NRAC

NAVAL RESEARCH ADVISORY COMMITTEE

Marine Corps Capabilities for Countering Precision Weapon Threats

2011 Study

Sponsored by

Commanding General, MCCDC

Terms of Reference

- **Characterize known and potential precision weapons and munitions types that could be potentially exploited by hostile governments and non-state actors, to include relatively inexpensive, home-made-type weapons**
- **Review and assess the current and planned Marine Corps policies, strategies, approaches (including training), and capabilities for responding to these potential precision weapons and munitions**
- **Identify promising science and technology areas for Marine Corps capabilities to respond to these potential precision weapons and munitions threats, which can include detection, tracking, identification, engagement, and ways to counter damage caused by precision weapons, as well as others**
- **Recommend any other initiatives that should be undertaken by the Marine Corps in an effort towards improving their overall capabilities for responding to the potential exploitation of precision weapons and munitions by adversaries**

Panel Membership

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Context
(Lt Gen Mills, 28 September, 2011)

- Future of amphibious operations against emerging threats?
- What adjustments will be required to these operations?

Bottom Line Up Front

Precision weapon systems projected for the future threat environment present a realistic threat to the feasibility of future amphibious operations. Staying ahead of emerging threats will require:

1. **An integrated Sea-Air-Ground operational capability, including**
   - A **survivable networked sea-air-ground system** for communication, detection, cueing, tracking and engaging
   - Increased use of **unmanned systems** as connectors, ISR nodes, airborne comm. relays, GPS surrogate

Bottom Line Up Front (2)

2. Expansion of the current USMC expeditionary force development process

- Accelerate the analysis and exploitation of potential threat weapons systems' weaknesses and vulnerabilities
- Accelerate countermeasures development and testing
- Accelerate the integration of threat analyses, S&T programs, and the USMC expeditionary force development process

3. Consider the establishment of an <u>Integration Cell</u> to support this expansion

- Cell functions: Foreign Materiel Exploitation requirements, intelligence analysis, S&T programs, laboratory and range tests, USMC concept development and wargaming, acquisition program requirements

Briefings to the Panel

NRL

BLACK DART

MITRE

NORTHROP GRUMMAN

Amphibious Capabilities Working Group

MIT Lincoln Laboratory

The Emerging Threat

Present Danger: Missing Missiles in Libya

“Experts told ABC News they are concerned that the weapons stockpiles including as many as 20,000 surface-to-air missiles are out in the open and could fall into the hands of terrorists”

“Human Rights Watch found at least 14 empty crates that had once contained a total of 28 SA-24 missiles. More than 20 SA-7 surface-to-air missiles remained in their original packaging. At a second site ... located a massive, unsecured ammunition storage facility with at least 70 bunkers containing explosive weapons. Inside the bunkers, ...found large quantities of munitions, as well as thousands of guided and unguided aerial weapons.”

An abandoned AA-8 Aphid air-to-air missile found at an unguarded weapons stockpile near Sirte, Libya.

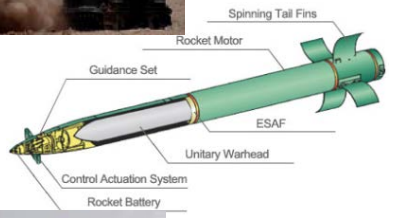
G-RAMM (Guided Rocket, Artillery, Mortars and Missiles)

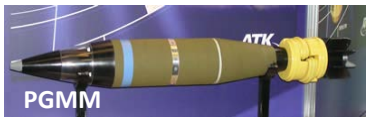
Class of weapons enhanced by homing, guidance, & control systems; actively change their flight paths to guide on their targets

- Guided **artillery**: Russian laser-guided Krasnopol. Has been sold to over 12 countries (incl China, India, Belarus). India is a producer
- Guided **mortars**: Swedish 120mm Strix (IR seeker); Israeli-Raytheon Dagger GPS-aided 120mm round; Russian Gran
- Guided **missiles**: SAMs, MANPADs, ATGMs,...

