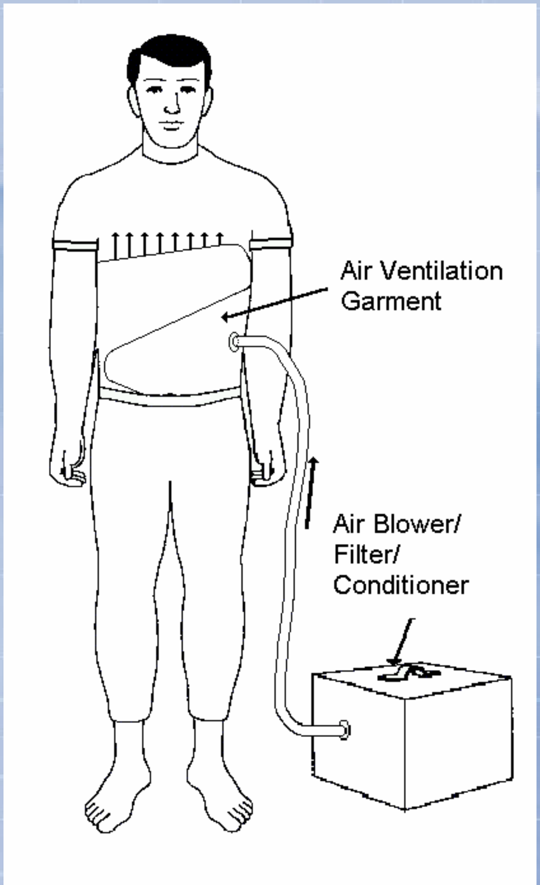
Reduction in core temperature Reduction in skin temperature Reduction in heart rate Reduction in sweat rate	=	Increased mission duration Decrease in hydration needs Improved mental acuity Maintain physical performance

With cooling, the Soldier is STRONGER LONGER and MENTALLY SHARPER

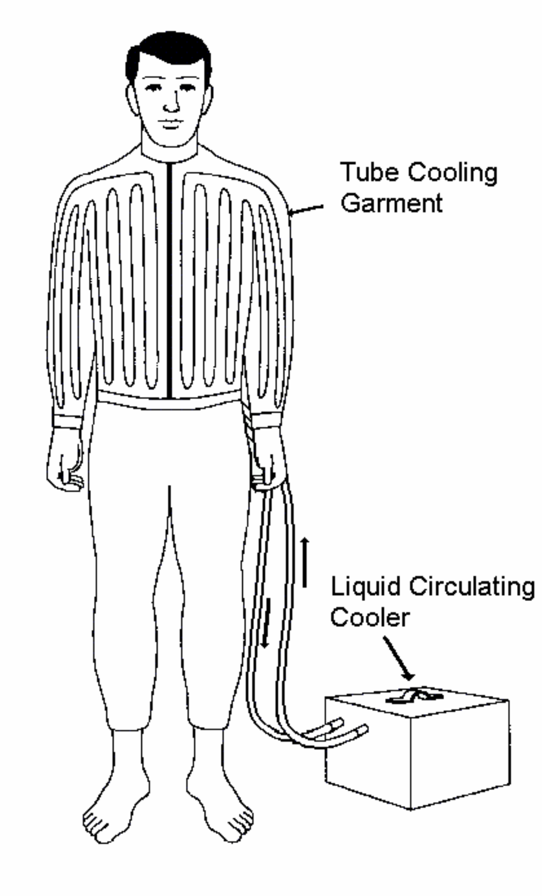
Microclimate Cooling Concepts



Heat Storage Garment

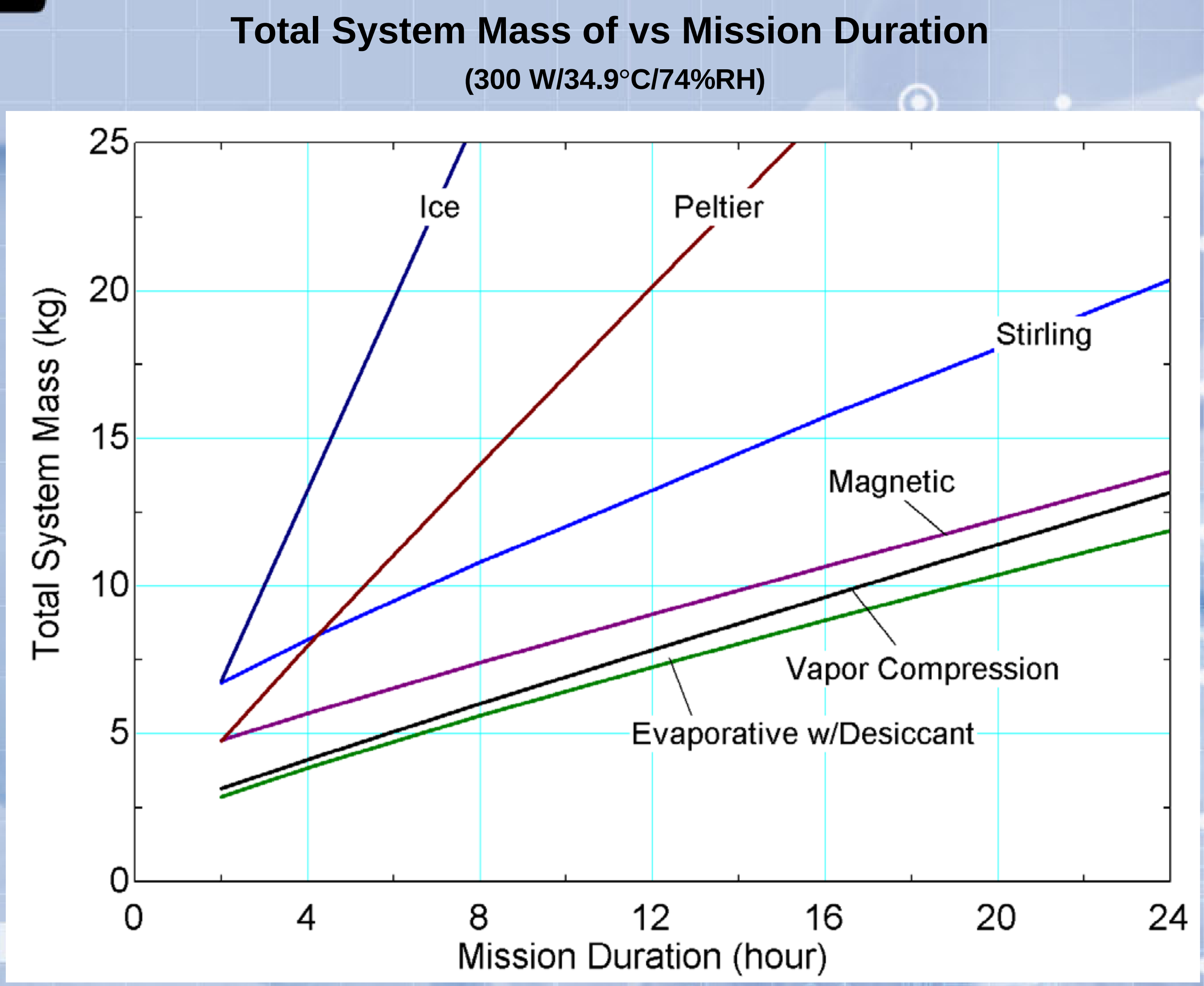


Air System



Liquid System

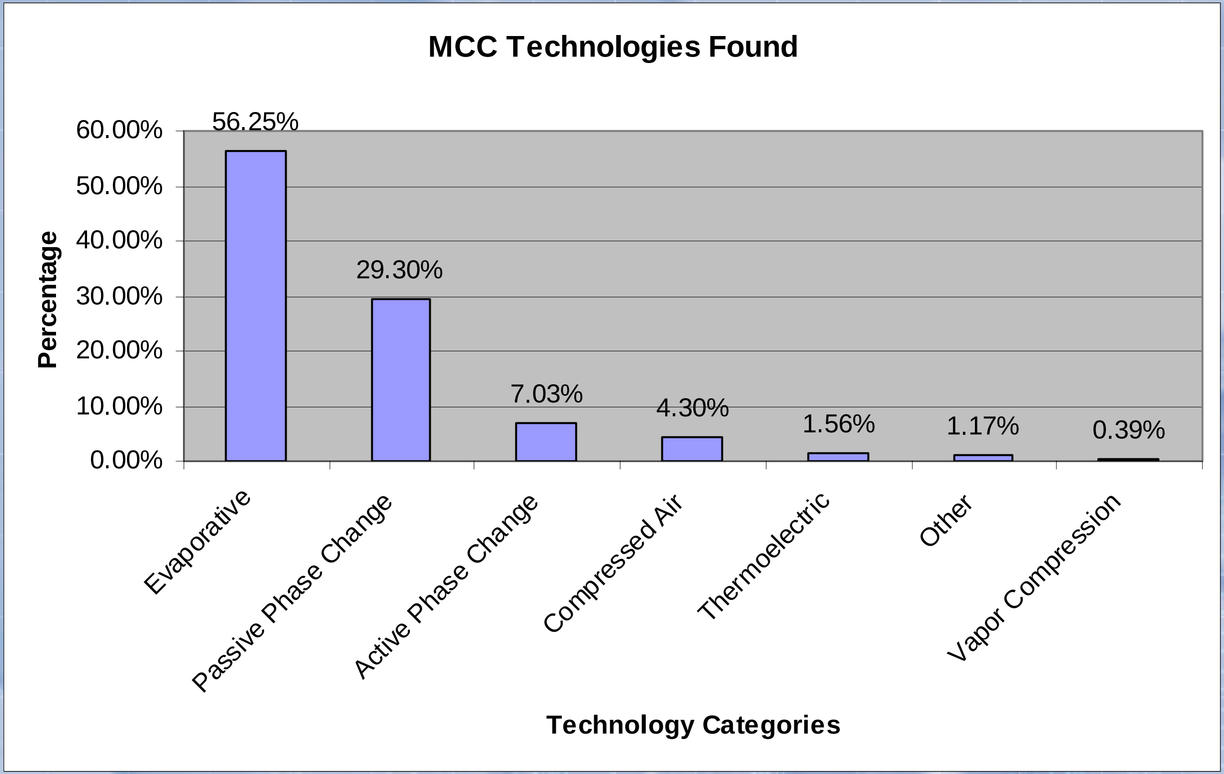
Mass vs. Duration for Various Cooling Technologies



Product Survey of Microclimate Cooling Systems

Identified over 250 products!

Percentage of Products Per Technology



NATICK SOLDIER CENTER

Microclimate Cooling Systems
Evaporative Systems

INDIVIDUAL PROTECTION DIRECTORATE

Evaporative Cooling Products: Items that absorb several times their weight in water when submerged

- Relies on water evaporation to provide cooling
- Multiple configurations (vest, hat, neck wrap) available
- Outer clothing may have to be opened/removed to reactivate product
- Nearly ineffective when worn under protective clothing
- ~$2-$260

STATUS: In production.

Microclimate Cooling Systems
Phase Change Systems

DESCRIPTION:
Vest carrier with four or six pockets into which frozen gel strips (starch – water mixture) are inserted to provide cooling.

SPECIFICATIONS:
- Used Navy shipboard since 1991
- ~12 pounds (six pocket version)
- ~8 pounds (four pocket version)
- Approximately 2 hours between gel strip exchange
- Approximately 200 watts of cooling (six pocket version)

STATUS: In production.

Microclimate Cooling Systems
Personal Ice Cooling System (PICS)

DESCRIPTION:
A battery powered mini pump circulates chilled water between the NBC sealed ice bag and a tube garment to remove metabolic heat from the body.

SPECIFICATIONS:
- 30 minute ice change-out
- 250 watts (estimated)
- Four hour battery change-out
- Three alkaline D-cell batteries
- Weight: 11 pounds

STATUS: In production.

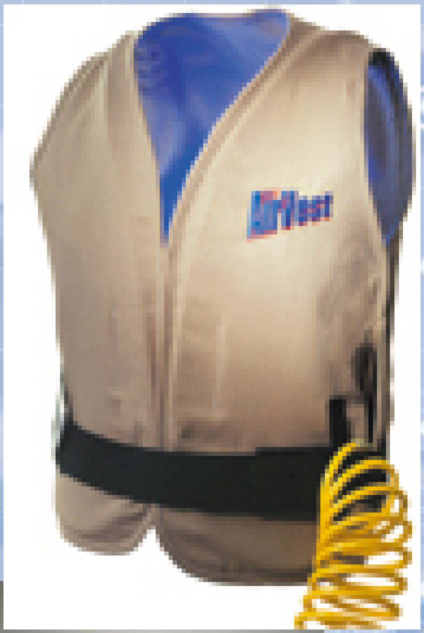
Microclimate Cooling Systems
Commercial Ice-based Active System

Active Phase Change Material (Ice based/liquid circulating) Products: Chilled water pumped from an ice reservoir to a tube lined cooling garment

- Requires freezer to recharge ice
- Requires cooler to transport ice
- Cooling rate decreases over time
- Pass-through device may be required in outer clothing to accommodate tubing
- Some systems are man mounted; others are hand carried and set down
- Cooling rate/duration dependent on amount of PCM
- ~$350-$1900

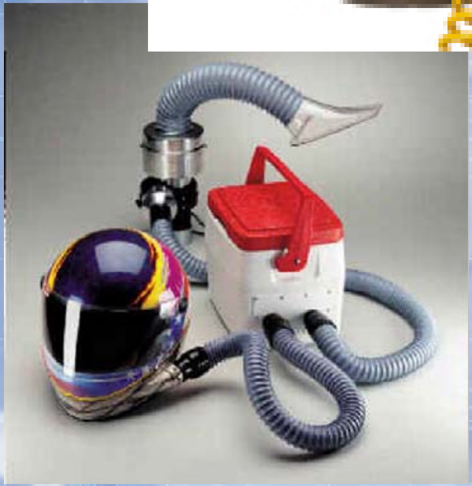
STATUS: In production.

Microclimate Cooling Systems
Compressed Air Systems



Compressed Air Products: Air distribution garment connected to a compressed air source

- •User is tethered; system is not autonomous
- •Pass-through device may be required in outer clothing to accommodate hose
- •Compressed air source required
- •Cooling rate constant over time
- •Some products use vortex tubes to refrigerate air
- •~$100-$260



STATUS: In production.

Microclimate Cooling Systems
Thermoelectric (Peltier) Systems

Thermoelectric (Peltier) Products: Refrigeration unit chills and circulates a fluid to a tube type cooling garment

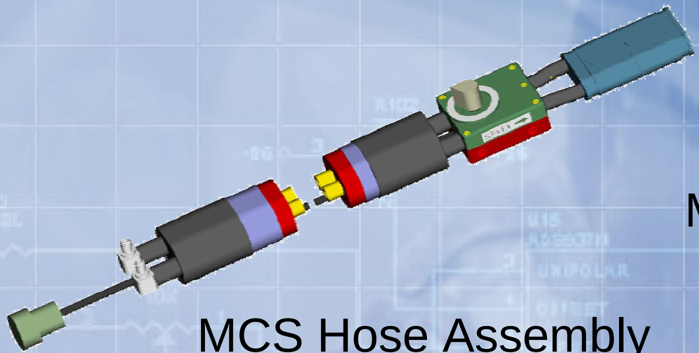
- DC current applied across two dissimilar materials, resulting in a temperature differential
- Low efficiency (i.e. requires more batteries)
- Pass-through device may be required in outer clothing to accommodate tubing
- Cooling rate constant over time
- Few moving parts
- ~$50-$714

STATUS: Development required.
Note: DARPA is developing a prototype based on advanced materials. Several years away.

Microclimate Cooling Systems
Air Warrior System

- Liquid circulated to garment to cool aircrew
- Autonomous cooler takes heat from the fluid rejects heat to warm (ambient) air
- Current Applications:
  - OH-58D
  - UH-60A/L
  - CH-47D
  - M9 ACE

Microclimate Cooling Garment (MCG)



MCS Hose Assembly

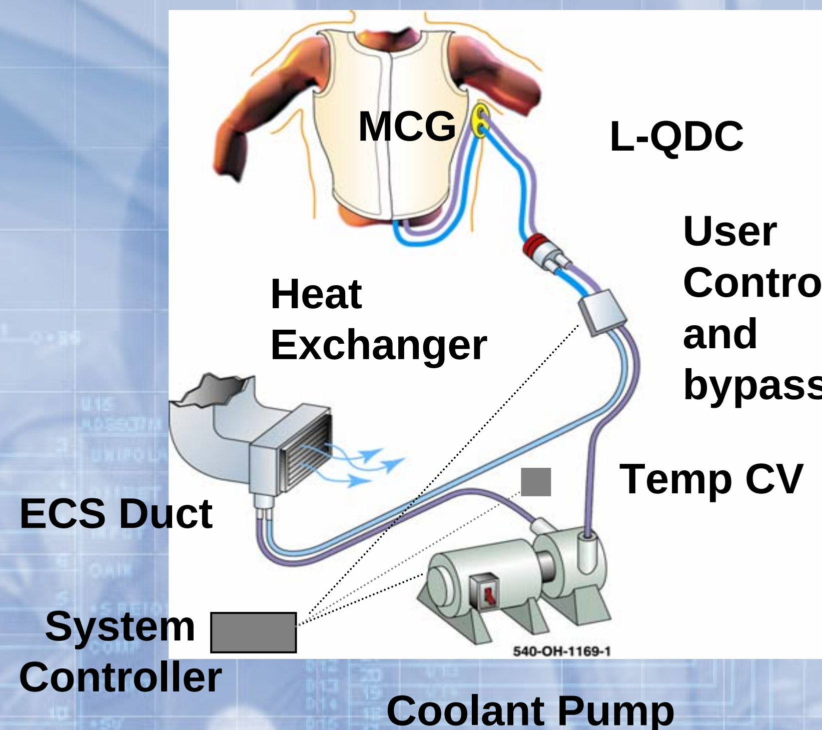
Microclimate Cooling Unit (MCU)

STATUS: In production.

Microclimate Cooling Systems
AH-64 (Apache) Cooling System

- Heat Exchanger incorporated inside cool air ducts - chills coolant directly
- MCG and coolant umbilical identical to baseline MCS

STATUS: In production.



