PENNSTATE ARL

Applied Research Laboratory
The Pennsylvania State University

Institute for Emerging Defense Technologies

An Overview

Presented to:
NDIA's Non-Lethal Defense "V" Symposium

March 2002

Background

- **Penn State is designated the Marine Corps Research University, and the Applied Research Lab (ARL) is its primary technology research performer.**

- **In 1997, ARL with the University formed the Institute for Non-Lethal Defense Technologies , now the Institute for Emerging Defense Technologies (IEDT), to provide multi-disciplinary support advanced technology areas within both the DoD and DoJ arenas. Non-lethal technologies remains the primary research area.**

- **The Institute, in addition to conducting basic and applied research, serves as a trusted agent in security technology assessments and concept development for the joint services and law enforcement.**

Core "Competencies"

The "core competencies" for the Institute for Emerging Defense Technologies are the competencies for the Applied Research Laboratory as a whole. Specific emphasis will be placed on the following research areas:

- **Non-lethal (NL)/less-than-lethal technologies**
- **NL weapon human effects**
- **NL/LTL technology testing and assessment**
- **Unmanned vehicles (ground and air) intelligent control**
- **Command and control synthetic visualization**
- **Numerical and theoretical laser effects modeling**
- **ELINT signal processing**
- **Alternative power sources for directed energy systems**
- **Chemical-biological incident sensors**
- **Emergency response tools**
- **Vehicle noise/signature reduction**
- **Physical security technologies**

Current Sponsors

- **Joint Non-Lethal Weapons Program**
  - **Human Effects Assessments**
  - **Emerging Technology Assessments**
  - **Human Model Development**
  - **Professional Military Education/Training**
  - **Advanced Tactical Laser ACTD support**

- **Law Enforcement (NIJ) – Blunt impact studies, Op Needs**

- **University of New Hampshire – Human Effects, NL Laser Research**

- **Joint Chem-Bio Program (USMC) – CB Multi-Sensor Anaylzer/ Detector**

- **US Marine Corps – Armored Vehicle Upgrade, Noise Reduction, Studies & Analysis**

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Non-Lethal Technology Experience

Portable Vehicle Stopper

Advanced Tactical Laser

66mm Crowd Control Munition

Blunt Impact Munitions

40mm NL Munitions

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Non-Lethal Technology Experience

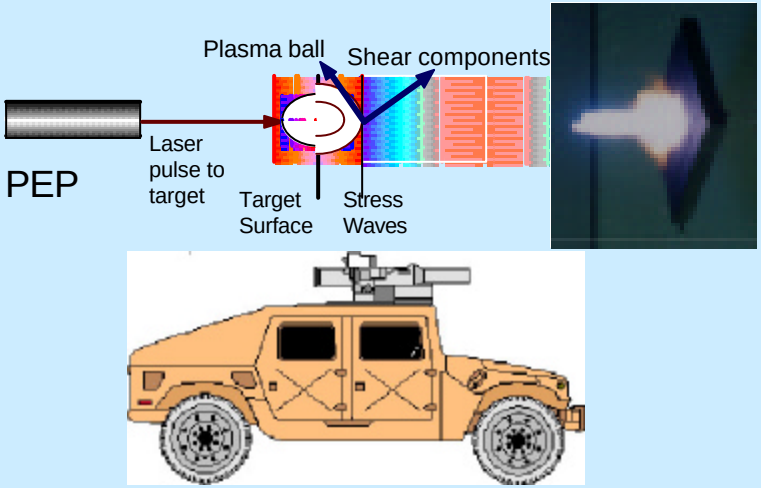
HPM Area Denial System

Running Gear Entangler

(Vessel Stopper)

Future Infantry Weapon - NL Cartridge

NL Mortar Round



Pulsed Energy Projectile

Recent Work

- **Completed the following Human Effects Assessment Panels:**
  - **66mm NL Munition**
  - **Crowds and Crowd Control**
- **Completed the following Independent Technology Assessments:**
  - **Vessel Stoppers**
  - **Pulsed Energy Projectile**
- **Completed the Attribute-Based Evaluation of Off-the-Shelf Less-than-Lethal Munitions in collaboration with Los Angeles Sheriff's Department.**

Recent Work

- **Conducting the following Independent Technology Assessments:**
  - **Objective Infantry Combat Weapon NL Munition**
  - **81mm NL Mortar Munition**
  - **Advanced Tactical Laser NL Applications**
- **Published the Concept of Operations for the Non-Lethal Area Denial Systems for the U.S. Navy Submarine Base Security Program**

Recent Work

- **Assigned as the "trusted agent" representative of JNLWD for the ATL ACTD**
- **Planned, organized and conducted the 1st International Law Enforcement Meeting on Minimal Force Options**
- **Investigating the feasibility of combining OC with Calmative Agents**
- **Developing an "eForum" for Law Enforcement NL Operational needs Assessment**

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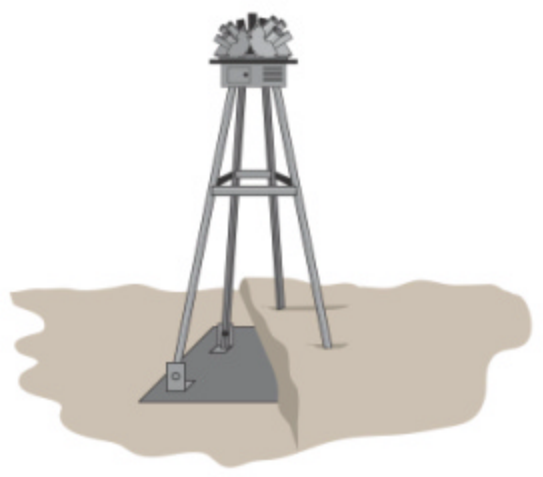
Non-Lethal Defense for Perimeter Security



Portable Tower Mount (PTM)

Operational Capability:
The PTM will enable facilities, commercial sites, and military units to rapidly deploy non-lethal (NL) security perimeters that include a network for sensors and RF links as well as man-portable mounts for NL devices. These compact and light weight towers will enable the site to adapt its security to changing situations and physical needs. Only the towers require development because the mount points will be designed for quick attachment of various off-the-shelf technologies.