– **Requires nation-state support to produce, but widely proliferated**

– **Supporting network commercially available: targeting (Google Earth); C2 (cell phones, optical fiber, internet)**





Unmanned Aerial Systems (UASs) with PW Capabilities

- **Most countries are developing ISR UAVs**
  - Could be the source of precision weapon guidance
- **UAVs of any size with GPS can be used as a suicide precision weapon**
  - Current threats typically require close-in operations & line of sight
- **Both China and Iran have UCAVs in development that could carry PGMs**
  - Likely 5-10 years from operational capability
- **Multi-UAV coordinated operations 10-20 years in the future for adversaries**

Harpy
Israel/China
Range ~300mi
Loitering Munition
70lb payload

Ababil/Swallow
Iran
Range ~90mi
ISR/Attack
88lb payload

Unmanned Systems: Both a Threat and a Capability Enabler

- As threats, UASs could be used as C3 and ISR platforms AND precision weapons
  - Low-flying, slow-moving small UASs are very difficult to detect, track, and defeat
  - A netted sensor architecture is a requirement for countering such a threat
- As future operational capability enablers, unmanned systems could include:
  - UASs for ISR and defense against PWs
  - USVs (Unmanned Surface Vehicles) for beach assaults
  - UUVs for ISR

PW Threat Summary

- Even small organizations can field more lethal and capable weapon systems, maintain awareness of the battlespace, and coordinate activities among dispersed forces.

- Precision weapons and supporting technologies are proliferating
  - **Weapons**: G-RAMM systems, specialized ammunition, advanced optics
  - **Comms**: high-level encryption, fiber-optic networks, cellular, satellite, VOIP, Twitter, web-presence
  - **ISR**: commercial satellite imagery, "Google Earth", commercial UAVs w/cameras
  - **Robotics**: a multitude of unmanned systems flooding the market, providing affordable, effective remote platform capabilities for air, land, and maritime surface/sub-surface environments

Increasingly, sub-state/non-state forces will be able to execute attacks on security forces, critical infrastructure, and key resources from greater range, with increased precision,

and with little or no warning

Amphibious Operations

NRAC Observations re: Amphibious Operations

Current:

- US has asymmetric advantage in weapons, C3, ISR
- Battlefield preparation
- Counter-battery (adversary only gets one shot...)
- Come-as-you-are

Future:

- Uncertain threat environment, esp. with precision weapons
- Condition setting ashore (must include electronic attack, counter C3, counter ISR)
- Single Naval Battle, including air-to-ground situational awareness, C3, integrated fires
- Come-as-you-are as the key enabler for fast response in an increasingly chaotic world

Current and Planned USMC Capabilities, Developments and S&T

USMC Capabilities for Responding to PW Threats

(current and planned)

- Single Naval Battle (Integrated Sea-Air-Ground)

- Battlefield preparation, including, e.g.,
  - ISR and counter fire
  - Electronic signatures, decoys, obscurants. Military deception may prove essential

- Interceptor: kinetic and/or functional kill of the PGM

- Electronic Attack and Cyber Attack
  - "Deny, degrade, disrupt"
  - GPS jamming and spoofing
  - C3 and video link jamming

Essential and particularly challenging in the littorals, near high-density population centers…