Microclimate Cooling Systems
Cool The Force Add-on for HMMWVs

-13000 HMMWVs receiving Add-on-Armor kits including Air Conditioner (Red Dot)
- Foster Miller, Inc. liquid circulating system down-selected
- Provides cooling for 1-4 occupants

STATUS: Limited operational evaluation (Iraq) in progress.

Heat Exchanger

Flow Control Assembly

Microclimate Cooling Systems
Compact Vapor Compression System

ASPEN SPECIFICATIONS:
- 120 watts of cooling (95 F ambient)
- Power: 50 watts @ 24 Vdc
- Weight: 4.65 lbs
- Size: 175 in^3

FMI SPECIFICATIONS:
- 110 watts of cooling (95 F ambient)
- Power: 50 watts @ 24 Vdc
- Weight: 4.0 lbs
- Size: 170 in^3

STATUS: TRL5 prototype. Estimated 6 months development for production.

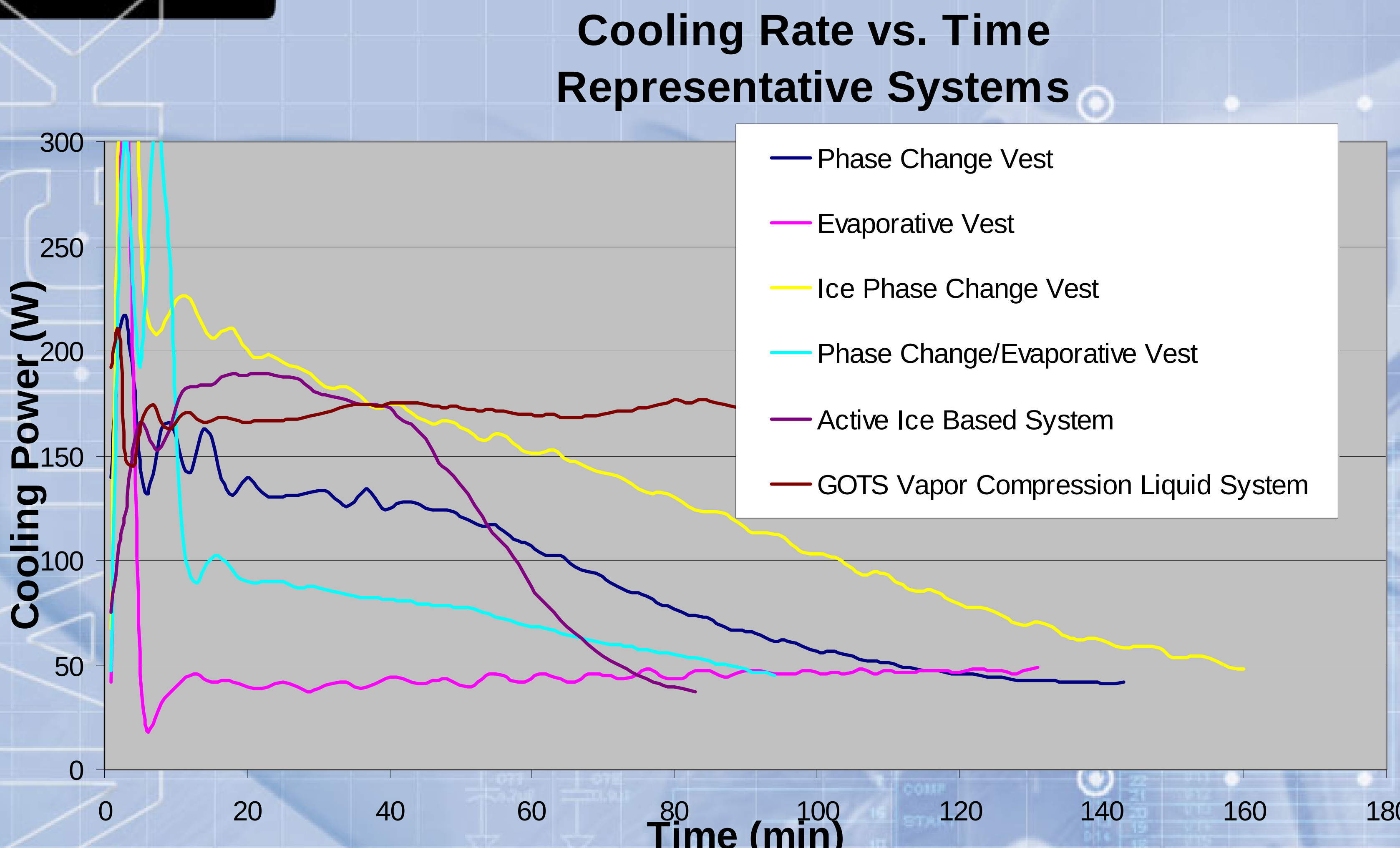
Microclimate Cooling Systems
Future Vapor Compression System

INDIVIDUAL PROTECTION DIRECTORATE

- Liquid circulating vapor compression cooling system
- 120 watts of cooling @ 95°F
- ≤6 pounds including power source
- Cooling fluid delivered at 77°F
- ≤92 in^3 (1.5 liters)

STATUS: Prototype anticipated in May 2006. Smaller (33%) version 1 to 2 years away.

Microclimate Cooling Systems
Evaluation of Various Existing Systems



Microclimate Cooling Systems General Observations

- 250± commercial Microclimate Cooling products available
- Evaporative systems are the most common type, followed by Passive PCM
- Evaporative systems provide minimal cooling under protective clothing
- Ice based Passive systems provide more cooling than paraffin systems on a per weight basis
- All have technical, logistical, cost, and operational trade-offs
- Cannot identify the “best” product without understanding specific user needs/requirements
- Vapor compression systems hold the most promise for near term dismounted Warfighter needs.

Microclimate Cooling
User Response

Subject: RE: Air Warrior

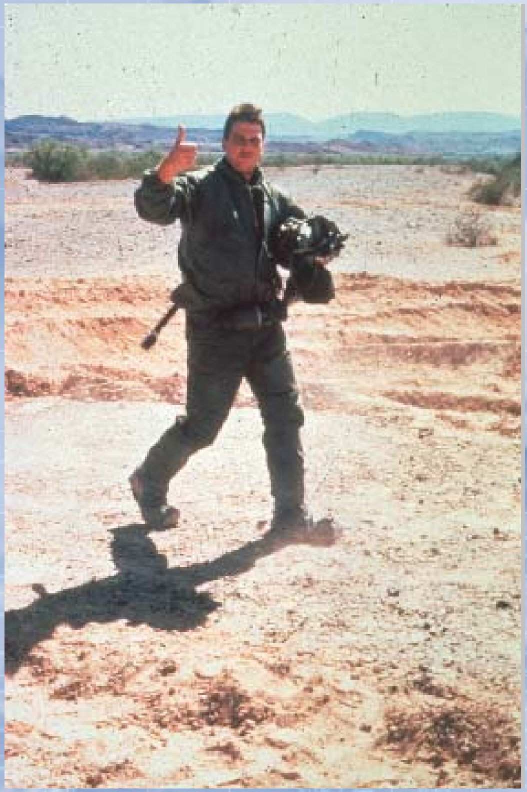
"***The crew agreed this system is the best thing we've done for the helicopter since we put a rotor on it!!! The system greatly enhances the crew's comfort level and significantly reduces fatigue.***"

LTC PAUL AMBROSE
LSA ANACONDA, IRAQ
Used with permission.

Microclimate Cooling

Without microclimate cooling, he’s not just hot, he’s a heat stress casualty

Without cooling



With cooling

Product Director
Test Equipment, Strategy and Support

March 9, 2006

Individual Protection Conference
March 7-9, 2006

Nicole Trudel
JPEOCBD
Chief, Test and Evaluation
nicole.trudel@jpeocbd.osd.mil

PD-TESS Mission

MISSION

The Product Director Test Equipment, Strategy, and Support Will Support the Milestone Decision Authority, Joint Project Managers, and the Test and Evaluation Community with the Development of Test Capabilities to Adequately Test and Evaluate, Chemical, Biological, Radiological, and Nuclear Defense Systems Throughout the Life Cycle Acquisition Process.

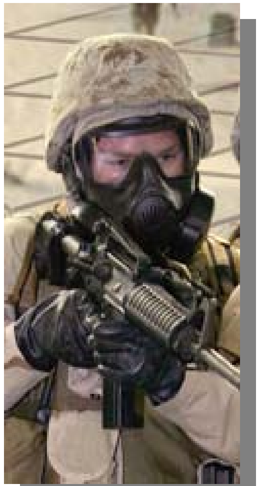
Background

- **The CBDP received an unprecedented $443 M to support T&E infrastructure development and improvements through the FY06 Enhanced Planning Process.**
- **Efficiencies will be gained through a new organization, "PD TESS" established by the JPEOCBD to provide centralized planning, management and accountability for executing the newly approved Joint T&E investment strategy.**
- **The new funding will support execution of a prioritized list of projects vetted through the Joint T&E Executive for CBD that will close T&E capability gaps identified by the joint community.**
- **Planned T&E capabilities will allow JPEOCBD to develop and assess the newest technologies and provide the best force protection capability to warfighters.**

PD TESS Structure

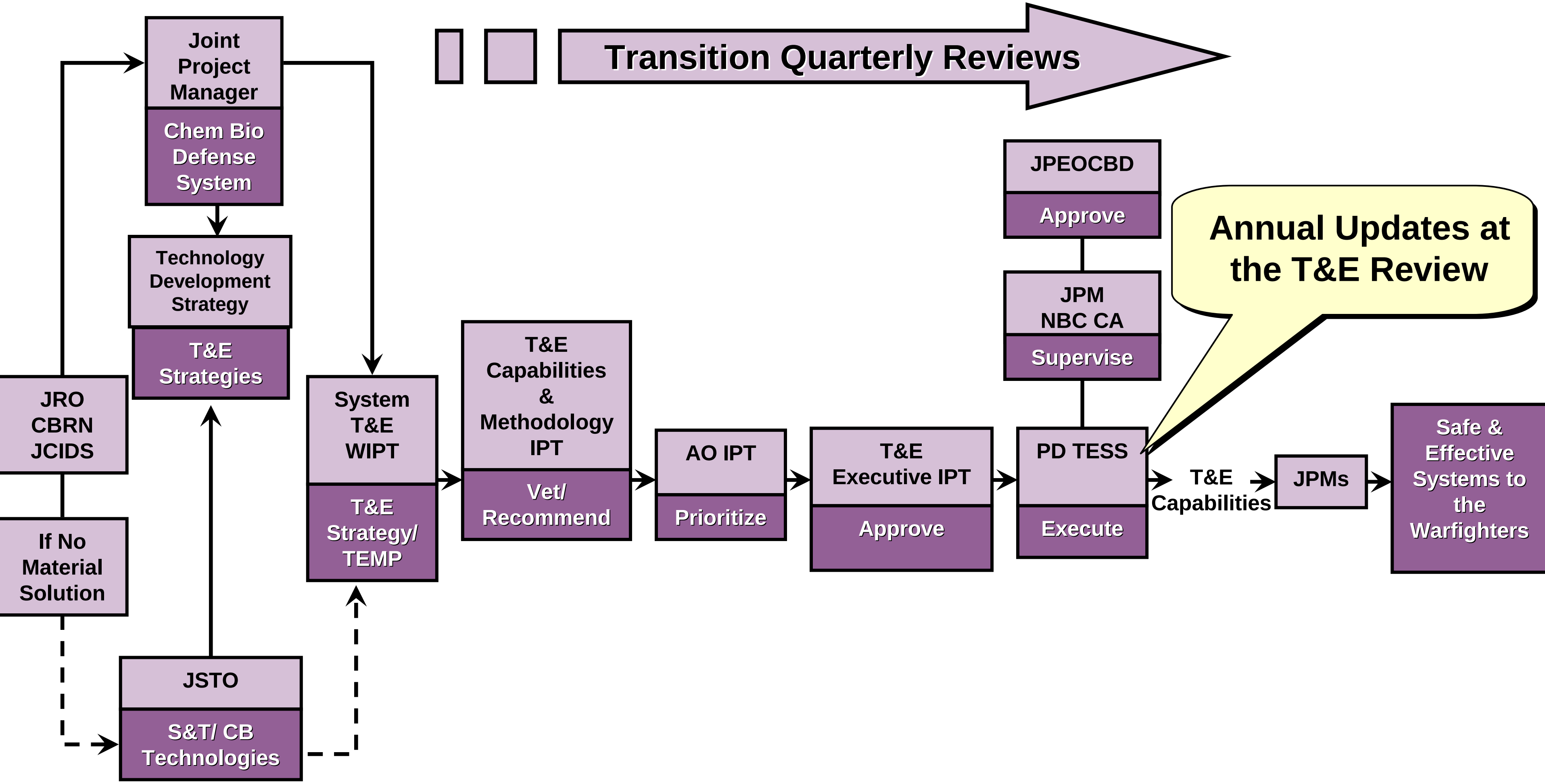
- **PD TESS**
  - Business Acquisition Manager
  - Contracts
  - Administrative
  - Deputy MAJ
  - Range Support MAJ
  - T&E Strategy/Facility Development
  - **Sense Laboratory (Bio)**
    - Standard Unit of Measure
    - WSLAT Chamber
    - Bio Standoff Chamber
    - Bio Spectral Instr QA/QC
  - **Sense Laboratory (Chem)**
    - Dynamic Test Chamber
    - NTA Chambers
    - Chem Standoff Chamber
  - **Sense Field**
    - Spectroradiometer
    - Test Grid & Safari
    - ASC & JABT Upgrades
  - **Shape**
    - Synthetic Test Environment
    - Stimulants and Stimulators
    - Modeling and Simulation
  - **Shield/Sustain**
    - LC / GC
    - ColPro Airflow Mapping
    - XYZ Efforts
    - Decon Facility Upgrades
    - MIST Upgrade
    - Mannequin Capability
    - ColPro Upgrades
    - CBART
  - **Threat/Simulant**
    - Simulant Development
    - 6.3 Coordination
    - Threat Agent Science

Coordinated Planning Process



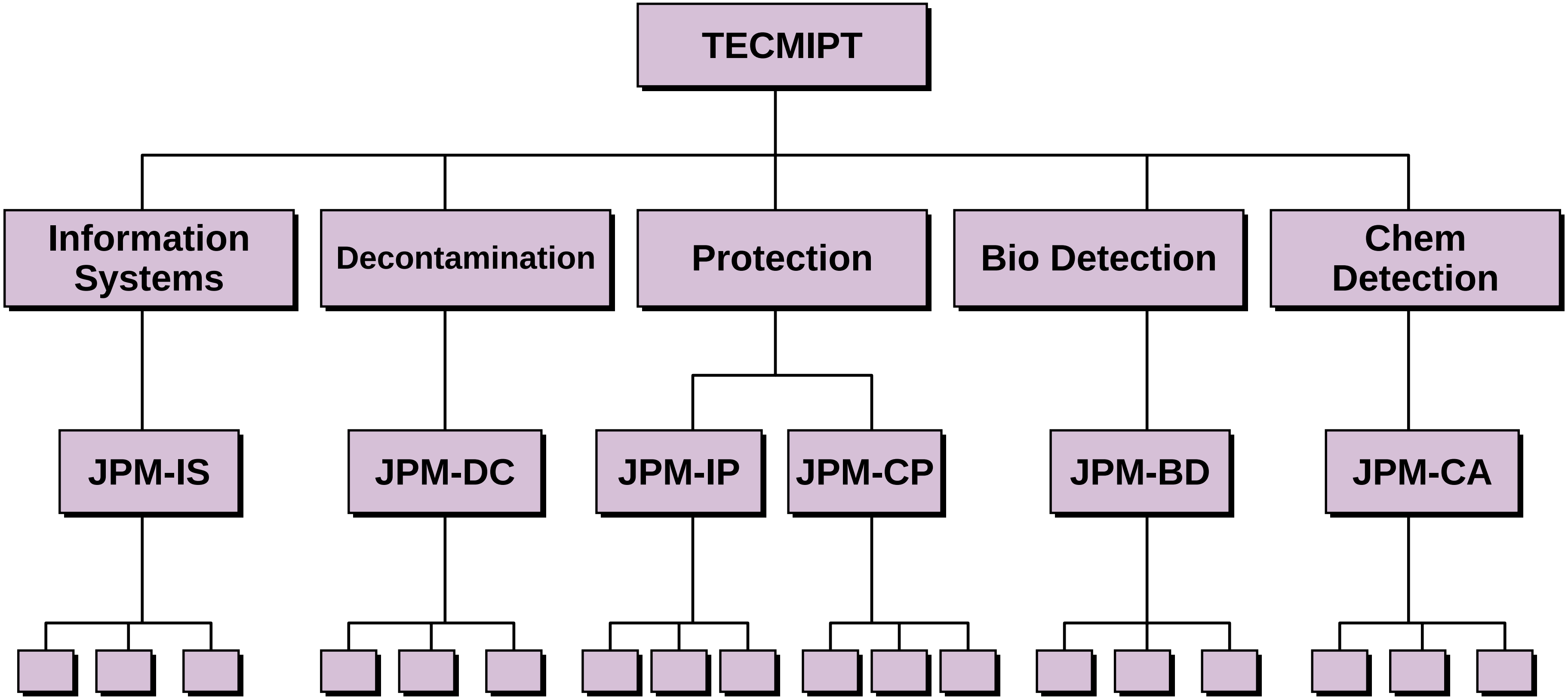
- Capability Gaps Identified by Commodity Areas.
- Vetting Completed by the TECMIPT Across Commodity Areas.
- Prioritization and Resourcing Recommendations are Formalized by the AO IPT.
- Infrastructure Investment Strategy Approved by the CBDP Executive Leadership.

