

Conducting Life Cycle Environmental Assessments for the Department of Defense on Emerging Non-Lethal Technologies

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ABSTRACT

The Urban Operations Laboratory (UOL) is comprised of M2 Technologies, Kansas State University, and CABEM Technologies, performs environmental research, training, assessment, and product development for the Department of Defense (DoD). UOL produces technologies that give our military forces the advantage in urban operations, while addressing complex environmental issues that affect the health and safety of our air, water, and land.

One of the UOL's tasks is to assist DoD in conducting life cycle environmental assessments during the acquisition phase of technology development. As part of life cycle environmental assessment (LCEA) work, UOL staff coordinate with DoD's Integrated Product Teams (IPTs) and Human Effects Review Boards to provide technical input on potential environmental concerns and participate in field testing, data collection, analysis, and interpretation.

Various levels of environmental assessments have been performed and/or are underway on over a dozen emerging systems and technologies.

Keywords: environment, risk, assessment, impacts, software

1 NEER CENTER

1.1 Background

In 2001 Congress appropriated funds to establish the Nonlethal Environmental Evaluation and Remediation (NEER) Center at Kansas State University. The successful model was subsequently expanded into the UOL to support dynamic military needs through practical environmental assessments, software tool design and development (Environmental Knowledge and Assessment Tool), and innovative technology development.

NEER performs environmental analysis for its military partners in accordance with federal regulations and policies, including: DoDI 5000.2 Operation of the Defense Acquisition System, National Environmental Policy Act, and Executive Order 13148 Greening the Government Through Leadership

in Environmental Management, among others. Further information is available at www.engg.ksu.edu/CHSR

1.2 Approaches and Tools

Working closely with DoD Integrated Product Teams and Human Effects Review Boards, NEER is able to provide technical input and assistance throughout the design and development process. Through an iterative approach involving multidisciplinary professionals, including scientists, engineers, and military analysts, NEER is able to effectively leverage a variety of resources and methods. In addition to the Environmental Knowledge and Assessment Tool (EKAT), various DoD databases and Environmental Protection Agency (EPA) models are utilized with special attention to green engineering principles. Empirical multimedia sampling and analysis are often performed by the team to supplement simulated and predictive data sets.

1.3 Technologies and Capabilities

To date, several innovative technologies, devices, and systems have been successfully evaluated at various phases of acquisition. Given the established user need for these non-lethal technologies and their integration, the capability to assess these systems in terms of unintended human health and ecological impacts is critical.

2 MILITARY AND THE ENVIRONMENT

2.1 History

Early in the 19th century, aspects of environmental management were integrated into the American military mission, including the Lewis and Clark Expedition. As military activities, equipment, and facilities became more complex and industrialized, the need for effective natural resource management and environmental stewardship become more important. In terms of environmental management and prioritization, there has been a progression from early command and control approaches with regulatory drivers, to

more recent preventive measures with overarching sustainability objectives.

2.2 Four Focus Areas

Military environmental programs are administered through four primary focus areas: conservation, restoration, compliance, and pollution prevention. The tremendous technical and financial challenges of investigating and remediating historic contamination sites demonstrate the need for strategies and tools that integrate environmental considerations much earlier in the technology development cycle.

3 ENVIRONMENTAL KNOWLEDGE AND ASSESSMENT TOOL

The Environmental Knowledge and Assessment Tool (www.ekat-tool.com) is an automated web-based tool designed by the NEER Consortium to identify, research, and evaluate environmental and pollution prevention options, and safety-related issues for products and systems.

Originally a concept of the Marine Corps System Command (MARCORSYSCOM) in order to better integrate their environmental requirements into their systems acquisition program, to support DODI 5000.2, the tool's components also makes it useful to other federal and state agencies, communities, and industry and small businesses.

EKAT is organized to bring basic information on technical and regulatory requirements and serves as a resource center linking to other references, tools, and databases to assist in research efforts to minimize any unintentional safety and environmental effects associated with product use.