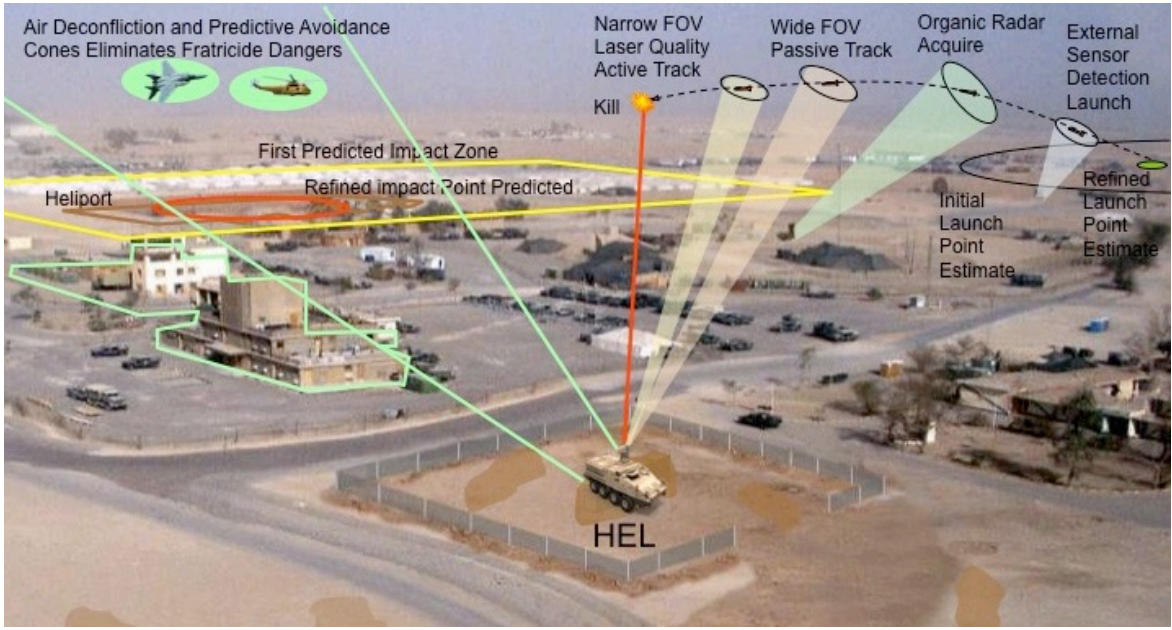
S&T Contributions to USMC Capabilities

- Marine Corps-led
  - GBAD-OTM (Ground-Based Air Defense On-The-Move), G/ATOR (Ground-Air Task-Oriented Radar)
- Marine Corps-leveraged
  - Army IFPC (Indirect Fire Protection Capability)
  - Industry-led and other nations' Kinetic Energy concepts
  - High Energy Lasers (HEL)
  - Obscurants, decoys
  - Leverage and influence Foreign Military Exploitation activities of the Intel Community
  - Unmanned systems
  - Electronic Attack and Cyber Attack – aim to disrupt the C2 and ISR, rather than killing the PW

But, effectiveness of ground-based hard kill systems (esp HEL) against indirect fire may be degraded by terrain, atmospheric effects, air de-confliction and predictive avoidance

High Energy Laser Systems: Issues

- Need for cueing (esp. against slow, low, small UAVs)
- Maritime environment affects performance
- Lack of commercial market for power increase
- All GBAD-OTM laser contenders at low level of technical maturity



- Predictive avoidance/de-confliction for ground-based lasers (technology/policy)
- Airborne lasers: size, weight, and power challenge
- 5% duty cycle: e.g., 40 sec magazine, 15 min recharge
- Ultra short pulse (10^{-15} sec) lasers. Lower level tech maturity than GBAD. Potentially unique propagation and kill mechanism

Findings - What's Missing

- A mechanism to provide the expeditionary force development process with required information, including threats and countermeasures

- An ability to predict the near and long-term threats associated with commercial technology advances (e.g., Google Earth)

- This drives the requirement for **adaptability**
  - Requires frequent experimentation
    - Known and predicted threats and countermeasures in a realistic environment (geopolitical understanding, influence of other factors, e.g., commercial shipping and fishing)
    - Experiments must connect the technology developers with the operators

What's Missing (cont.)

- Ship-to-Shore connectors with adequate capacity, speed, armor, and defensive capabilities remain a challenge
  - Consider unmanned systems, e.g. "Unmanned Breacher Vehicle"*
- A holistic view of counter PWs – defeat the critical systems, not only the weapon. Countering philosophy must include shaping the battlefield and must address the entire kill chain, e.g., C3 and ISR capability, obscurants, decoys, deception
  - Panel was unable to examine some countermeasures (Cyber and Electronic Attack)

***"The Next Wave: Assault Operations for a New Era"**
Naval Institute Proceedings, November, 2011
LtCol J. Noel Williams, U.S. Marine Corps (Retired)