Proposed Technical Approach:
Sponsor requirements will be defined and assessed. Alternative designs will be evaluated and the most promising configurations will be modeled. The final selection will be built in prototype form for field evaluation.Tasks include the formulation of specific security requirements, model shop fabrications, and field trials at a designated sponsor site (I.e. airport, nuclear power station, urban water supply, secure military installation) ARL/PSU has formulated this configuration as part of a “layered” perimeter defense system.

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Tensioned Wire Sensor Fence (SMART Fence/TWSF)

Operational Capability:

The TWSF turns any fence into a continuous sensor system that detects and localizes intruders. It consists of hardware available in local stores, PC based software, and inexpensive geophones. The State Department, and military organizations, e.g. US Army War College, US Army ARDEC, Picatinny Arsenal, Letterkenny Arsenal, Yuma Proving Groungs, and Keyport Navy Installation) have all expressed interest.

Proposed Technical Approach:

An engineering development TWSF will be installed, operated and optimized.Tasks include installation, software improvement, and performance data collection.There is a prototype TWSF installed and operating at the ARL/PSU. The technology is PC based detection and localization algorithms, wire and bracket hardware, and commonly available geophones.

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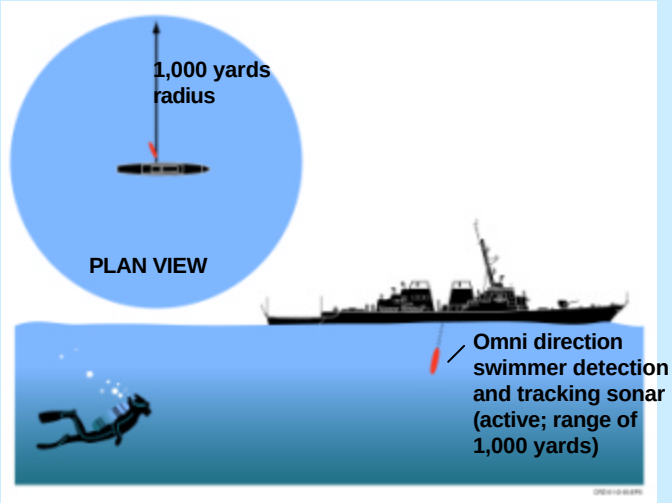
Swimmer Detection System

The Portable Anti-Swimmer Auto-Detection System



Operational Capability

- Existing detection systems are large (not portable), and do not provide an auto-detection capability
- This will be a portable detection system capable of auto-detection of swimmers at a maximum range of 500 yards
- The system can be deployed by a single ship and be used while a ship is in homeport, visiting a foreign port, or at anchor
- The system will be composed of a transducer array and an automated detection, classification, and localization system

ARL Penn State has the technical background to develop such a system based on its acknowledged USW DCL expertise. The system will incorporate an existing MCM transducer and intelligent processor technology to provide auto-detection of swimmers at a standoff range that will provide the ship with the time and information to determine hostile intent and take appropriate action.

Proposed Technical Approach

The problem will be solved with a multi-pronged approach:

1. **Development/modification of a small, high frequency transducer array**
2. **Development and testing of automated swimmer detection, classification, and localization algorithms**
3. **Integration of the swimmer detection system**
4. **Demonstration of the prototype system against actual swimmers at a CONUS Naval Station**

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National Institute of Justice (NIJ) Less-than-Lethal Technology Support

Enhanced Capability:

The National Institute of Justice (NIJ) is the primary law enforcement organization in the U.S. responsible for research and development of technologies which can directly assist law enforcement and corrections professionals. The current less-than-lethal (LTL) research work is seriously underfunded, and yet has great potential for providing these and other 1st responders with a wider set of options for maintaining public order and safety during the initial stages of response to terrorist acts, unlawful/violent protest, and other threats to our homeland security.

Proposed Approach:

The Applied Research Lab has established itself over the last few years as the premiere research university within the LTL/non-lethal technology arena. With a broad understanding of the operational and technical requirements, ARL though its Institute for Emerging Defense Technologies has already provided superior technological support as a trusted agent for law enforcement, both domestically and internationally. In an expanded “honest broker” role, the Institute will provide enhanced testing, evaluation and assessment of public order-related technologies which are increasingly important to police and corrections officials.

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Gladiator TUGV
(Tactical Unmanned Ground Vehicle)

"Concept"
TUGV
(Not actual system)

Operational Capability:

The Gladiator TUGV will provide military forces with an unmanned, semi-autonomous ground vehicle for remoting combat tasks in order to reduce risk and neutralize threats to the Marine Air-Ground Task Force. The primary function of Gladiator is reconnaissance, surveillance, and target acquisition (RSTA), but will also have "plug-and-play" modular payloads for expanded warfighting capabilities in different battlespace environments.

Proposed Technical Approach:

A simulation-based design approach to the development and evaluation of alternative Gladiator designs will be pursued. Different designs will be virtually exercised within the context of the Concept of Employment. ARL has formed an interdisciplinary team along with SUMMA Technology, Inc., to design and develop an innovative, robust, cost-effective system that spans the spectrum of technical requirements from vehicle design, functionality, analysis, manufacture, and test.

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