Key modules and capabilities of EKAT include the following:

- Environmental screening. The environmental screening feature allows the user to evaluate chemicals or materials for potential environmental compliance and safety and health issues by comparing chemicals to federal environmental regulations and other pertinent lists.
- NEPA Decision Tree. The National Environmental Policy Act (NEPA) module assists Marine Corps users in meeting federally-mandated requirements to consider environmental and related issues in proposed actions.
- EmisCalc. EmisCalc allows the user to estimate actual air pollutant emissions or calculate the potential emissions for processes using EPA-approved air emission factors from the EPA Factor Information Retrieval database.
- TRACI for EKAT. TRACI for EKAT Tool is a modified version of the EPA software tool, The Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI), which allows the user to evaluate the environmental impact of releases to air and/or water over the lifecycle of a product, helping the individual understand and mitigate future liability.

- PESHE Report Generator. Marine Corps users utilize the Programmatic, Environmental Safety and Occupational Health Evaluation (PESHE) module to create the necessary report, as required by the Department of Defense for all programs, in support of DODI 5000.2.
- EKAT Wizard. The EKAT wizard feature is set up in a question and answer format to guide users and help them determine which assessments, tools and other EKAT resources can help best address their requirements.

EKAT contains additional research capabilities, including information resource documents and research guides, providing the user with quick access to environmental resources for researching material properties, reviewing specific environmental regulations or health and safety issues, and finding pollution prevention alternatives, as well as providing links to other Internet resources on the matter.

4 METHODOLOGY AND APPROACH

4.1 Initial Characterization

Clearly understanding the proposed technology concepts, materials and byproducts, and intended uses are important. Determining potentially applicable regulations and acquiring key data are performed with tools such as EKAT. Potential impacts are estimated and baseline information is compiled.

4.2 Evaluating Impacts

Evaluating environmental impacts for a proposed action or technology is the heart of the environmental assessment process. Interdisciplinary teams of subject matter experts systematically collect and evaluate theoretical and empirical data to further predict, quantify, and assess any unanticipated impacts. At this stage, information is synthesized to ascertain the level of significance. Preliminary findings are then analyzed, along with any needed mitigation measures.

4.3 Decision-Making

Tentative recommendations are shared with military and technology leaders in selecting the proposed action or technology.

4.4 Documentation

Based on proponent feedback, draft reports, such as a Life Cycle Environmental Assessment (LCEA) or PESHE, are cooperatively completed. As part of this process, monitoring and oversight plans are incorporated. Programmatic recommendations are completed and used as technical resources for further site-specific/geospatial evaluations and local public involvement.

The methodology of life cycle environmental assessment is mindfully integrated throughout the system development

and acquisition life cycle. The acquisition continuum provides several opportunities for both formal and informal environmental analysis, thus contributing to technology maturation while addressing environmental quality. During initial planning and design, NEER professionals review the capabilities and requirements. Environmental experts are part of the IPT from the beginning. Efforts are initiated on PESHE construction before system development and demonstration begins. Environmental specifications and attributes are an integral part of prototype development.

During field testing, data are collected to update and confirm predictions and verify compliance with standards. Considerations for deployment, transportation, and storage activities are carefully implemented. Before fielding and production, formal program assessments are completed. This information is provided to military installations for site-specific analysis. Given the holistic methodology, demilitarization and disposal actions are proactively evaluated to minimize waste generation and maximize reuse and recycling back into the technology sphere.

5 NON-LETHAL TECHNOLOGIES

5.1 Background

Prior to 1995, non-lethal technologies had been used primarily in specialty law enforcement applications. The successful utilization by U.S. Marines in 1995, to assist the safe withdrawal of U.N. Peacekeepers in Somalia, served as a pivotal event in establishing the efficacy of their use. The Pentagon issued a policy directive codifying the development and employment responsibilities for non-lethal weapons systems. It designated the U.S. Marine Corps as the Executive Agent and provided official definition, "Weapons are explicitly designed and primarily employed so as to incapacitate personnel or materiel, while minimizing fatalities, permanent injury to personnel, and undesired damage to property and the environment." The following year, the Joint Non-Lethal Weapons Directorate (JNLWD) was created. Partnering with the JNLWD, NEER has supported the advancement of several non-lethal programs.