Recommended Initiatives

NRAC Recommended Initiative

- Enhance the expeditionary force development process by:
  - Promoting the acquisition of threat weapons systems
  - Accelerating the analysis of weaknesses & vulnerabilities
  - Accelerating the transition of threat vulnerability analyses into countermeasures options via S&T initiatives program planning, and CONOPS development
  - Testing the effectiveness of countermeasures & tactics in laboratory & operational environments (e.g., Black Dart)
  - Integrating threat analyses, countermeasures, and S&T planning into expeditionary force development process

Establish an Integration Cell to support, sponsor, and monitor the activities outlined above

NRAC Recommended Initiatives

- Conduct experiments on the use of airborne platforms and/or electronic support measures to track small, slow, low-flying UASs
- Design and conduct experiments on the use of current and planned unmanned platforms as
  - Ship-to-Shore connectors
  - Counter-battery airborne ISR nodes
  - Airborne communication relays
  - Airborne GPS surrogate

Exploit all available range and laboratory facilities for the conduct of these experiments, with MCWL as executor.

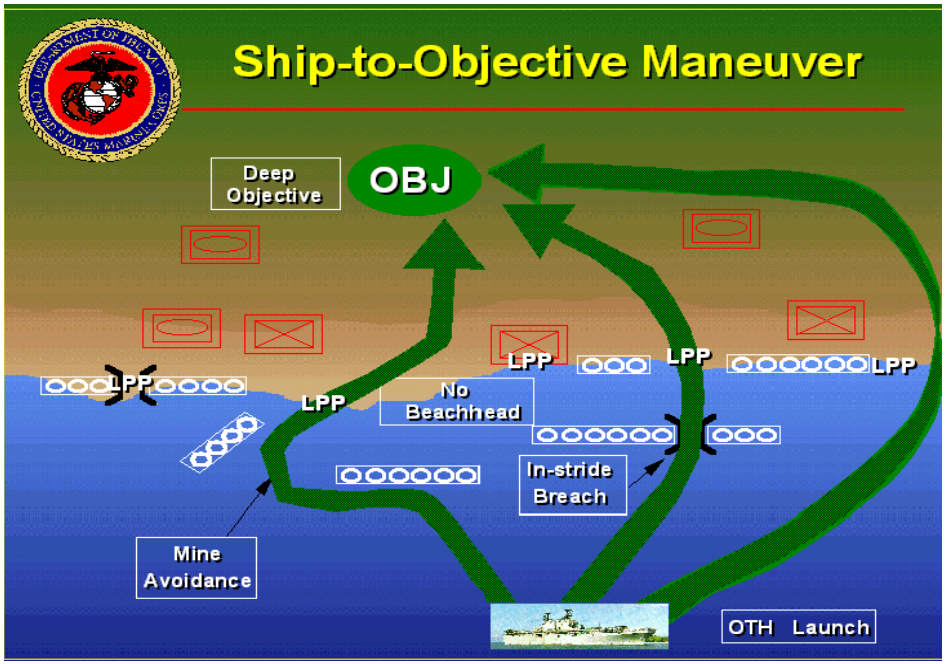
- Design and conduct experiments on Cyber and Electronic Attack threats and countermeasures in amphibious operations environments

Questions?

