Advancing Military Systems Toward Sustainability Through Innovative Environmental Assessment

Monday, May 4, 2009

prepared for
NDIA 2009 Environment, Energy, and Sustainability Symposium

by
Oral Saulters, Ryan Green, and Blase A. Leven
Kansas State University
Amanda Prill
M2 Technologies, Inc.
Overview

- Background
- Environmental Assessment Methods and Approaches
- UOL Project Examples
- Looking to the Future – Other Initiatives
- Other Partners
- Conclusions
What is the UOL?

- **One Program – Urban Operations Laboratory**
  - Effective public-private partnership
  - M2 Technologies
  - CABEM Technologies
  - Kansas State University

- **Seven Tasks**
  - Bomb Detection and Countermeasures
  - Operations Environmental Laboratory
  - Robotics and Sensors, Nanotechnologies
  - Human Factors
  - Strategic Planning, Integrated Facility Support
UOL Task – Operations Environmental Laboratory

- Nonlethal Environmental Evaluation and Remediation Center (NEER)
  - Environmental Assessments (EA) team
  - Performs life-cycle environmental evaluations and remediation analyses activities

- Environmental Knowledge and Assessment Tool (EKAT)
  - Web-based environmental decision tree software
    - PESHEs, NEPA evaluations, LCEAs
  - Initial funding agency was USMC, Quantico, VA
  - Program adopted and modified for use by National Center for Medical Intelligence (NCMI)
The Drivers

- Existing ESOH Requirements
  - Int’l, Fed, State, Local, Military, etc. (Multimedia regs, NEPA, EMS, etc)
  - Systems Engineering (DoDD 5000.01, DoDI 5000.02, MIL-STD-882D, etc)
  - EO 13423 Strengthening Federal Environmental, Energy, and Transportation Management
  - ISO 14000 series (env mgmt, LCA, impacts, GHGs, etc)
  - Green ammo initiatives

- Looking Forward
  - Sustainability frameworks for bootprints
  - Green Chemistry and Engineering
  - Cradle-to-Cradle
Military and the Environment – a Complex Marriage

- A Long History
  - Lewis and Clark Expedition, 1804 (Natural & Cultural Resources)
  - Progress from control to prevention to sustainability
  - Focus areas: conservation, restoration, compliance, pollution prevention

- Military Munitions Legacy
  - 15 M acres, ~ 2300 sites (GAO, 03)
  - Colorado (34 sites)
  - $8-35 Billion and 75 years to clean up

- Need for Better Tools & Methods
  - EKAT/Innovative EA
UOL Life Cycle Framework – Proactive and Iterative
Life Cycle Framework – Proactive and Iterative (cont’d)

- Initial Characteristics
  - Description/rationale
  - EKAT screenings and NEPA tools
  - Baseline

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Category</th>
<th>Results</th>
</tr>
</thead>
</table>
| benzene | CWA | benzene (71-43-2) - a hazardous substance listed under Section 311 of the Clean Water Act (CWA). The reportable quantity (RQ) is 10 pounds (4.54 kg). [Reference 117]

benzene (71-43-2) - has a recommended exposure limit (REL) for worker exposure to this material in air. The REL is C₈ TWA 0.1 ppm ST 1 ppm See Appendix A.

The concentration in air that NIOSH states is immediately dangerous to life and health (IDLH) is 10 ppm C₈. [500 ppm].

benzene (71-43-2) belongs to the group of chemicals, Coal Tar Pitches and Coal Tar Pitch
Life Cycle Framework – Proactive and Iterative (cont’d)

- Evaluating Impacts
  - Multidisciplinary and flexible teams of SMEs
  - Models, sampling
  - Predictive and empirical
Life Cycle Framework – Proactive and Iterative (cont’d)

- Decision Making
  - IPT, PM, leadership
  - User feedback loops

- Documentation
  - Strategic-level
  - Operations-level
  - Site-specific
    (public stakeholders)

<table>
<thead>
<tr>
<th>ESOH Category</th>
<th>COLOR CODED RATINGS &amp; NUMERIC VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GREEN (1.0)</td>
</tr>
<tr>
<td></td>
<td>YELLOW (2.0)</td>
</tr>
<tr>
<td></td>
<td>RED (4.0)</td>
</tr>
<tr>
<td>PLANNING (0.25)</td>
<td>0.25</td>
</tr>
<tr>
<td>HAZARDS (0.1)</td>
<td>0.2</td>
</tr>
<tr>
<td>REQUIREMENTS (0.4)</td>
<td>0.4</td>
</tr>
<tr>
<td>FUNDING (0.25)</td>
<td>0.50</td>
</tr>
<tr>
<td>SUM TOTAL (1.35)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Roll-Up Rating (Color) Status</th>
<th>Roll-Up Rating (Numeric) Score Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>GREEN</td>
<td>(1.00 – 1.30)</td>
</tr>
<tr>
<td>YELLOW</td>
<td>(1.31 – 2.00)</td>
</tr>
<tr>
<td>RED</td>
<td>(2.01 +)</td>
</tr>
</tbody>
</table>
Technology Acquisition – Assessment Opportunities

- Materiel Solution Analysis
  - Planning & AoA

- Technology Development
  - COTS, design, and prototype T&E

- Engineering & Manufacturing Development
  - Integrated systems
  - Manufacturing processes

- Production & Deployment
  - Deploy, transport, storage

- Operations & Support
  - Life-cycle sustainment
  - Demilitarization & disposal
Military Systems – Nonlethal Applications