T& E Capabilities Project Development & Strategy Approval Process



JPM PROGRAM REQUIREMENTS DRIVE THE PROCESS

Test Capability Gaps
Vetting Process



Individual Protection Equipment (IPE) Commodity Capability Package

SHIELD

Today	Desired
• Swatch Testing – Traditional Chemical Agents – DPG/ECBC (SMARTMAN, Boot, Glove) – Simulants – Natick, ECBC and DPG • Filter Testing – Traditional Chemical Agents – ECBC and DPG – Simulants – ECBC and DPG • Limited full CB system performance simulant testing (MIST) – DPG	• IPE Model • Agent/Simulant Correlation • Standardized list for TIC Threats and battlefield contaminants • Full system simulant testing (IPE Test Grid) • Traditional and Biological agent testing (Sweating Articulated Mannequin) • Swatch and Filter Agent (TIC/TIM and NTA) testing • T/RH variation • Cartesian grid • Air flow mapping • Air quality • Field operational effects capability

T&E Investment Strategy

S&T Thrust

- IPE Model
- Agent/Simulant Correlation
- Standardized list for TIC Threats and Battlefield Contaminants
- Air flow mapping under ensemble
- Cartesian grid
- Air quality measurement and control
- Field operational effects capability

JPM

- Agent (Chem, Bio, TIC, NTA) and Simulant Swatch Qualification
- Agent (Chem, Bio, TIC, NTA) and Simulant Filter Qualification
- IPE System Model Validation

Independent Testers

- Full System Networked Field Simulant Testing
- Model accreditation

Solution

PTA

- Full System CB Simulant Testing at DPG
- NTA Swatch and Filter Testing at ECBC
- Traditional Agent and TIC/TIM (swatch and filter) Testing at ECBC and DPG
- Full System Traditional Agent Testing at DPG (mannequin)
- Swatch Chemical Simulant Testing at Natick

Individual Protection Equipment (IPE) Capability Gaps

SHIELD

FY06 | FY07 | FY08 | FY09 | FY10 | FY11

CA7 (DPG)

Lab Equipment (FY06):
A. Water Jet Cutting Machine precision sample cutting machine
B. High Performance Liquid Chromatography lab test equipment
C. Electrophoresis
D. Perkin-Elmer Fluorometer
E. Versatile Test Glove Box

SupportSoftwaret/IT Equipment (FY06):
A. Test Data Management Architecture
B. Lab Info Management System (LIMS)
C. Advanced Real-Time Monitoring

Support Software/IT Equipment (FY11):
A. Test/Training Enabling Architecture (TENA) compliance

6.3 Base and Supplemental

6.3 Supplemerntal Efforts (FY06):
A. NTA Methodology

6.3 Base Efforts (FY06):
A. NTA Chemistry

6.3 Supplemental (FY07):
A. Droplet Particle Size

6.3 Supplemental (FY08):
A. IPE Air Flow Mapping
B. IPE Force Application
C. TIC/Battlefield Contaminants
D. IPE Overarching Model
E. Agent Simulant Correlation

6.4/6.5

IPE XYZ Grid Dev

IPE Mannequin Development

Upgrade MIST Chamber

NTA Facility

Capability Gaps:

- **Live agent testing**
- **Movement in suit over time as it affects performance**
- **Modeling of IPE system performance**

Questions?

http://www.jpeocbd.osd.mil/


BACKUPS

Acronym Key

AO – Action Officer
ASC - Active Standoff Chamber
Bio – Biological
CBART – Chemical Biological Agent Resistant Tests
CBD – Chemical Biological Defense
CBDP – Chemical Biological Defense Program
CBRN – Chemical, Biological, Radiological, Nuclear
Chem - Chemical
COLPRO – Collective Protection
DPG – Dugway Proving Ground
ECBC – Edgewood Chemical Biological Center
FY06 – Fiscal year 2006
IPE – Individual Protection equipment
IPT – Integrated Process Team
JABT – Joint Ambient Breeze Tunnel
JCIDS – Joint Capabilities Integration and Development System
JPEOCBD – Joint Program Executive Office for Chemical and Biological Defense
JPM – Joint Project Manager
JPM-BD – Joint Project Manager, Biological Defense
JPM-CA – Joint Project Manager, (NBC) Contamination Avoidance
JPM-CP – Joint Project Manager, Collective Protection
JPM-DC – Joint Project Manager, Decontamination
JPM-IP – Joint Project Manager, Individual Protection
JPM-IS – Joint Project Manager, Information Systems

Acronym Key (Cont.)

JRO – Joint Requirement Office

JSTO – Joint Science and Technology Office

LC/GC - Liquid Chromatograph/Gas Chromatograph

MIST - Man-in-Simulant Test

NBC – Nuclear, Biological, Chemical

NBC CA – Nuclear, Biological, Chemical Contamination Avoidance

NTA - Non Traditional Agent

PD TESS – Product Director, Test Equipment, Strategy, and Support

PTA – Primary Test Activity

QA/QC – Quality Assurance and Quality Control

S&T – Science & Technology

T&E – Test & Evaluation

TECMIPT – Test & Evaluation Capabilities and Methodology IPT

TENA – Test/Training Enabling Architecture

TIC – Toxic Industrial Chemical

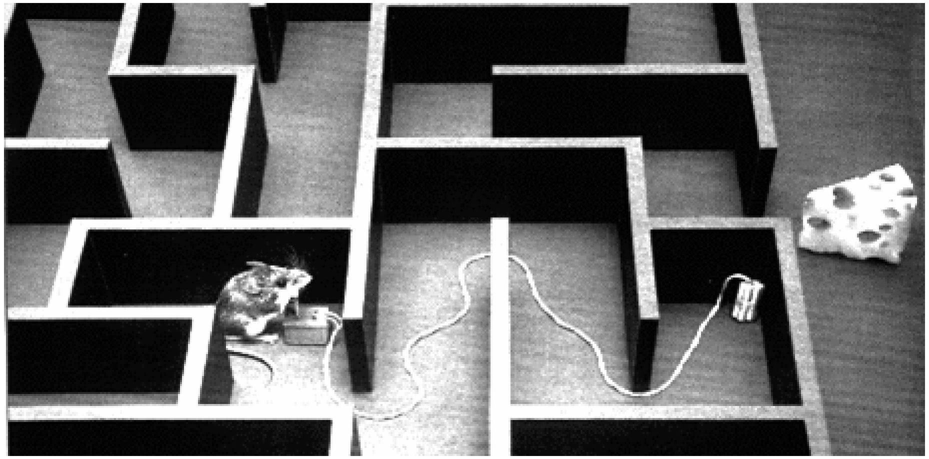
TIM – Toxic Industrial Material

T/RH – Temperature/Relative Humidity

WIPT – Working Integrated Process Team

WSLAT – Whole System Live Agent Testing

JPEO & Technology Integration



How do I get the Cheese?

PRESENTED TO:
Chemical Biological Individual Protection Conference
Charleston, SC
March 8, 2006

CURT WILHIDE
Chief, Advanced Technology
JPEO CBD
703.681.1607
Curt.Wilhide@jpeocbd.osd.mil

"A hiatus exists between the inventor who knows what they could invent, if they only knew what was wanted, and the soldiers who knew, or ought to know, what they want and would ask for it if they only knew how much science could do for them. You have never really bridged that gap yet."

Winston Churchill
<u>The Great War</u>, Vol. 4

Vision

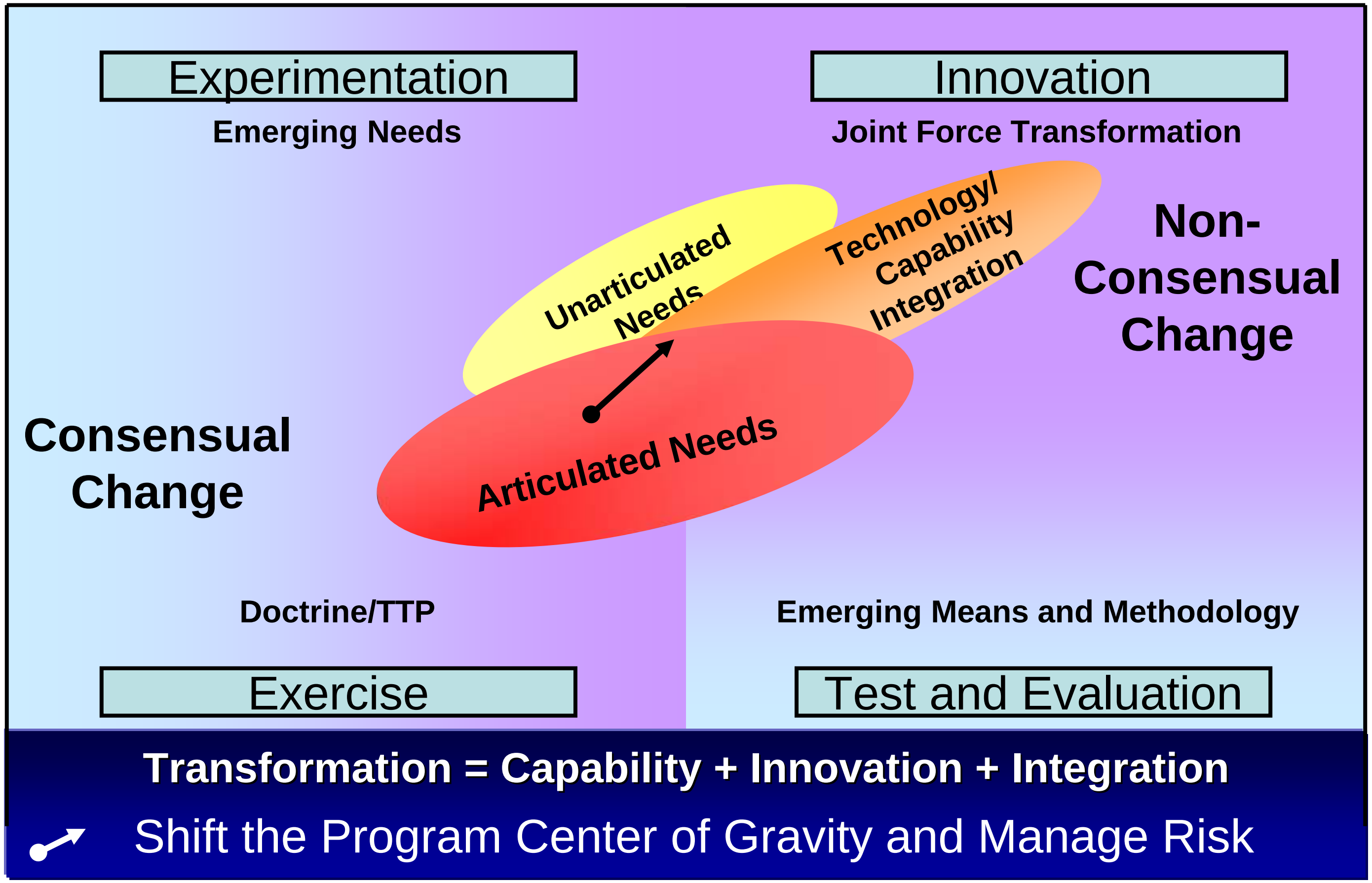
Develop and Sustain a Comprehensive, Agile, and Flexible Materiel Development framework that:

- **Provides integrated, modular, network-centric material responses to operational capability needs**
- **Provides Multiple Program, Agency, Vendor Access**
- **Integrates Major Defense Acquisition Programs and CBD Program execution**
- **Changes the culture from the bottom up through the emphasis on system of systems approach across commodity lines, experimentation, and operational prototyping**
- **Discovers, creates, or causes to be created new military capabilities to mitigate CBRN operational risks**

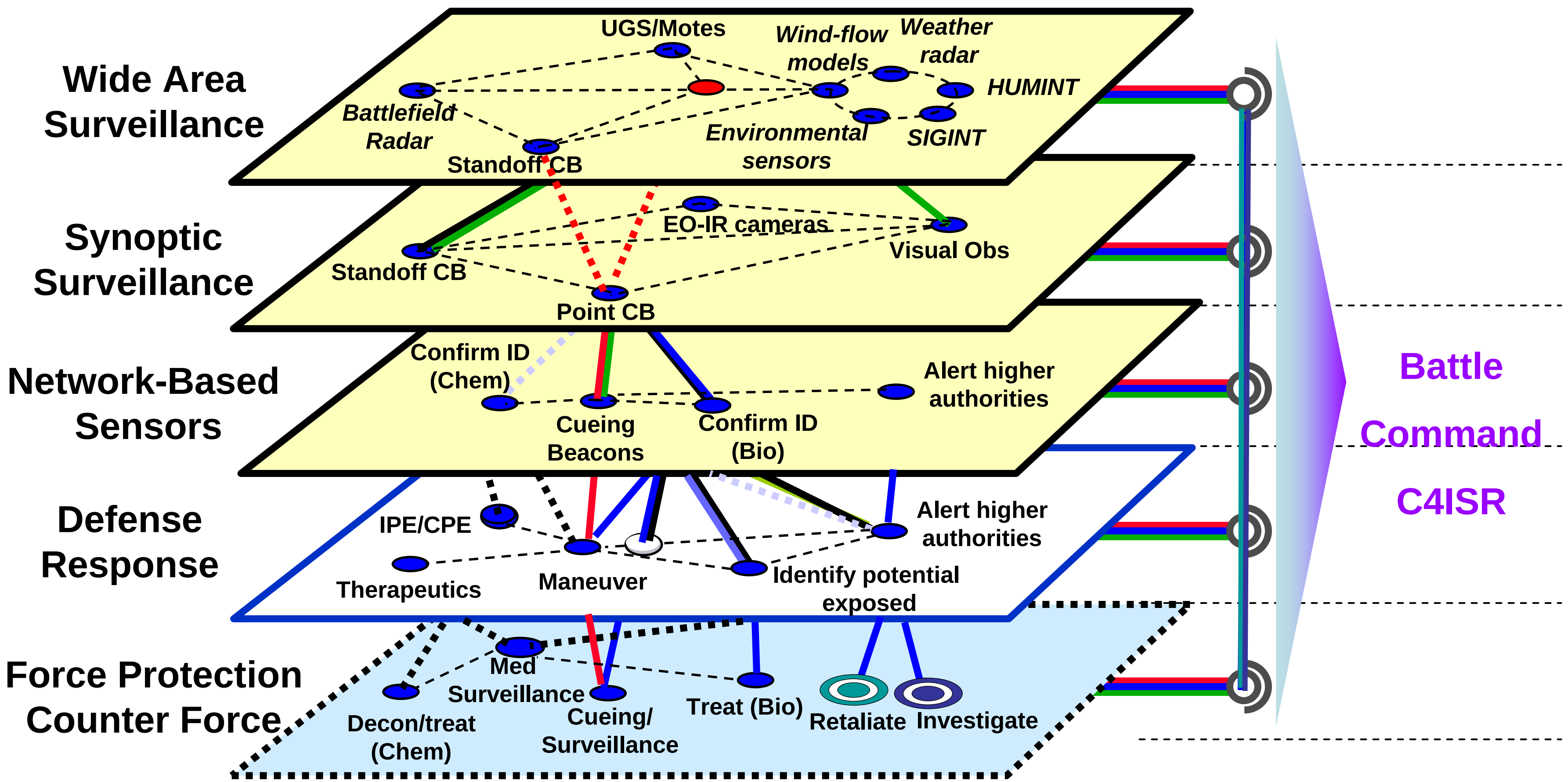
Integration Drivers

- **Shape Future Force Agility, Flexibility and Capability**
  - Common Interfaces for System of Systems
  - Modular, Tailorable, and Networked
  - Broad Spectrum Capability for Complex CBRNE Environment
- **Ensure Program Alignment and Relevance**
  - Shape MDAP CBRN Survivability Solutions
  - Technology Transition Agreement
  - Technology Readiness Assessment
- **Define S&T Strategy**
  - Traceability
  - Transformation
  - Manage Risk

Capability Development Framework To Support Transformation and Manage Risk

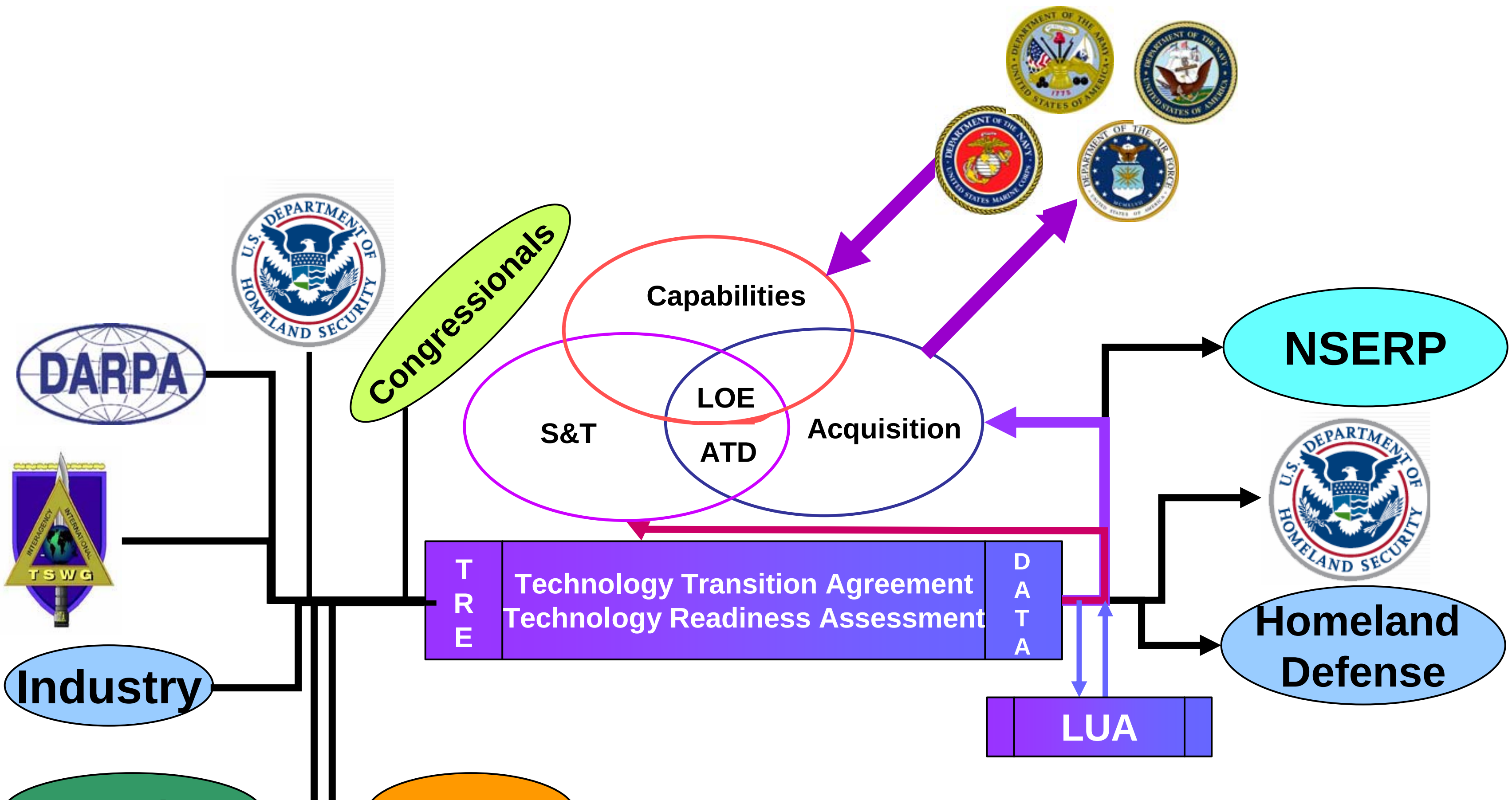


Integrated CBRN Network-Centric Approach



Integrated layered capability provides improved CBR mitigation, greater operational capability potentially easing component requirements