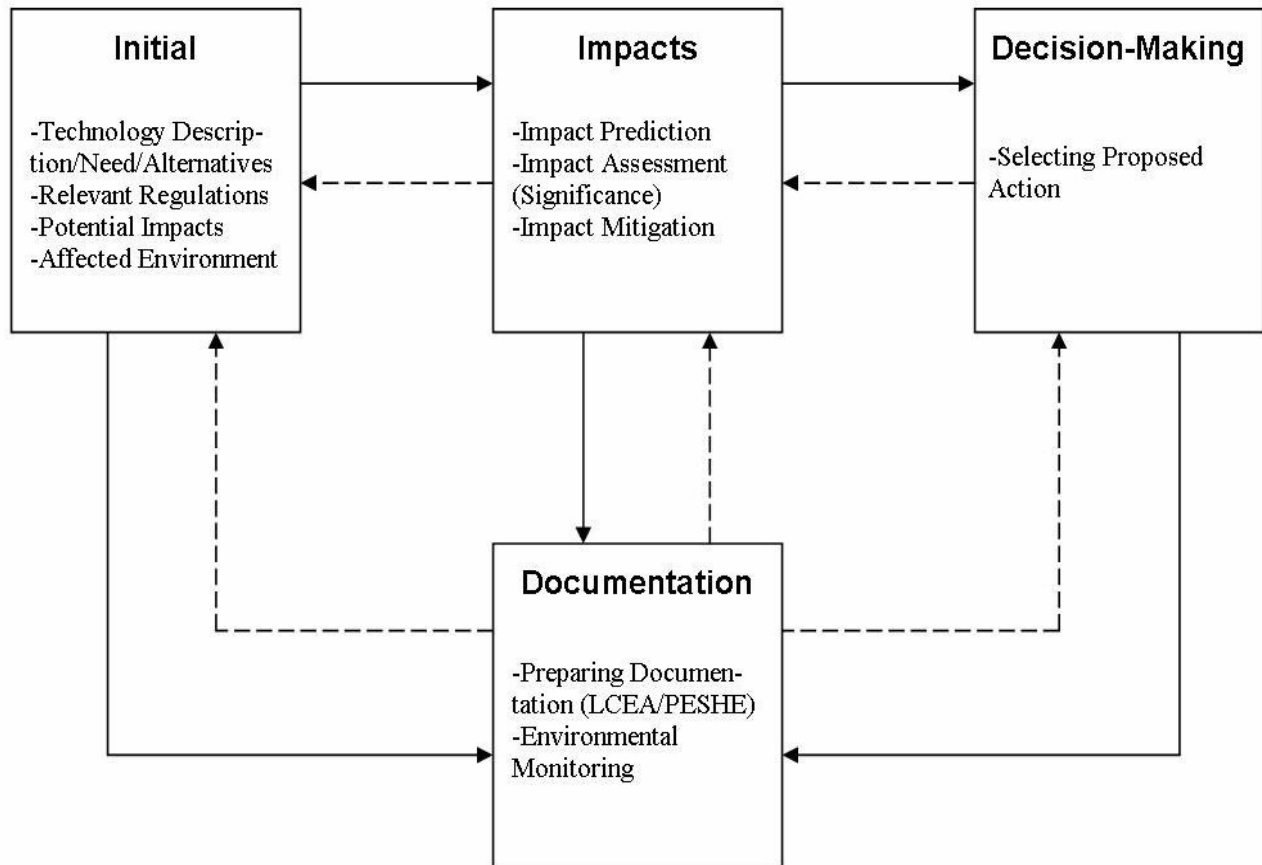


Figure 1
Urban Operations Laboratory
Conceptual Framework for Life Cycle Environmental Assessments
Department of Defense Non-Lethal Technologies

