Joint Science and Technology Office (JSTO) Filtration Initiatives

Joint Project Manager for Individual Protection and Collective Protection Industry Day
July 22, 2008

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.
Agenda

• Joint Science and Technology Overview
• General Technology Development Approach
• Air Purification Technologies
  – Sorptive Media
  – Particulate Removal Media
  – Oxidative
  – Regenerative
  – Hybrid and other Media-less approaches
  – Residual Life Indication
• Funding Summary
CB Defense Program

Delivering Joint Warfighting Capabilities
CBRN Doctrinal Elements

Sense

- CBRN Detection
  - Point
  - Stand-off
  - Reconnaissance
  - Medical Diagnostics

Diagnostics

C4ISR

Shield

- Individual Protection
  - Percutaneous
  - Respiratory
  - Ocular

- Collective Protection
  - Mobile
  - Transportable
  - Fixed

- Prophylaxis
  - Biological
  - Radiological

Protection

C4ISR

Shape

- Battle Analysis
- Battle Management
- Modeling
- Simulation - Training
- Integrated Early Warning
- Medical Surveillance

Decontamination

- Individual
- Equipment
- Fixed Site

Medical Treatments

- Chemical
- Biological
- Radiological

Decontamination

Therapeutics

Protection & Hazard Mitigation (PHM)

Unclassified
Like Improvised Explosive Devices (IEDs), future threat use of CB weapons will likely be immediate, intense, and local. Thus, to have its greatest impact, protective and hazard mitigation measures must be constantly available. This necessitates low-burden equipment.

Sources of Burden:
- Physiological
- Cognitive
- Logistical
- Operational
Technology Development Process

Basic Rsch

1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9
Technical Readiness Levels (TRL)

Applied Research

Adv Tech Dev

Integrate/ SD&D

Proc

Program Milestones

A B C FRP

Increasing Fidelity wrt Operational Environment

Unclassified
Technology Development Process

1. Feasibility
   - "Breadboard"

2. Component Integration
   - "Brassboard"

3. Effectiveness (Agent & Simulant Work)
   - Increasing Fidelity

4. Scalability Factors

5. Materials Compatibility

6. Environmental Safety / Occupational Health

7. Relevant Environment

8. Operational Environment

Unclassified
Additional “ilities”

- Maintainability
- Supportability
- Transportability
- Sustainability
- Packaging, Handling, and Storage
- Additional equipment required to support system
- Affordability
- Training and Training Support (e.g. training aids, training systems, etc.)
- Technical Data
- Survivability
- Reliability
- Human Factors
- Facilities
- Producibility
Technology Readiness Assessments

- Informal internal assessments to confirm TRLs 3 & 4, and a formal and/or independent assessment to confirm TRL 6 at Milestone “B” for transition to an acquisition program
- Expect TRL maturity “step” to provide ‘proof’ of completion
- Data must be objective, robust, and statistically significant supporting the performance of a technology for its intended application
- Correlation of data to the intended operational environment is critical
Air Purification Technologies
Sorbptive Media

- **Performance Objectives**
  - Increased TIC Capacity
  - Lower resistance
  - Smaller size volume/lower profile

- **Technical Objectives**
  - Increase retention of high volatility substances by increasing affinity/reactivity
  - Increase capacity of media

- **Output**
  - Well characterized novel sorptive materials
  - Validated novel bed designs
  - Design equations/parameters

- **Focus**
  - Near – TIC optimized M98 size filter
  - Mid – Low-profile/Low-burden optimized IP filters for demo (FY11)
  - Far – Smart Materials

**Reticular Chemistry**

- MOFs
- ZIFs
- COFs

**Meso-Porous Structures**

- CNTs/CNFs

Current efforts at UCLA, Northwestern University, Kansas State University, University of South Florida, Indiana University, University of Colorado, Vanderbilt University and Naval Research Laboratory; IP Integration at Edgewood Chemical and Biological Center; CP Filter Integration at 3M and New World Associates
Particulate Removal Media

- **Performance Objectives**
  - Lower resistance
  - Lower profile

- **Technical Objectives**
  - Significantly increase Figure of Merit (FoM)
  - Increase robustness of new media to meet durability and loading requirements

**Output**
- Well characterized novel materials
- Validated designs
- Design equations/parameters

**Focus**
- Near – Irregular cross-section fibers
- Mid – Nano-fiber HEPA Media (FY11)
- Far – Functionalized nano-fibers

Current efforts at Research Triangle Institute, Air Force Research Laboratory, Argonide, UCLA and Cornell University; Integration at Edgewood Chemical and Biological Center
Challenges

Specific Issues and Challenges:
- How can these materials be improved to meet performance requirements over the range of environmental conditions and optimized against targeted TICs?
- How to design robust nano-materials that perform in the intended environment?
- How to design around potential health effects of nano-materials?
- How are these new materials scaled to commercialization?

Example: CK Break-Through of Material Samples

Performance Varies With Conditions!
Oxidative Filtration

• Performance Objectives
  – Size, weight and power reduction
  – Broad Threat Spectrum
  – Reduce O&M costs

• Technical Objectives
  – Decrease required rxn temperature
  – Increase robustness of catalyst
  – Reduce size of post treatment

• Output
  – Validated prototypes
  – Design equations and parameters

• Focus
  – Near – CATOX demonstrator (FY09 – FY11)
  – Mid/Far – Low-temperature combustion / Membrane reactor

Current efforts at Honeywell, and the University of Southern California; Technical Assessment at the Edgewood Chemical and Biological Center
Regenerative Filtration

- **Performance Objectives**
  - Size, weight and power reduction
  - Broad Threat Spectrum
  - Smaller size volume/lower profile

- **Technical Objectives**
  - Improved broad spectrum media
  - Better engineered heat transfer
  - Design simplicity

- **Output**
  - Validated prototypes
  - Design equations and parameters

- **Focus**
  - Near – Hunter Manufacturing demonstration
  - Mid/Far – Tech watch for novel and effective approaches

Current efforts at Hunter Manufacturing; Technical Assessment at the Edgewood Chemical and Biological Center
Residual Life Indicator (RLI)

- **Performance Objectives**
  - Indicate remaining service life (normal O&M)
  - Warn user of impending failure

- **Technical Objective**
  - Broad range indicators
  - Direct interrogation of the media

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**Output**
- Agent indicators
- Validated broad-spectrum process

**Focus**
- Near (transitioned) – Colorimetric acid gas indicators
- Mid/Far – Direct interrogation sensor technologies

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Elector Impedance Spectroscopy

Current efforts at Morphix, 3M, and Edgewood Chemical and Biological Center
Seeking methods that directly interrogate the residual capacity of the filter bed. Additional work on detectors for specific chemicals (e.g. colorimetric strips) is not desired.
Current Filtration Investments

- Sorptive
- Particulate
- Oxidative
- Regenerative
- Hybrid
- RLI

Core
CBDIF
Cong
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Total PHM S&T Funds includes Individual and Collective Protection, and Hazard Mitigation
Questions?