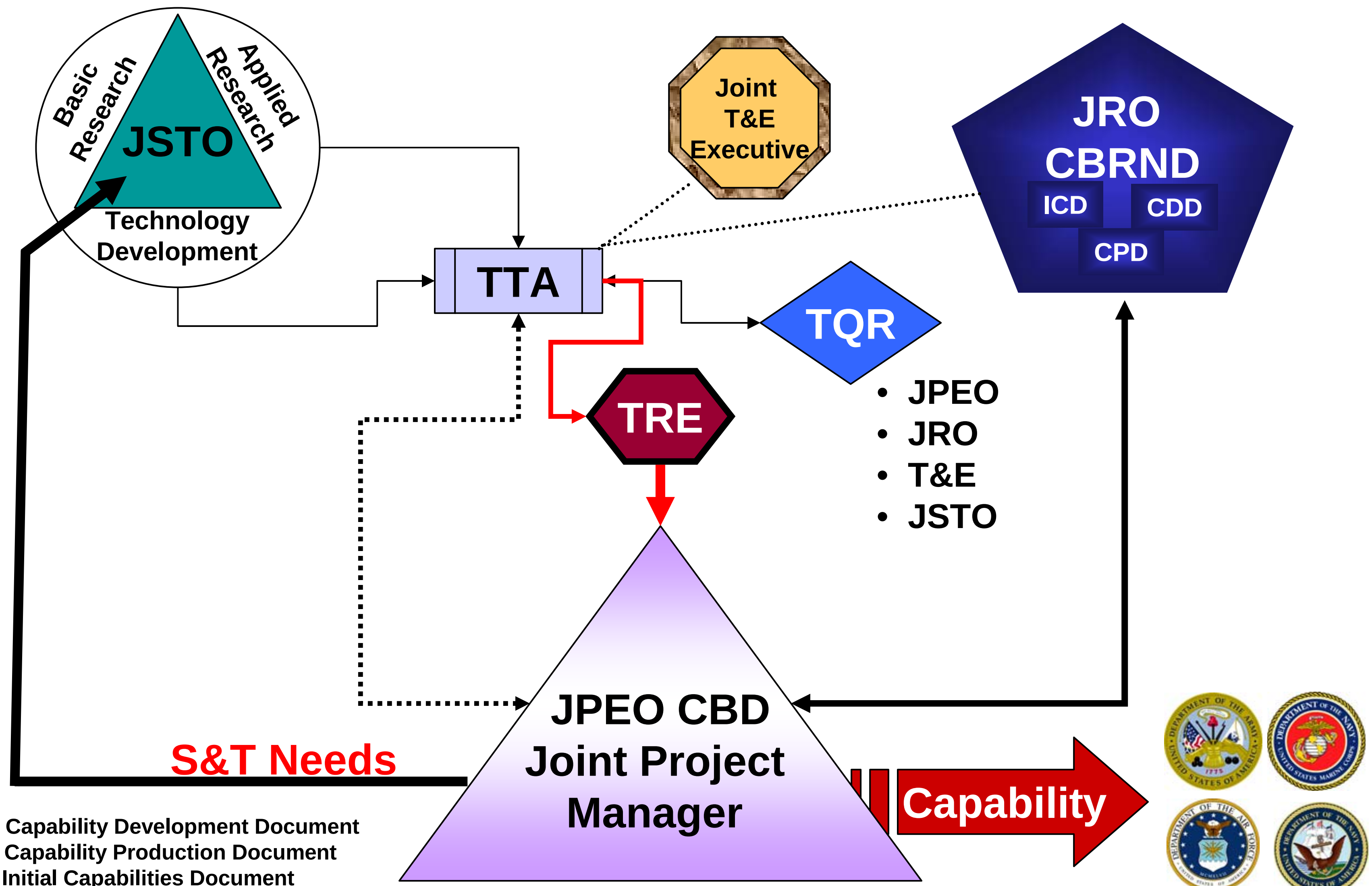
Integrated Transition Process



- Multi-Agency, Vendor Opportunities
- Multiple Transition Opportunities
- Technology Readiness Assessment creates an objective playing field

ATD: Advanced Technology Demonstration
LOE: Limited Objective Experiment
LUA: Limited Utility Assessment
NSERP: Non-Standard Equipment Review Panel
TRE: Technology Readiness Evaluation

Technology Development and Review



CDD: Capability Development Document
CPD: Capability Production Document
ICD: Initial Capabilities Document
TQR: Transition Quarterly Review
TRE: Technology Readiness Evaluation
TTA: Technology Transition Agreement

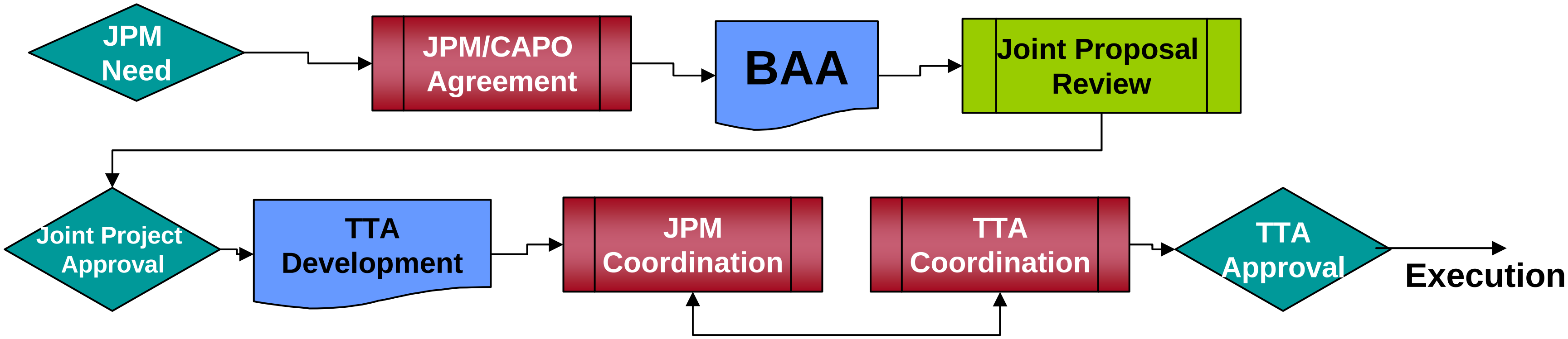
Technology Transition Agreement

- Required for 6.3 Programs
  - Identifies Target Program of Record
  - Concept of Use
  - Traceability
- Technology Development Strategy → Acquisition Strategy
- Test and Evaluation Strategy → TEMP
- Contains Information Necessary to Conduct Technology Readiness Assessment (TRA)
  - Exit Criteria (to Include defined Technology Readiness Levels)
  - Receiver Operator Characteristic (ROC) Curve/ Spider Chart (s)
    - Metrics
    - Attributes
- Agreement Between the JPM and CAPO with Joint T&E Executive coordination

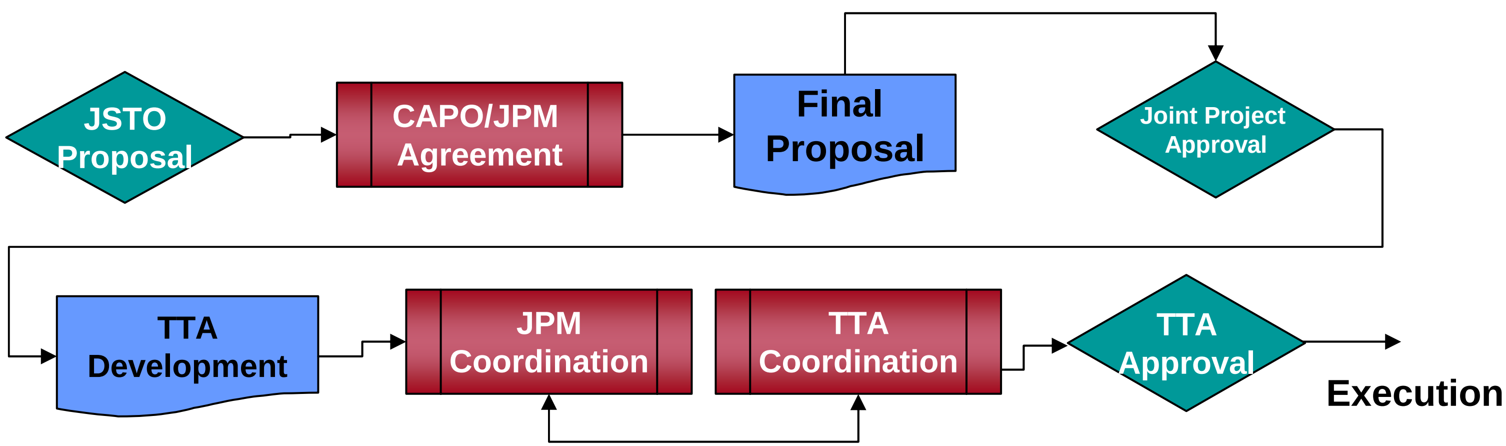
TTAs for FY06 6.3 Programs Almost Complete

Sources for Capability Development

Requirements/ Capability Pull



Technology Push



What is Next

- **Advanced Planning Briefing for Industry**
  - **10-11 April 2006**
  - **Acquisition and S&T Joint Presentation**
  - **Access and Opportunities with Acquisition and S&T Managers**
- **Joint Science and Technology Solicitations**
  - **BAA: Pending for future work**
- **Joint Program Executive Office Web Portal**
  - **http://www.jpeocbd.osd.mil/**

Joint Program Executive Office

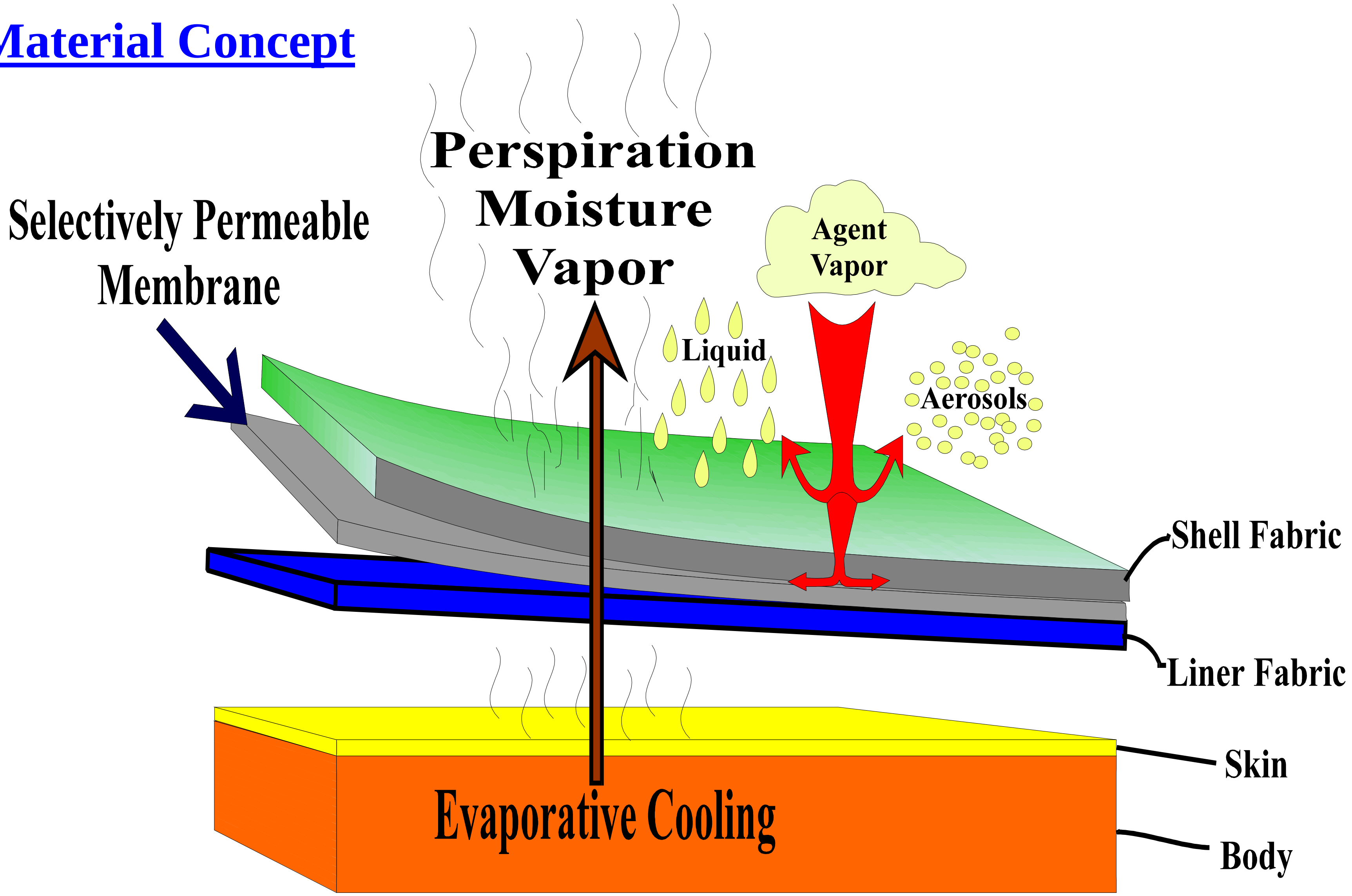
Chemical and Biological Defense

MEMBRANE DEVELOPMENT FOR THE NEXT GENERATION OF CHEMICAL BIOLOGICAL PROTECTIVE CLOTHING

Eugene Wilusz, Quoc Truong, and Walter Zukas
Chemical Technology Team
Natick Soldier Center,
Donald H. McCullough III, Junwei Li, and Steven L. Regen
Lehigh University, and
Zoltan A. Fekete and Frank E. Karasz
University of Massachusetts (Amherst)

ATTN: AMSRD-NSC-IP-C
Natick, MA 01760-5019
COM: (508) 233-5486
FAX: (508) 233-4331
EMAIL: Eugene.Wilusz@natick.army.mil

Material Concept



Vapor (V) Chemical Agent Protective Closure Systems

Vapor, Aerosol, Liquid, (VAL) Chemical, and Biological Agent Protective Closure Systems

All Purpose Personal Protective Ensemble (AP-PPE)

- **Based on selectively permeable membranes**
- **Increased protection from liquids and aerosols**
- **Reduced weight and bulk**
- **Improved comfort and compatibility**
- **Improved operational suitability**
- **Reduced shelf-life burden**

Membranes – Where do we go from here?

- Optimize permselectivity
- Ensure protection vs. toxic industrial chemicals (TICs)
- Introduce self-detoxification
- Integrate compatible closures

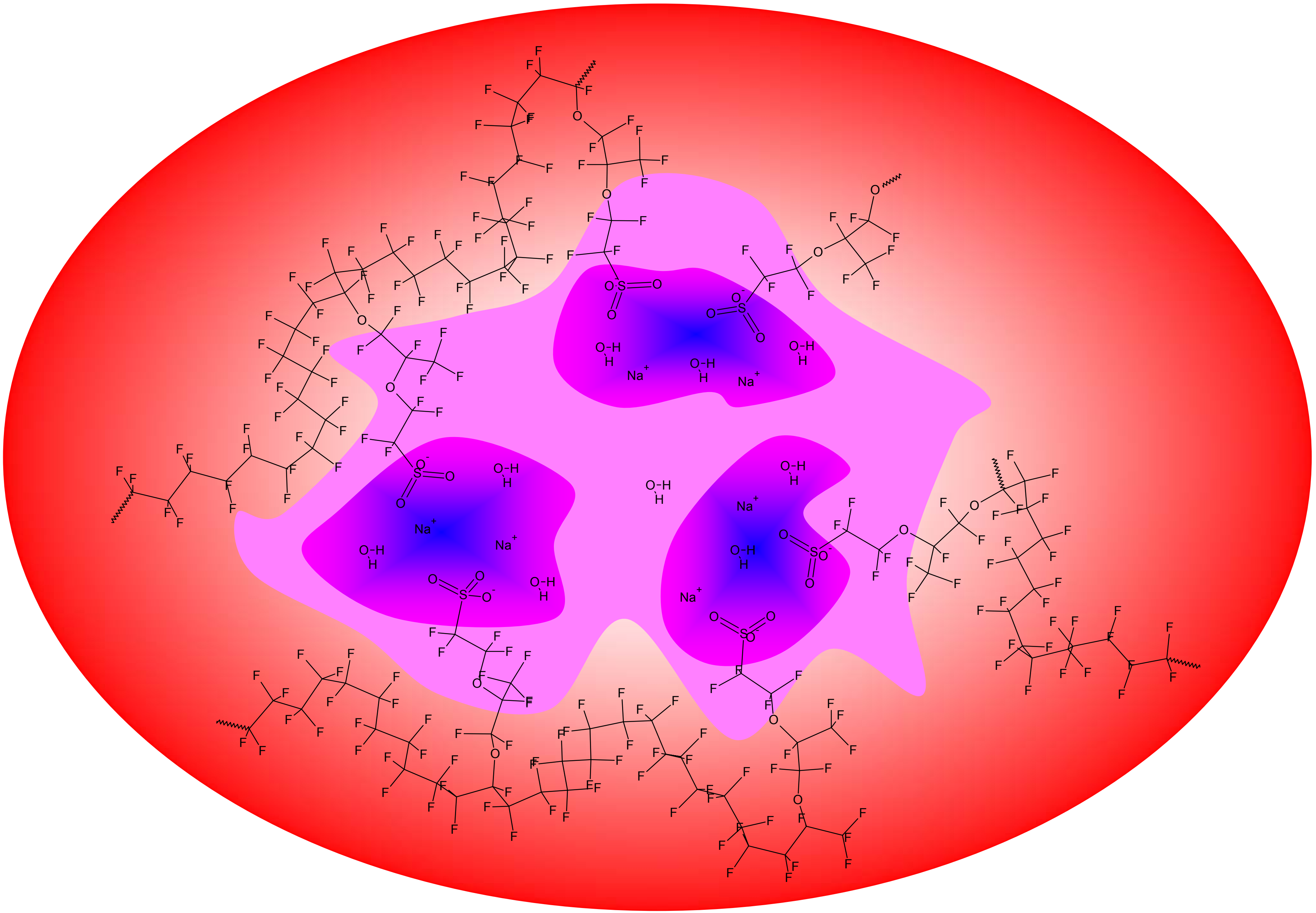
Ion Implanted Membranes

- **Improve the permselectivity of membrane materials for use in chemical/biological (CB) protective clothing through the ion beam modification of the surface layers of available membranes**