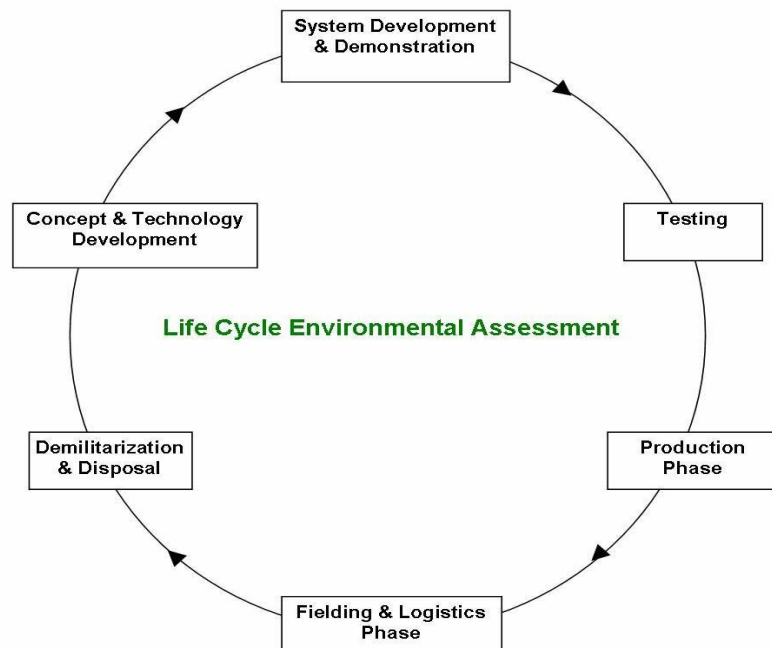


Figure 2
 Urban Operations Laboratory
 Acquisition Continuum and Life Cycle Environmental Assessments
 Department of Defense Non-Lethal Technologies

5.2 Mobility Denial System/Anti-Traction Material

The Mobility Denial System/Anti-Traction Material project is a Marine Corps led program using a water-based slippery gel material which is sprayed on surfaces and designed to preclude and/or minimize access to designated areas by individuals and vehicles. NEER evaluated early formulations and identified potential chemicals of concern. Support activities included developing a GIS suitability training tool, sampling and analysis, risk assessment, installation consultation, etc. Based on findings, the gel material was optimized, and personal protective equipment and best management practices were incorporated.

5.3 Aroma Compounds and Odorants

Aroma compounds and odorants are foul-smelling mixtures used for targeted delivery as area clearing mechanisms.

NEER identified problematic constituents in formulations and reviewed conventional and novel delivery subsystems for various DoD agencies. Release scenarios were estimated and safe concentrations were calculated to assist technology development. Recommendations for payload enhancement, ecotoxicity testing, and controlled release delivery were completed.

5.4 Flash-Bang Grenades/Non-Lethal Airburst Munitions

For this U.S. Navy sponsored program, early launch small-arms platforms and payloads were assessed by NEER. Based on input, problematic compounds were eliminated. Improved flash-bang pyrotechnics have been developed as the basis for these versatile systems. Limited field sampling and analysis, in test chambers and ambient conditions, were completed. Innovative metal-based payloads, fuzes, and activators are currently being analyzed.

6 CONCLUSIONS

Early partnership and cooperative involvement are essential to successful DoD project designs and implementation, involving both interdisciplinary teams and robust tools. Collaborative efforts have led investigators and researchers to improved product design and selection of component materials that will minimize any unwanted environmental consequences. Given the current precarious global geopolitical matrix, it is likely that the use and capabilities of non-lethal technologies will grow in the future. Integrated life cycle environmental assessments and military acquisitions contribute to triple bottom line savings (environment, economics, social), as mission readiness and environmental stewardship are invariably interdependent.