Possible PW Scenario Targeting an Amphibious Assault

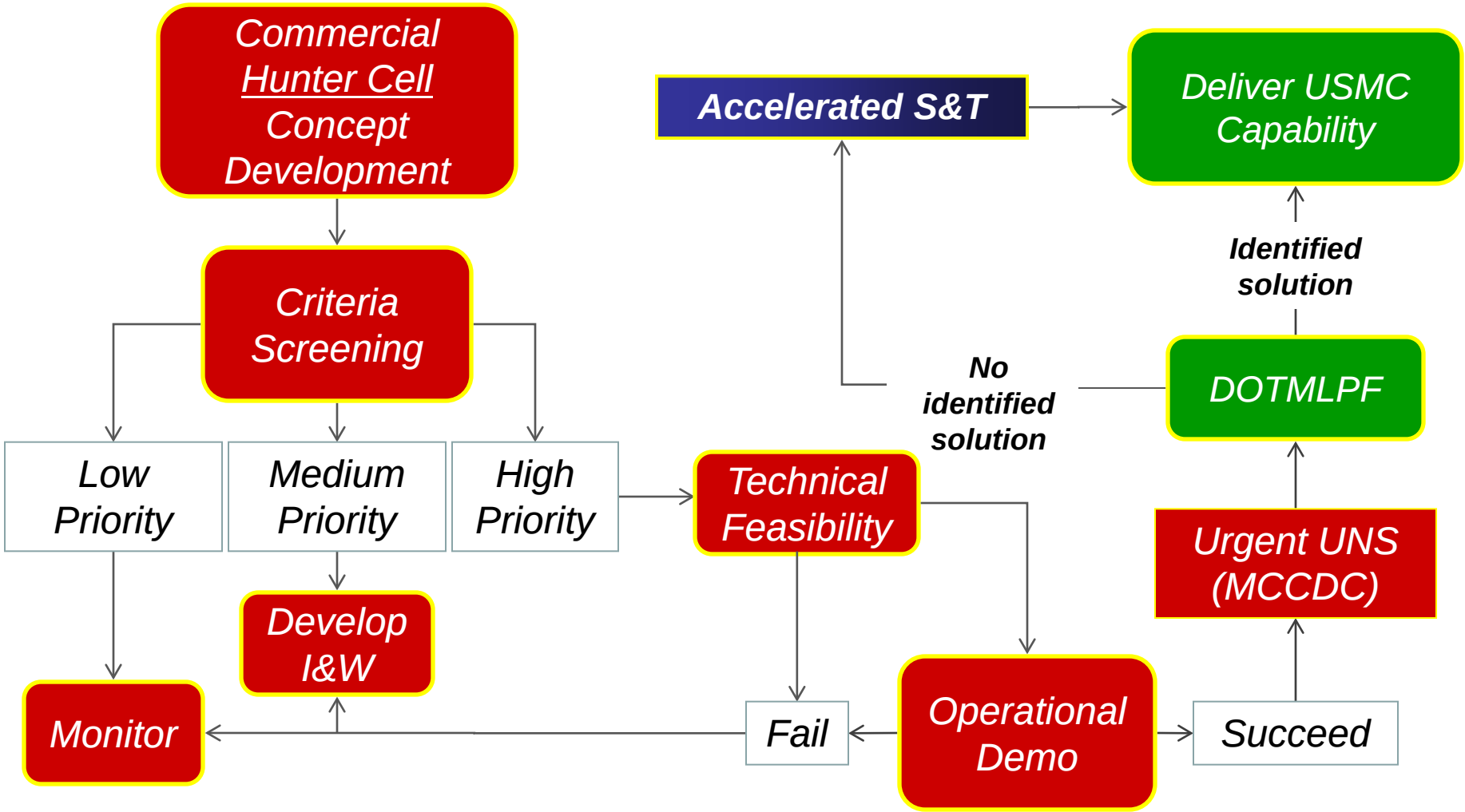
- Enemy uses UAS-provided ISR along coast line, aided by spotters on the ground, to provide target-quality data to shooter
  - Targeting inbound assault/connector vehicles

- Once USMC forces are ashore, or nearly ashore, enemy launches coordinated multiple mortar attack against their vehicles.
  - Fired from populated areas if possible
  - Multiple rounds from multiple positions timed within seconds of each other. Strike targets with 90% accuracy



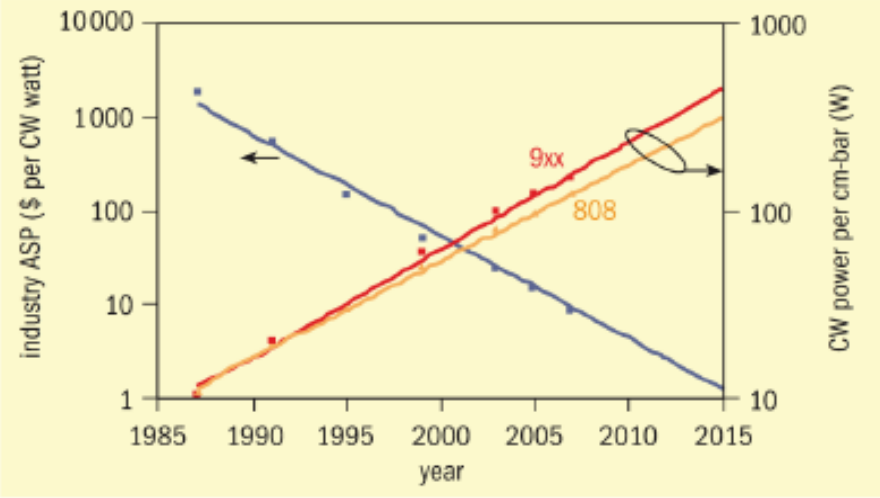
- **The first wave of the USMC amphibious assault is stopped.** USMC loses a large number of personnel and a significant number of vehicles. Unable to support additional waves.
  - The USMC is hard-pressed to continue with its amphibious assault