- **Two-fold approach: computer modeling of the irradiation process to develop a better understanding of the process at the molecular level and irradiation experiments of materials at different energy levels and with different ions for permselectivity measurements.**

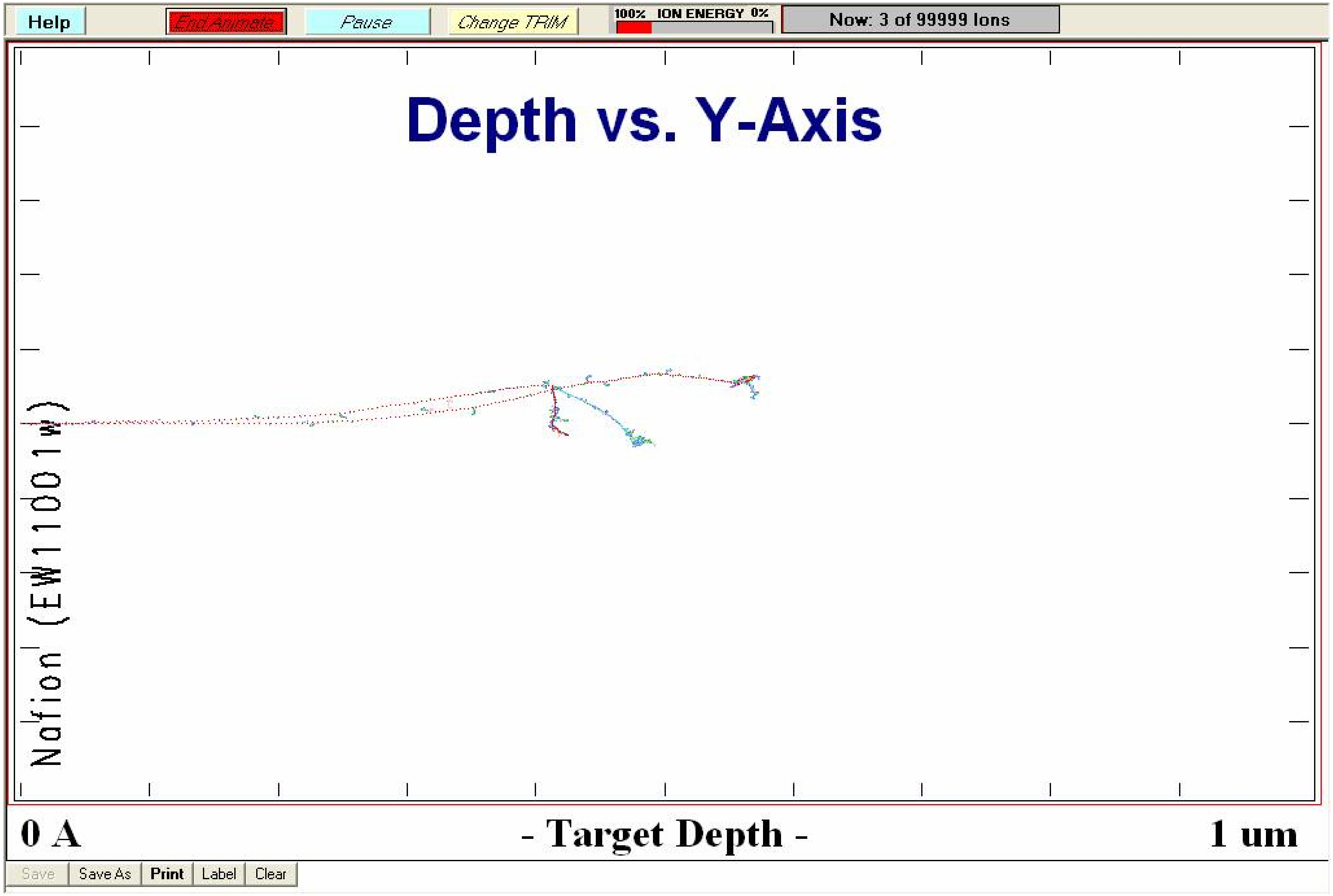
- **Correlation between the two efforts will ultimately yield a powerful tool for the development of permselective membranes for CB garments.**

Nafion® (du Pont): $[\text{—}(CF_2CF_2)_n\text{-}(CF_2CF(OCF_2CF(CF_3)OCF_2CF_2SO_3H))\text{—}]_x$

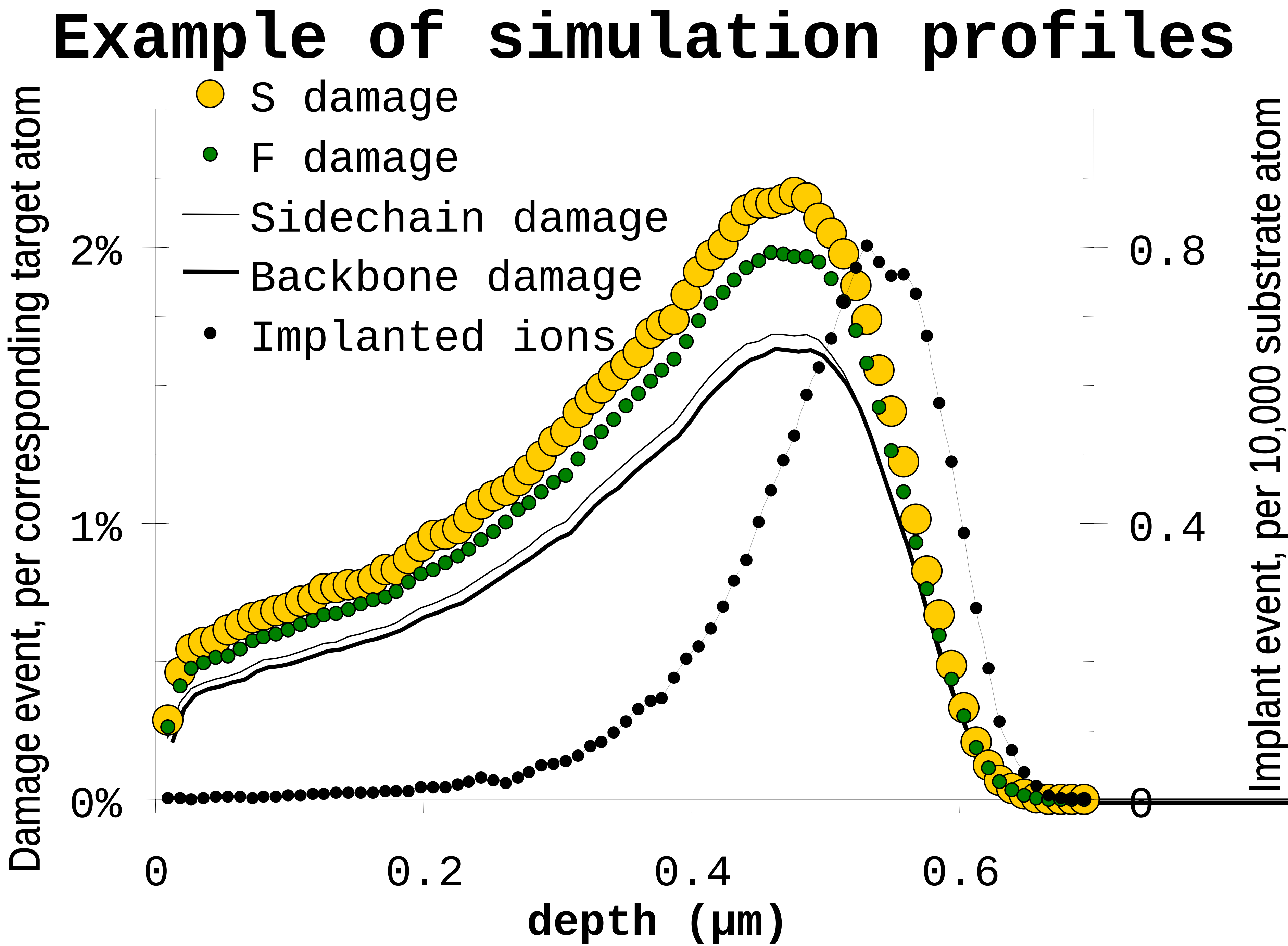


Schematic model of Nafion: hydrophilic, intermediate and hydrophobic phases

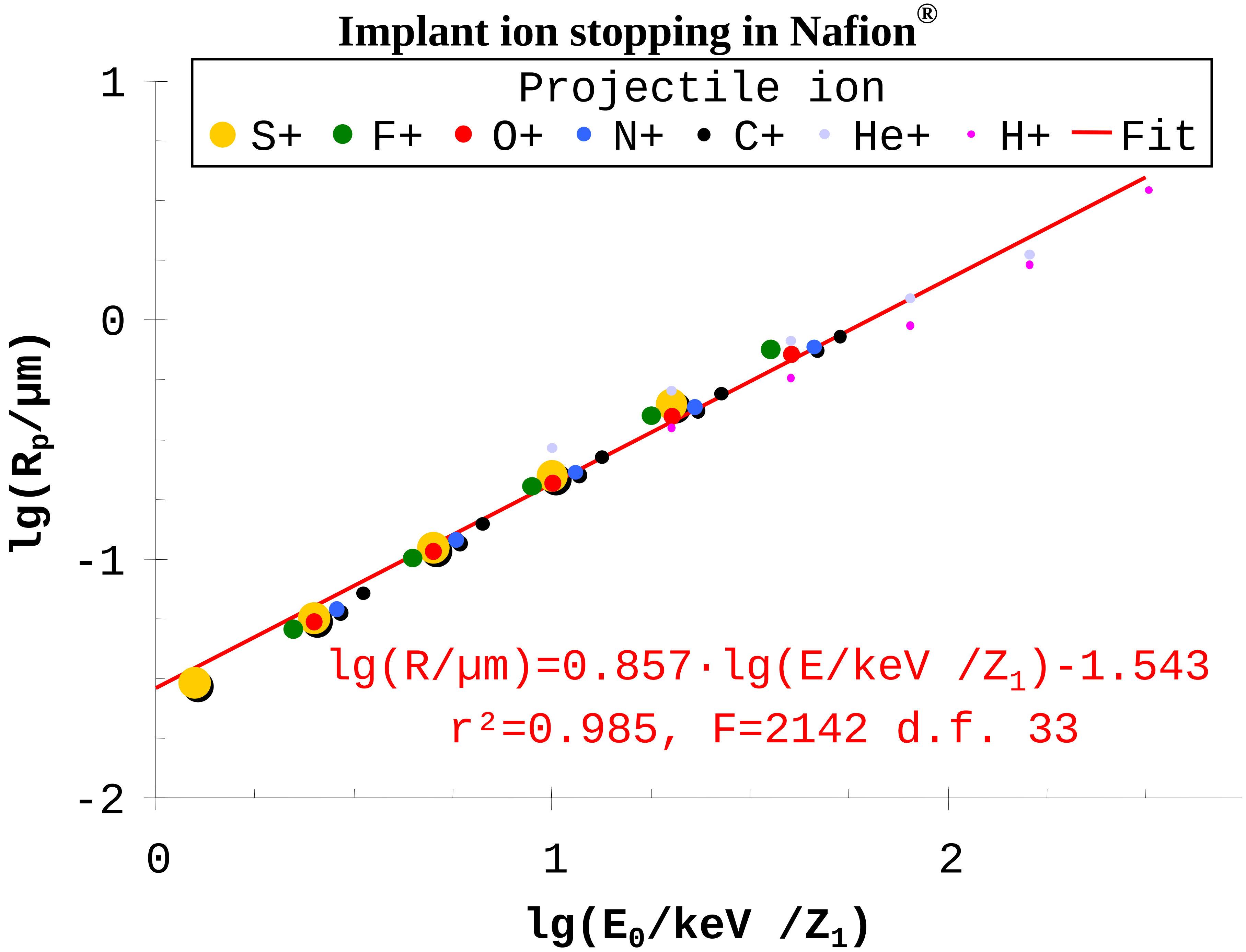
Transport of Ions in Matter (SRIM v.2000.41)[1]



[1]Ziegler, J.F.; Biersack, J.P.; and Littmark, U., The Stopping and Range of Ions in Solids (1985)

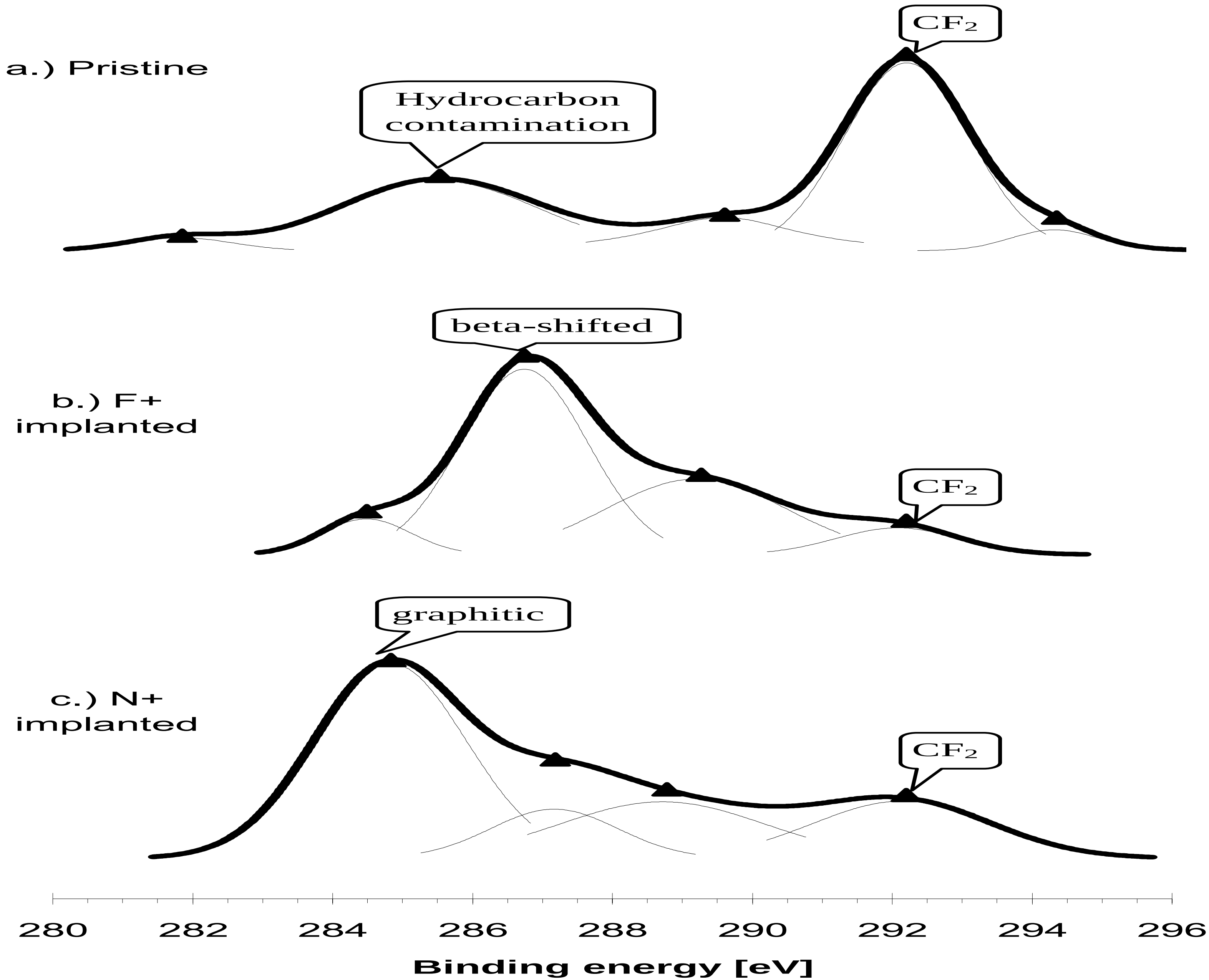


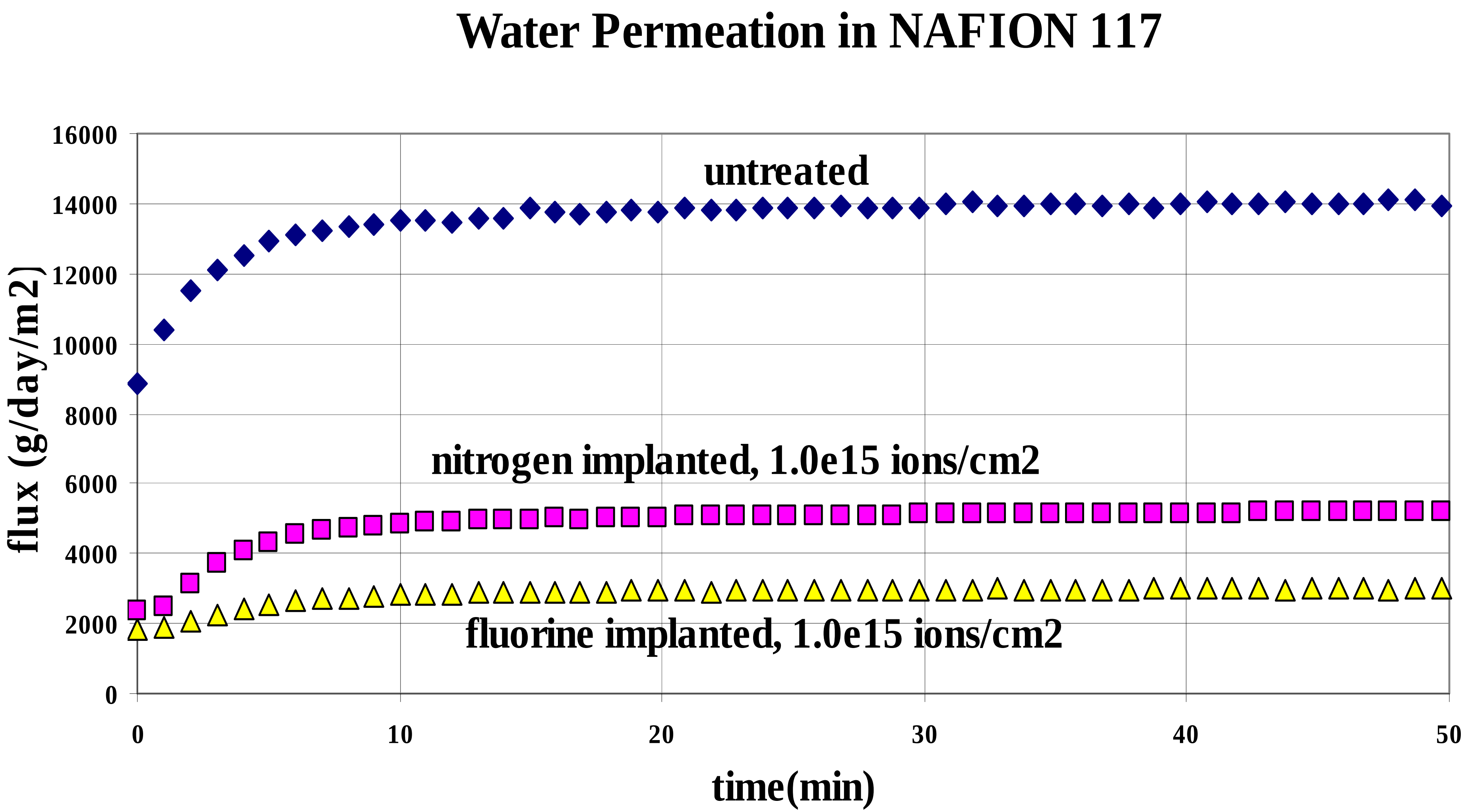
Example of simulation profiles
S damage
F damage
Sidechain damage
Backbone damage
Implanted ions
Damage event, per corresponding target atom
Implant event, per 10,000 substrate atom
2%
1%
0%
0.8
0.4
0
0
0.2
0.4
0.6
depth (μm)