- Emerging Systems Evaluated or Under Evaluation
  - Mobility Denial System/Anti-Traction Material
  - Improved Flash-Bang Grenade
  - Joint Nonlethal Warning Munition
  - Odorants and Aromatics
  - Mission Payload Module – Nonlethal Weapon System
  - Nonlethal Airburst Munitions
  - Nonlethal Thermobaric Technology
  - Pulsed Energy Projectile
  - Running Gear Entanglement system
  - Luminescent Gel Capsules
  - Bomb Detection and Countermeasures
Mobility Denial System/Anti-Traction Material (Marines)

- **Initial Characteristics**
  - Slippery hydro-gel sprayed on surfaces
  - Identified benzene and acrylamide in initial design
  - GIS site suitability tool

- **Evaluating Impacts**
  - Sampling and analysis
  - Risk assessment
  - Optimized formulation (removed benzene, minimized acrylamide)
  - PPI (two-tie dusk masks, goggles, moisture resistant clothing)
  - BMP (cleanup, avoid water resources, tech manual)
Mobility Denial System/Anti-Traction Materials (cont’d)

- Decision Making
  - Evaluated site-specific NEPA (29 Palms, CA)
  - NEPA Decision-Memorandum
  - Programmatic FONSI

- Documentation
  - Life cycle environmental assessment
  - Technical Manuals
  - PESHE
Odorants and Aromatics (Army)

- **Initial Characteristics**
  - Foul smelling payload delivered via nonlethal munitions
  - Identified thiophenol (highly toxic) in early formulation

- **Evaluating Impacts**
  - Toxicity assessment and predictive modeling
  - Down-selected formulation (removed thiophenol)
  - Calculated release scenario impacts (dispersal)
  - Recommended ecotoxicity testing
  - PPE for certain phases
  - BMP (controlled release)
Odorants and Aromatics (cont’d)

- Decision-Making
  - Conditional
  - Programmatic
  - FONSI

- Documentation
  - LCEA
Nonlethal Airburst Munitions (Army)

- **Initial Characteristics**
  - Various launch platforms and payloads considered (rubber balls, pyrotechnics, flash-bang, etc.) for small arms longer range
  - Identified tungsten ballast in initial design

- **Evaluating Impacts**
  - Literature review of tungsten compounds and particle size impacts
  - Down-selected payload and platform (eliminated tungsten)
  - Evaluated conventional and novel components
  - Limited field sampling
  - Integrated prototype being finalized
  - Additional environmental data collection planned
Nonlethal Airburst Munitions (cont’d)

- Decision-Making
  - Programmatic FONSI

- Documentation
  - LCEA
  - PESHE
  - Chamber & field test data reports
Mission Payload Module - Nonlethal Weapon System

- Initial Characteristics
  - SEP, TEMP, THEEP

- Evaluating Impacts
  - IPT, SBT, Contracting

- Decision-Making
  - HERB, MDA

- Documentation
  - PESHE, LCEA, IHHAR
Luminescent Gel Capsules (UOL)

- **Initial Characteristics**
  - Area surveillance marking and monitoring technology
  - Emission of visible light or thermal signal (infrared)
  - Identifying materials and properties
  - Core reactions, shell, and oxidation products

- **Evaluating Impacts**
  - EKAT screening
  - Toxicity assessments and predictive modeling

- **Decision-Making & Documentation**
  - LCEA underway
Other Initiatives and DoD Efforts

- DoD and Other Sustainable Development Initiatives
  - Insensitive Munitions
  - Design for Demilitarization
  - Product Stewardship
  - Cradle to Cradle
  - Zero Waste
  - Substance Flow Analysis
  - Military Sustainability
Other Stakeholders

- **Consortium for Environmental Stewardship and Sustainability (CESAS)**
  - A network of partner organizations working collaboratively to advance sustainability and sustainable development

- **National Institute for Land Management and Training**
  - Provides nationwide technical support for the U.S. Army Integrated Training Area Management (ITAM) program and related activities
Improving Systems and Processes

- Lessons
  - Early upstream involvement key (teams and tools)
  - Joint planning and testing
  - E and SOH integration
  - Balance ESOH aspects with product performance
  - Relationships and network beyond project
Improving Systems and Processes (cont’d)

- **Benefits**
  - Risk and liability reduction
  - Regulatory cost, time, and pollution prevention savings
  - Product and service innovation
  - Triple bottom line effectiveness (people-planet-prosperity)

- **Challenges**
  - Transcend stovepipe barriers
  - Leadership commitment (PMs as champions)
Acknowledgments

- Marines Expeditionary Rifle Squad (MERS), USMC Systems Command
- Joint Non-Lethal Weapons Directorate (and other U.S. DoD Services)
- M2 Technologies, Inc.
- CABEM Technologies, Inc.
- CESAS Network
- Kansas State University faculty and graduate students
www.uol.ksu.edu

Amanda Prill, Assistant Program Manager
M2 Technologies, Inc.
Manhattan, KS
785-323-0295
prilla@M2tech.us

Blase Leven, Associate Director
Kansas State University
Manhattan, KS
785-532-6519
baleven@ksu.edu

Jay Fredkin, Owner
CABEM Technologies
Franklin, MA
508-541-3123
jayfredkin@cabemtechnologies.com

Oral Saulters, EA Team Leader
Kansas State University
Manhattan, KS
785-532-6233
osaulter@ksu.edu