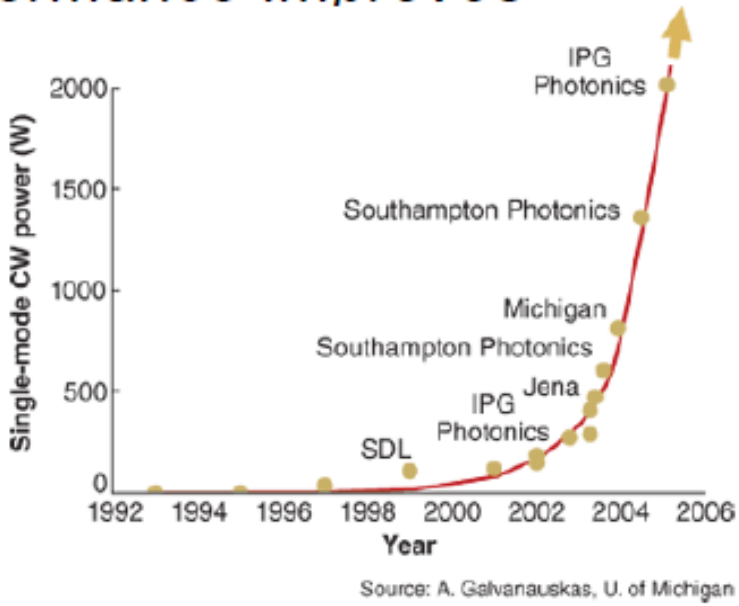
Commercial Hunter Cell . . . a model



Comm'l Market Drives Advances in Fiber Laser Technology

Price Decreases While Performance Improves





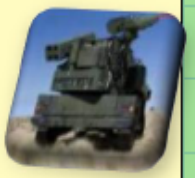
Source: A. Galvanauskas, U. of Michigan

- **$/W decreases 20 %/yr**

Source: "Industrial markets beckon for high-power diode lasers", Optics & Laser Europe", October 2007, p.26
Add'l data from "For Laser Diodes, It's a Material World", Photonics Spectra, August, 2009

- **Power/fiber increases exponentially**
- **LM recently purchased 1st 10 KW Single Mode fiber laser (IR&D)**

Navy Lethality Roadmap



	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20
	LaWS		HPL FNC		GBAD_OTM		Free Electron Laser			
Key Milestones	PASS, IMU, & FSM Test		100kW ADM Maritime Demo	100kW Maritime Installation	EDM At Sea OA		IOC 25kW Flight Demo	CPD	LRIP	LRIP
Targets										
Lethal / ISR UAS	UAV 2	UAV 3	ISR UAV 4 MALE	ISR UAV 5						
Tactical Targets		E/O ASCM		Attach Craft Topsides		Small Boat Rockets		GBAD DRM Target 1		
CRAM/Warheads	Mortars									
ASCM and TBM			Missile Target 1				Missile Target			
Functions										
Effects Tests	Seeker & E/O Components		Drone UAV/ISR	Full Target UAV		FNC target / Components				
Analysis Tools	Complex Target VM	Tactical UAS VM 2	Missile VM 1	UAS VM 3			Missile VM 2	Tactical VM		
Aimpoint Module			Proto UAV Aimpoint				Ship System Combat Module 1	GBAD Combat Module 1		

GBAD Master POA&M