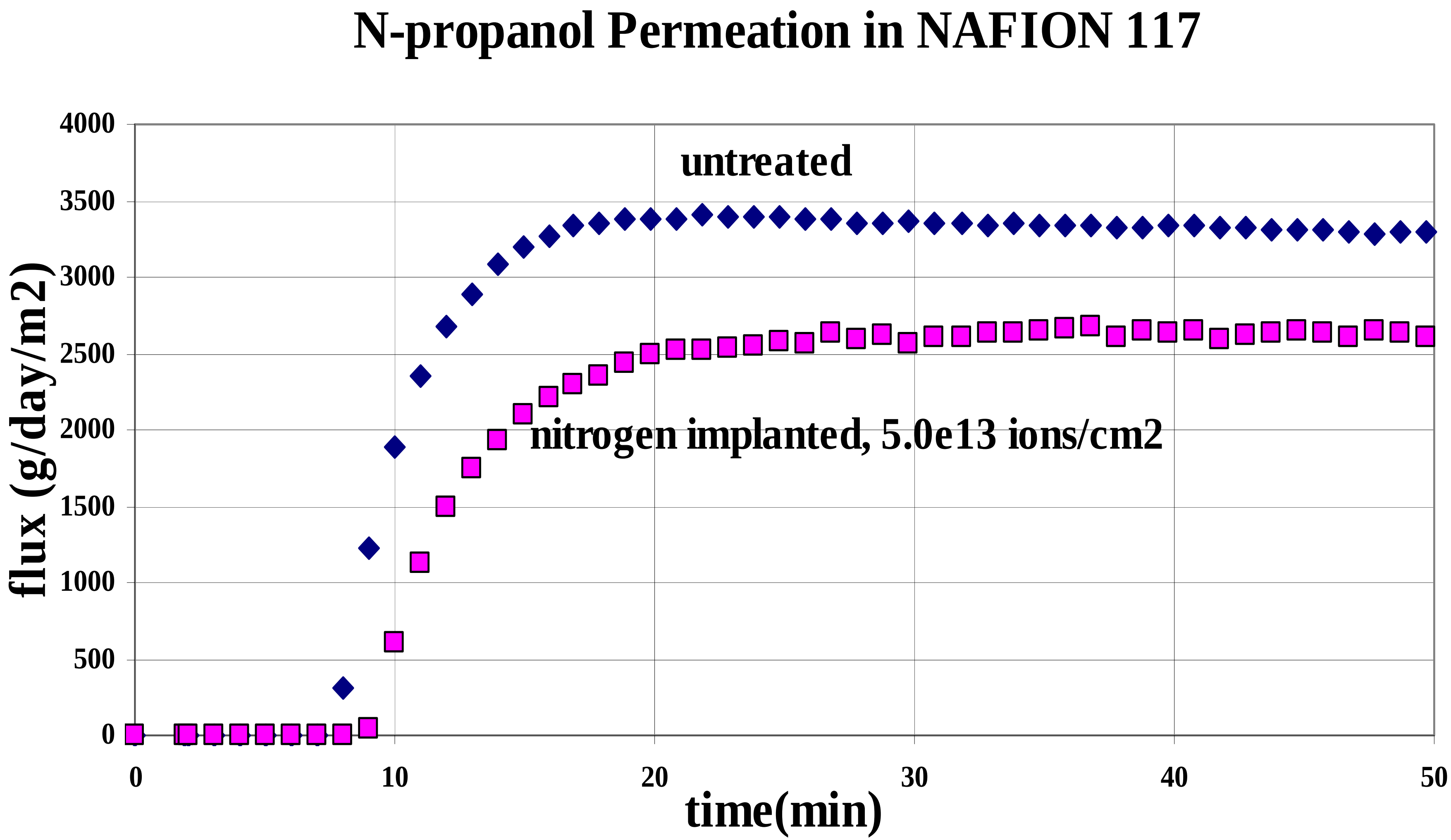
Implant ion stopping in Nafion®
Projectile ion
S+
F+
O+
N+
C+
He+
H+
Fit
1
0
-1
-2
lg(Rp/µm)
0
1
2
lg(E0/keV /Z1)
lg(R/µm)=0.857·lg(E/keV /Z1)-1.543
r²=0.985, F=2142 d.f. 33

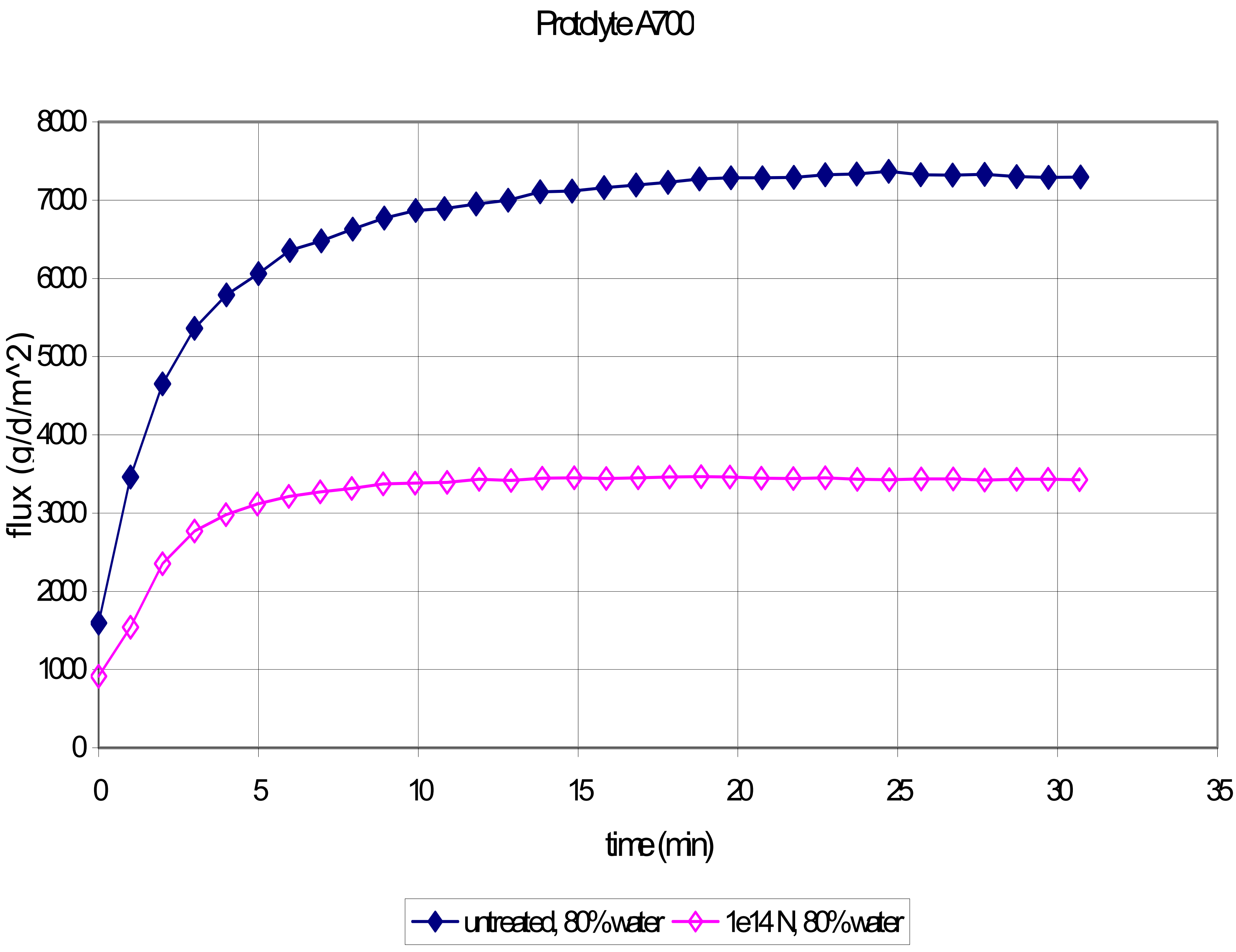
Surface analysis: C_{1s} XPS spectra of pristine and ion beam damaged Nafion®

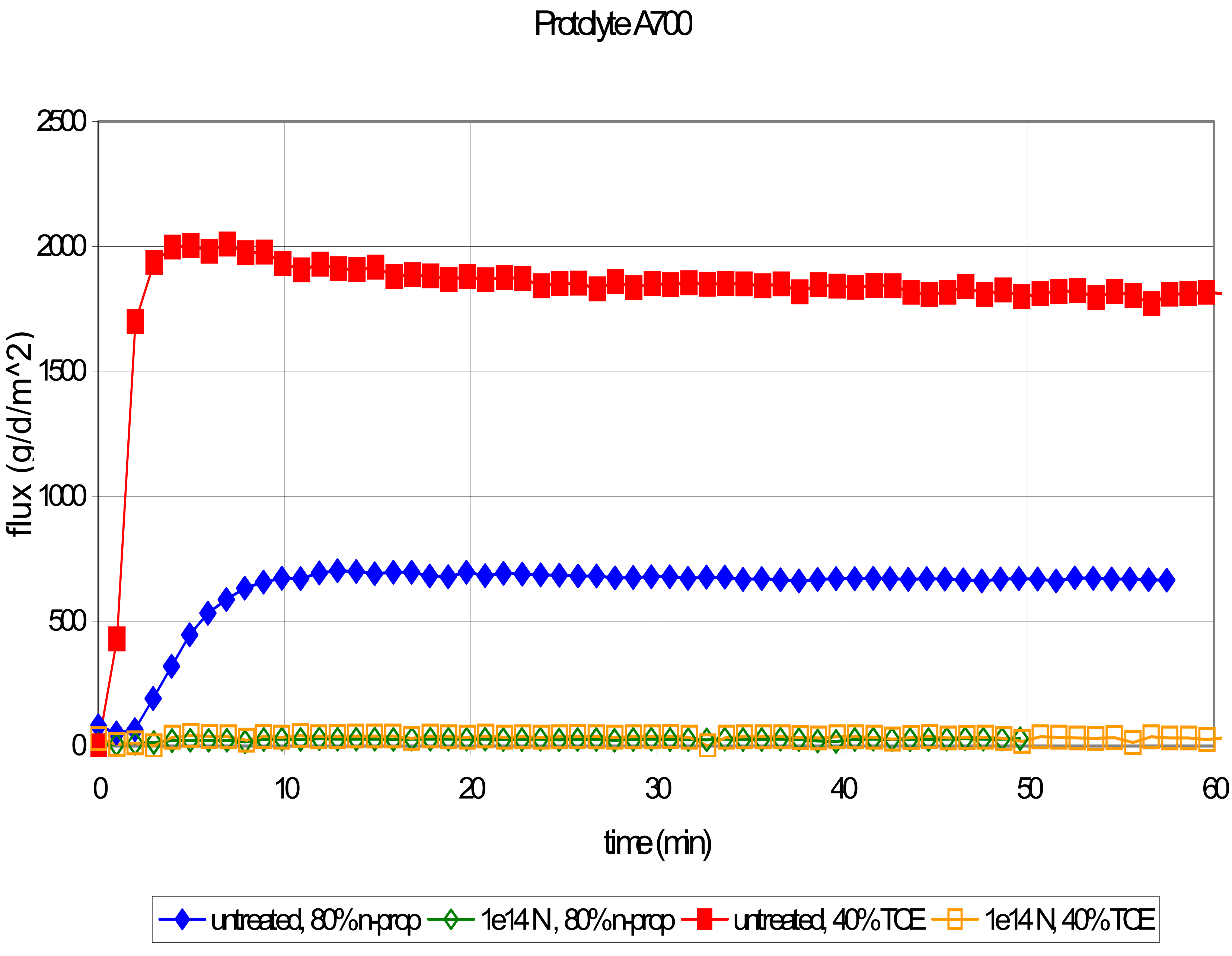




Water Permeation in NAFION 117
untreated
nitrogen implanted, 1.0e15 ions/cm2
fluorine implanted, 1.0e15 ions/cm2
flux (g/day/m2)
time(min)
0
2000
4000
6000
8000
10000
12000
14000
16000
0
10
20
30
40
50


N-propanol Permeation in NAFION 117
untreated
nitrogen implanted, 5.0e13 ions/cm2
flux (g/day/m2)
time(min)
0
500
1000
1500
2000
2500
3000
3500
4000
0
10
20
30
40
50


Protolyte A700
flux (g/d/m^2)
8000
7000
6000
5000
4000
3000
2000
1000
0
0
5
10
15
20
25
30
35
time (min)
untreated, 80% water
1e14 N, 80% water

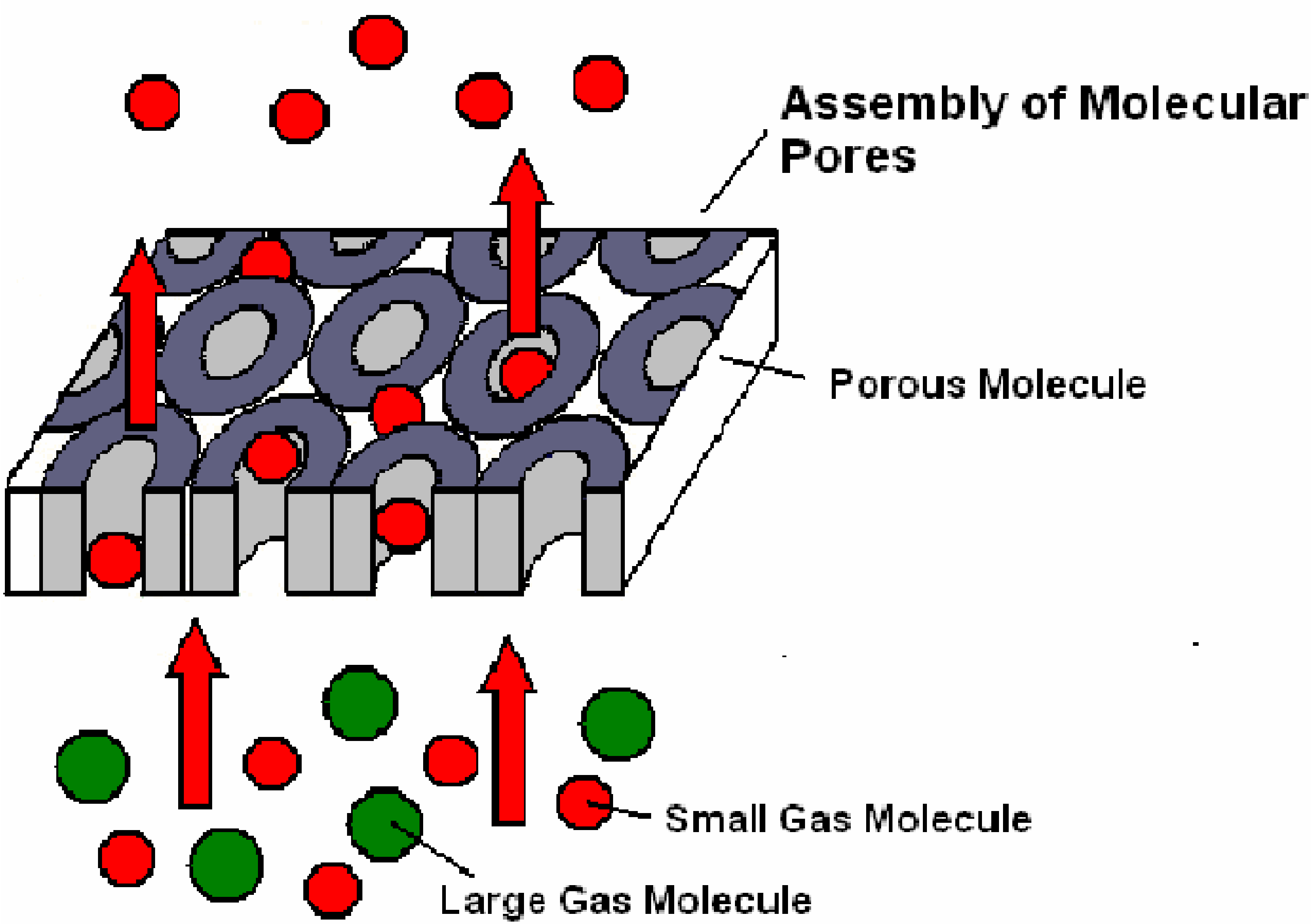


Protolyte A700
2500
2000
1500
1000
500
0
flux (g/d/m^2)
0
10
20
30
40
50
60
time (min)
untreated, 80% n-prop
1e14 N, 80% n-prop
untreated, 40% TCE
1e14 N, 40% TCE

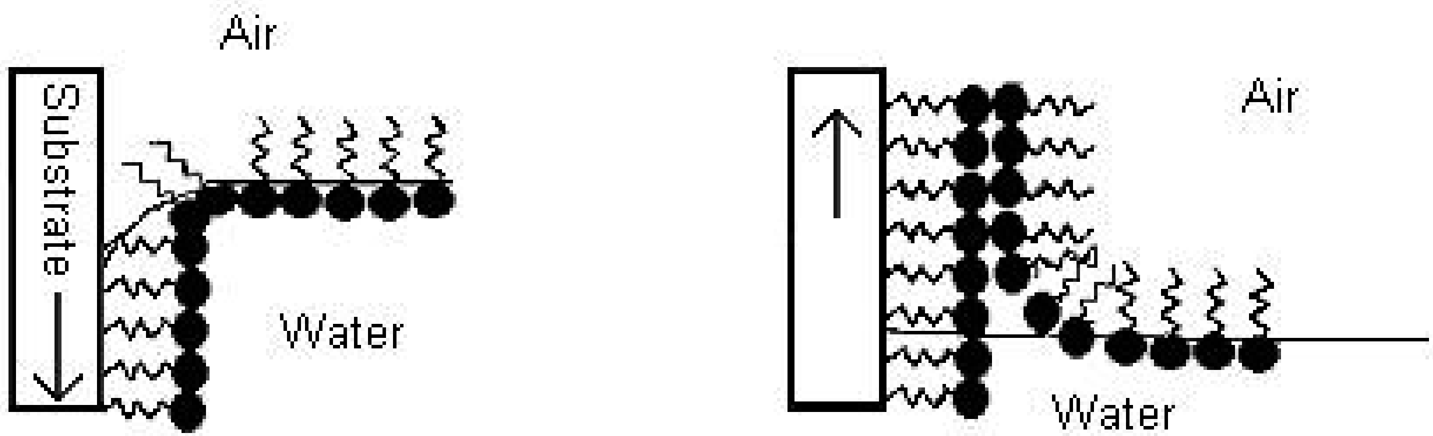
Summary – Ion Implantation

- Medium-energy ion beam treatment is a promising technique for developing barrier membranes selectively permeable to water vapor.
- Theoretical calculations are a useful adjunct for optimizing treatment conditions.
- XPS measurements of the surface reveal that ion bombardment leads to loss of fluorine, with the eventual formation of a carbonized layer.
- This two-pronged approach will ultimately yield a powerful technique for the development of permselective membranes for CB protective garments.

Perforated Monolayer Approach

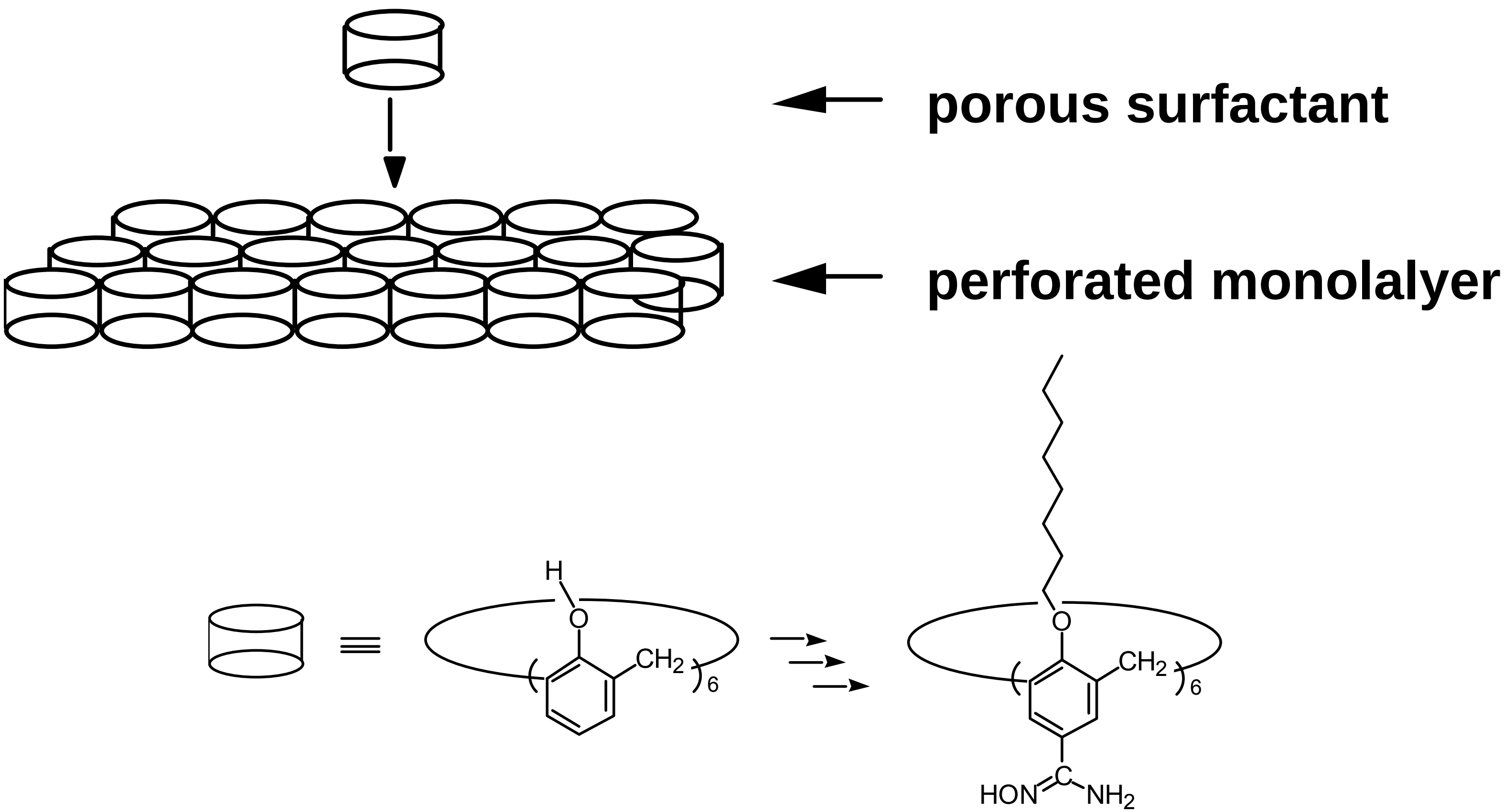


The Langmuir-Blodgett Method



A stylized illustration showing a single surfactant monolayer being transferred to a hydrophobic support on a down-trip, followed by the transfer of a second monolayer on the up-trip, to form a bilayer.

Perforated Monolayers

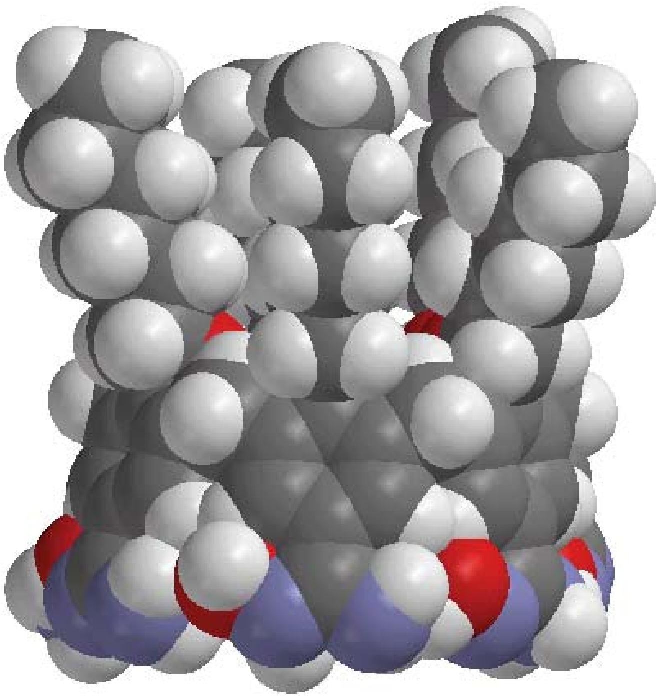


calix[6]arene

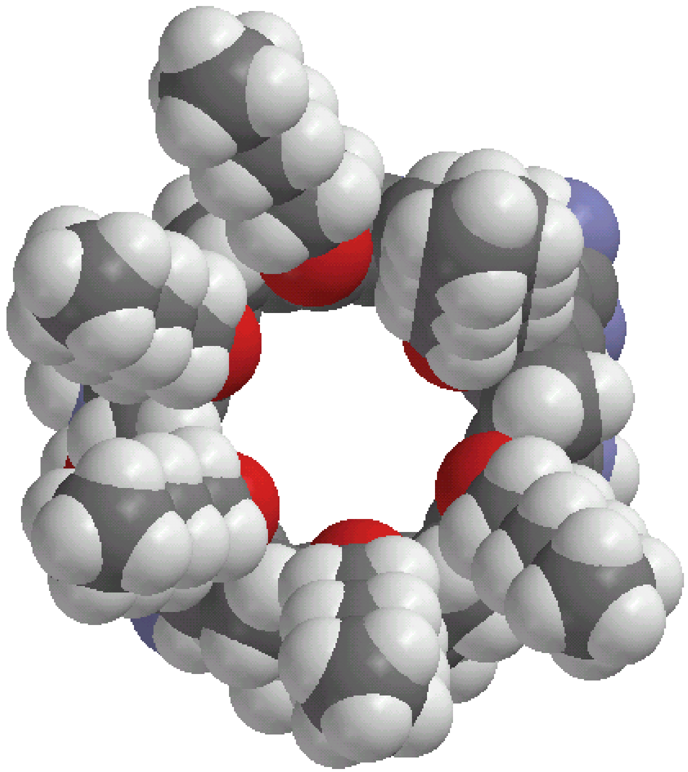
II

An illustration of a perforated monolayer formed from a porous surfactant.

. Space filling models of an analog of **II**

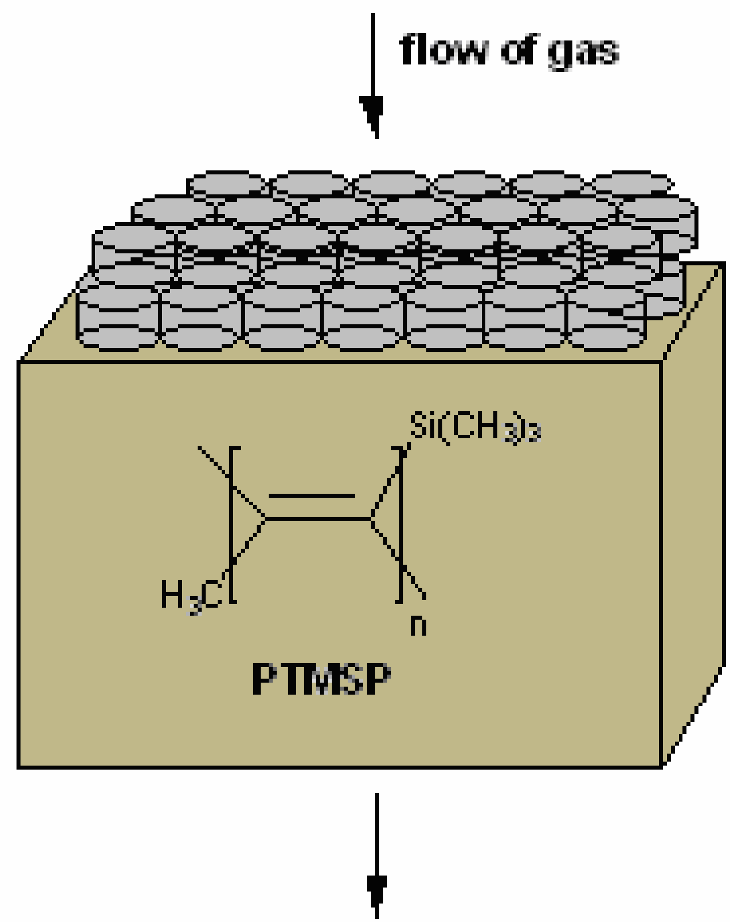


Side View

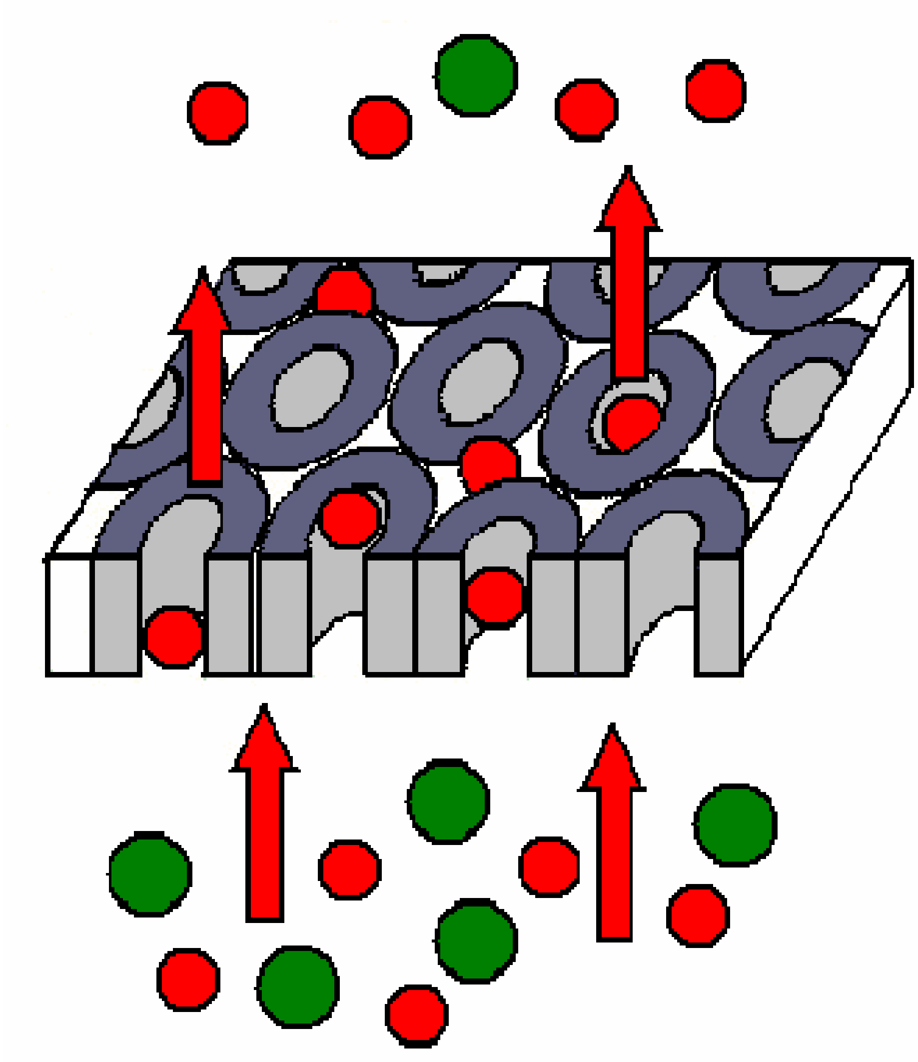


Top View

Composite membrane formed from a bilayer of **II** and poly[1-(trimethylsilyl)-1-propyne] (PTMSP)



Perforated Monolayer of II

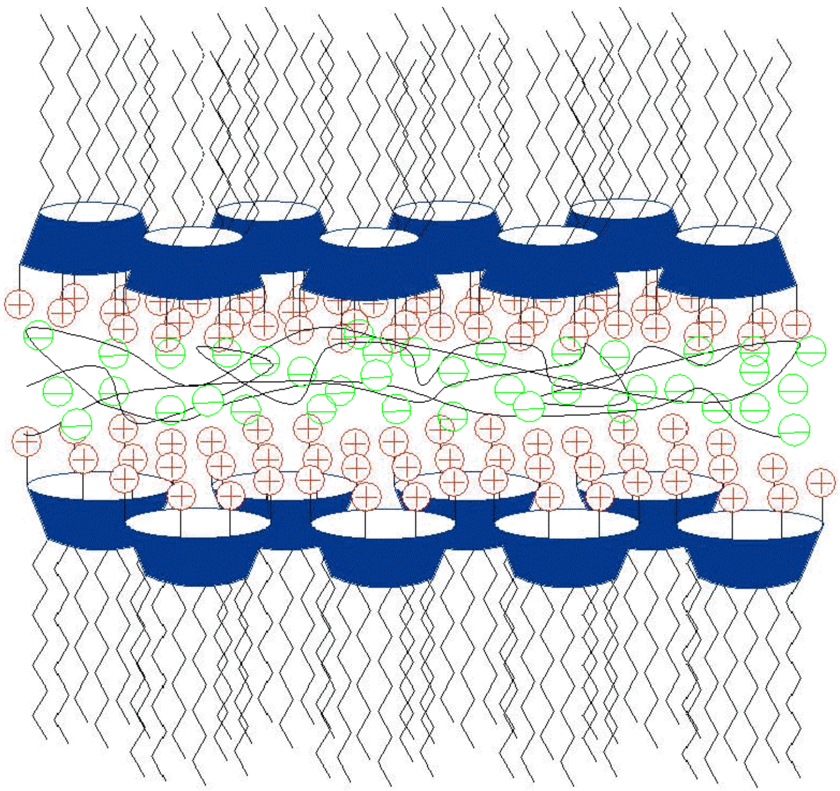


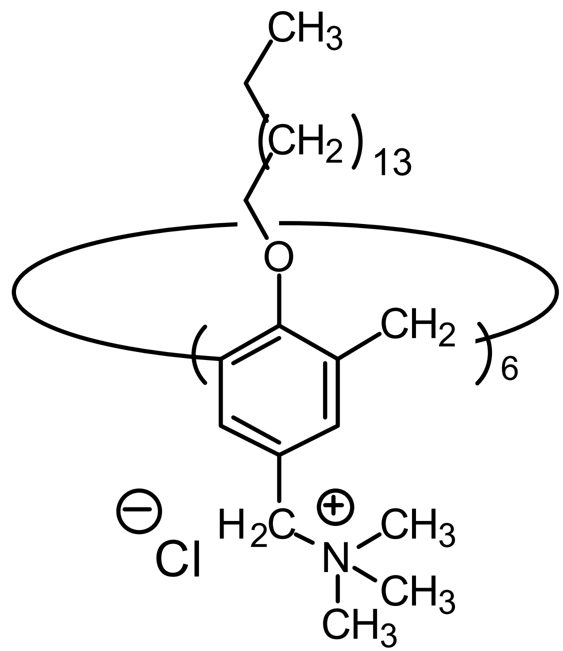
$\alpha_{He/N2} = 18$

Improved Perforated Monolayers through “Gluing”

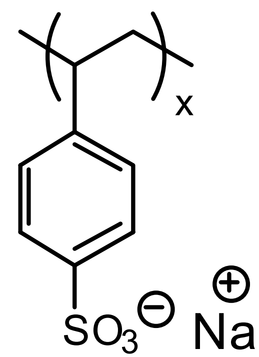
- Ionic cross-linking of a cationic calix[6]arene-based LB film by use of a water-soluble polyanion, would produce a two-dimensional network with enhanced stability
- Filling in void space (defects), the polymeric counterion would result in enhanced permeation selectivity

Glued LB Bilayer





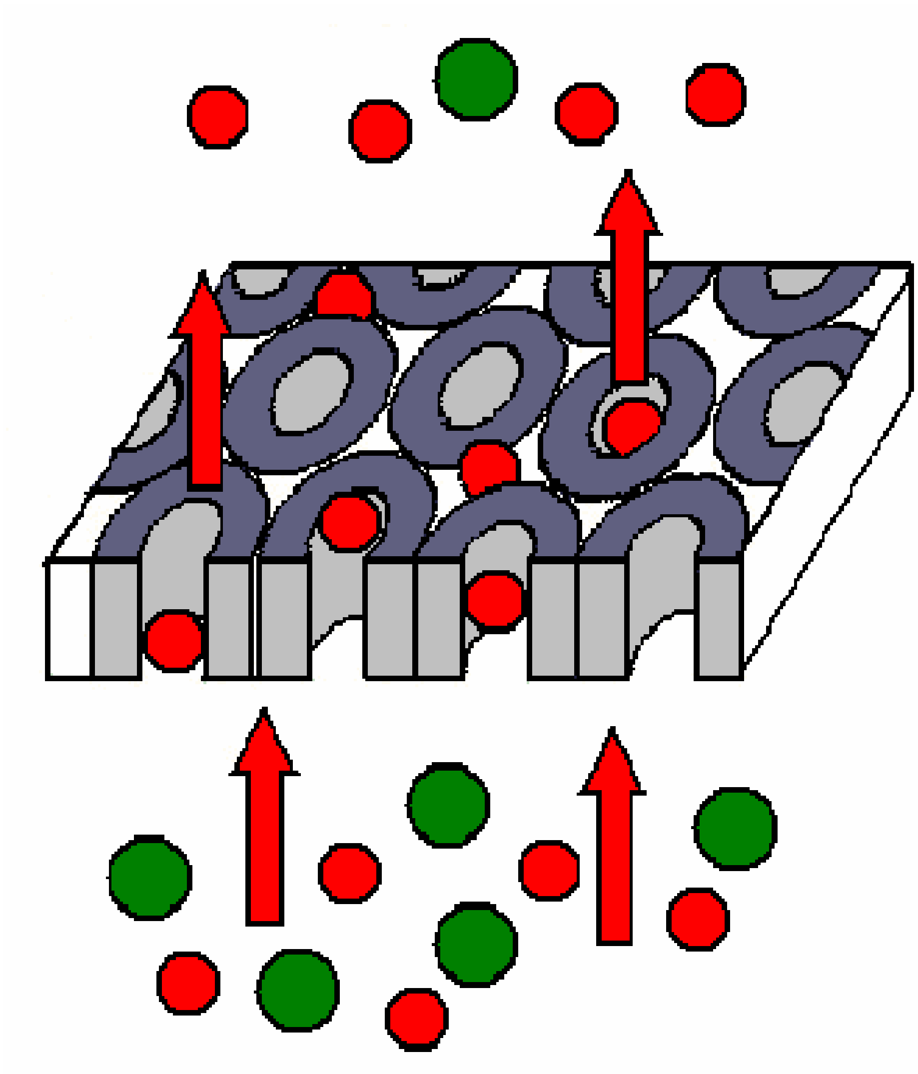
1



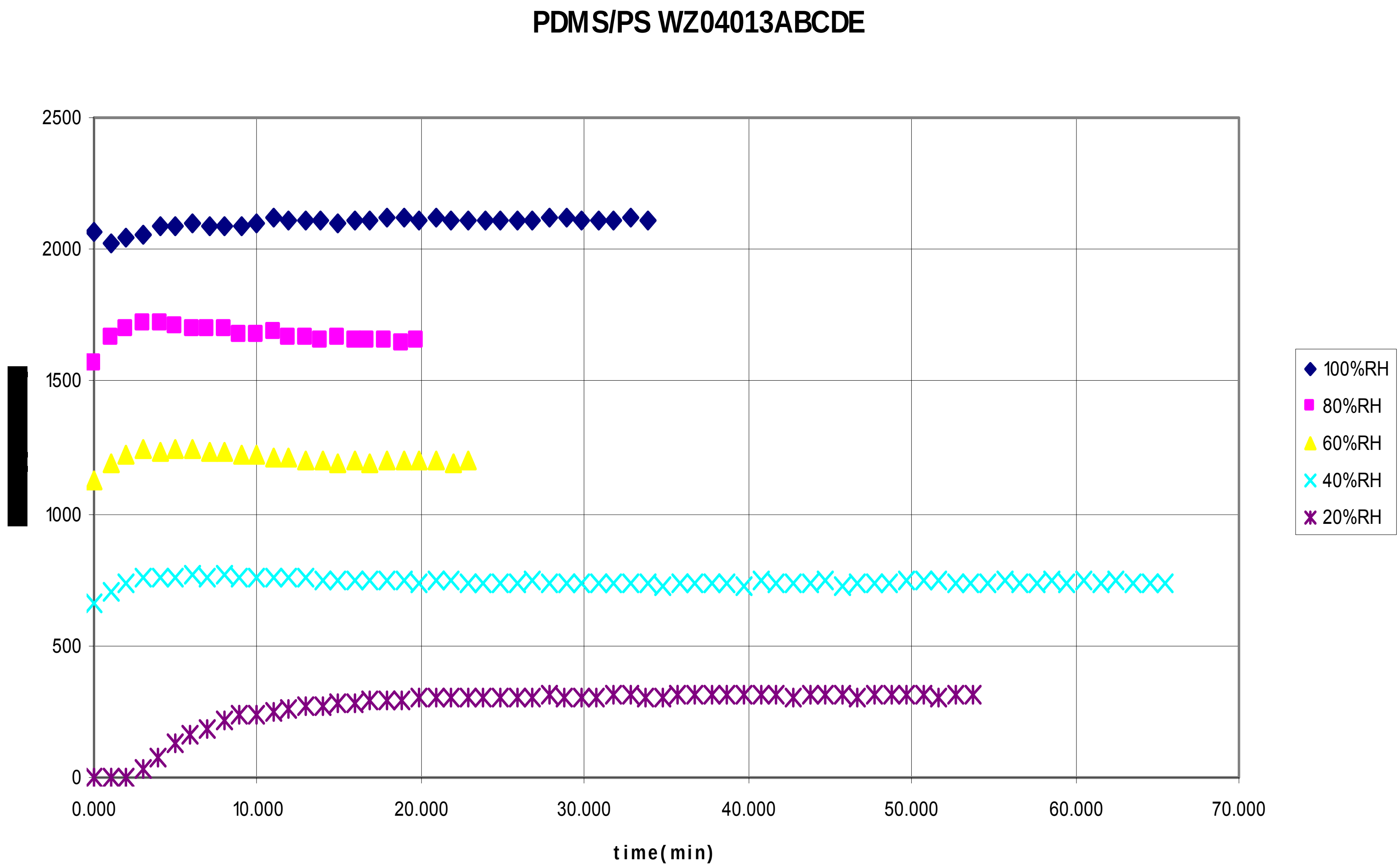
PSS

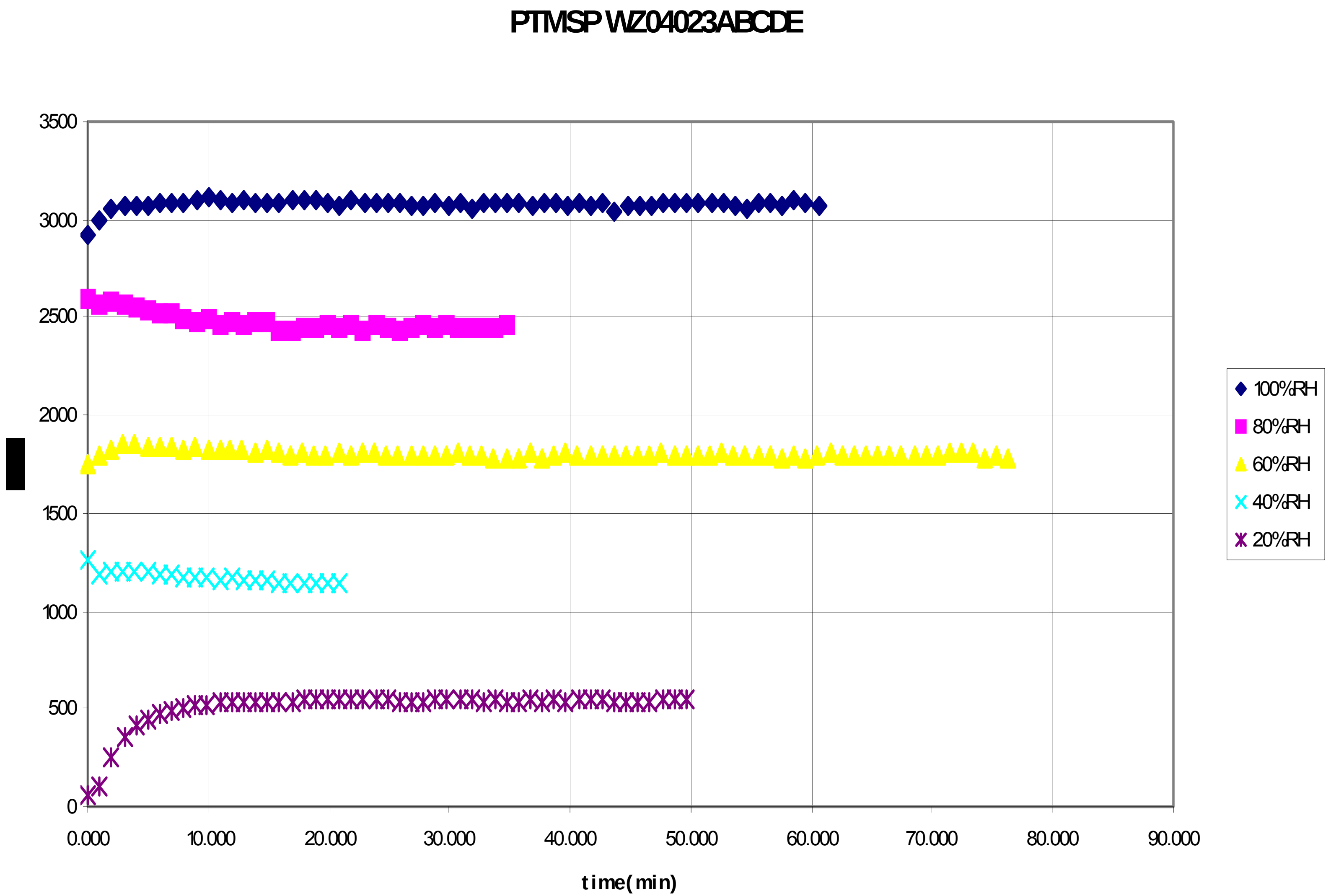
An illustration of a LB bilayer, made from a multiply charged calix[6]arene that has been glued together through the use of a polymeric counterion.

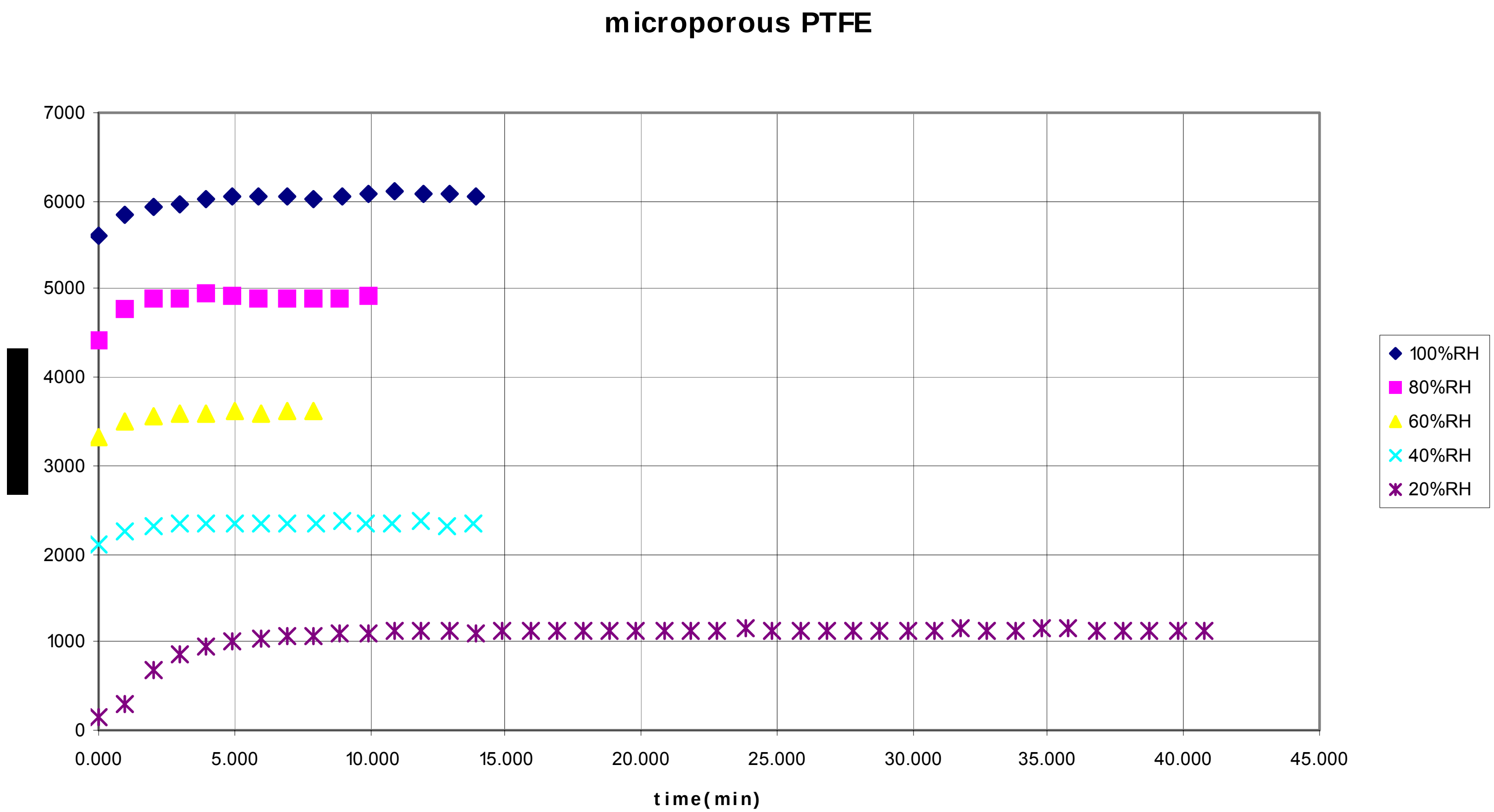
Perforated Monolayer of III & PSS



$\alpha_{He/N2} = 240$


PDMS/PS WZ04013ABCDE
[redacted]
2500
2000
1500
1000
500
0
0.000
10.000
20.000
30.000
40.000
50.000
60.000
70.000
time(min)
100%RH
80%RH
60%RH
40%RH
20%RH


PTMSP WZ04023ABCDE
[redacted]
3500
3000
2500
2000
1500
1000
500
0
0.000
10.000
20.000
30.000
40.000
50.000
60.000
70.000
80.000
90.000
time(min)
100%RH
80%RH
60%RH
40%RH
20%RH


microporous PTFE
[redacted]
7000
6000
5000
4000
3000
2000
1000
0
0.000
5.000
10.000
15.000
20.000
25.000
30.000
35.000
40.000
45.000
time(min)
100%RH
80%RH
60%RH
40%RH
20%RH

Summary – Monolayers

- The surface modification of organic polymers by a tightly packed monolayer of calix[6]arenes or other surfactants could constitute an attractive, selectively permeable barrier, allowing the passage of water vapor (perspiration), while serving as a barrier to chemical warfare agents
- Due to its ultrathin and microporous structure, it is expected that the flux of water across such a membrane would be maximized
- The composite membranes could be used in the protective layer of the next generation of chemical protective clothing
- These novel clothing ensembles would potentially be dramatically lighter weight than current systems

Summary/Challenges
Clothing Operational Context

Improved system integration with suit, mask, helmet, gloves, boots, body armor, weapons, etc. (JSLIST Upgrade)

Cool, lightweight CB duty uniform based on nanofiber or membrane technology with increased mission duration and a reduced logistics burden. (JSLIST Upgrade)

Reactive clothing materials with increased protection, reduced doffing hazard, and reduced logistics burden. (JSLIST Upgrade)