Railgun Overview & Testing Update

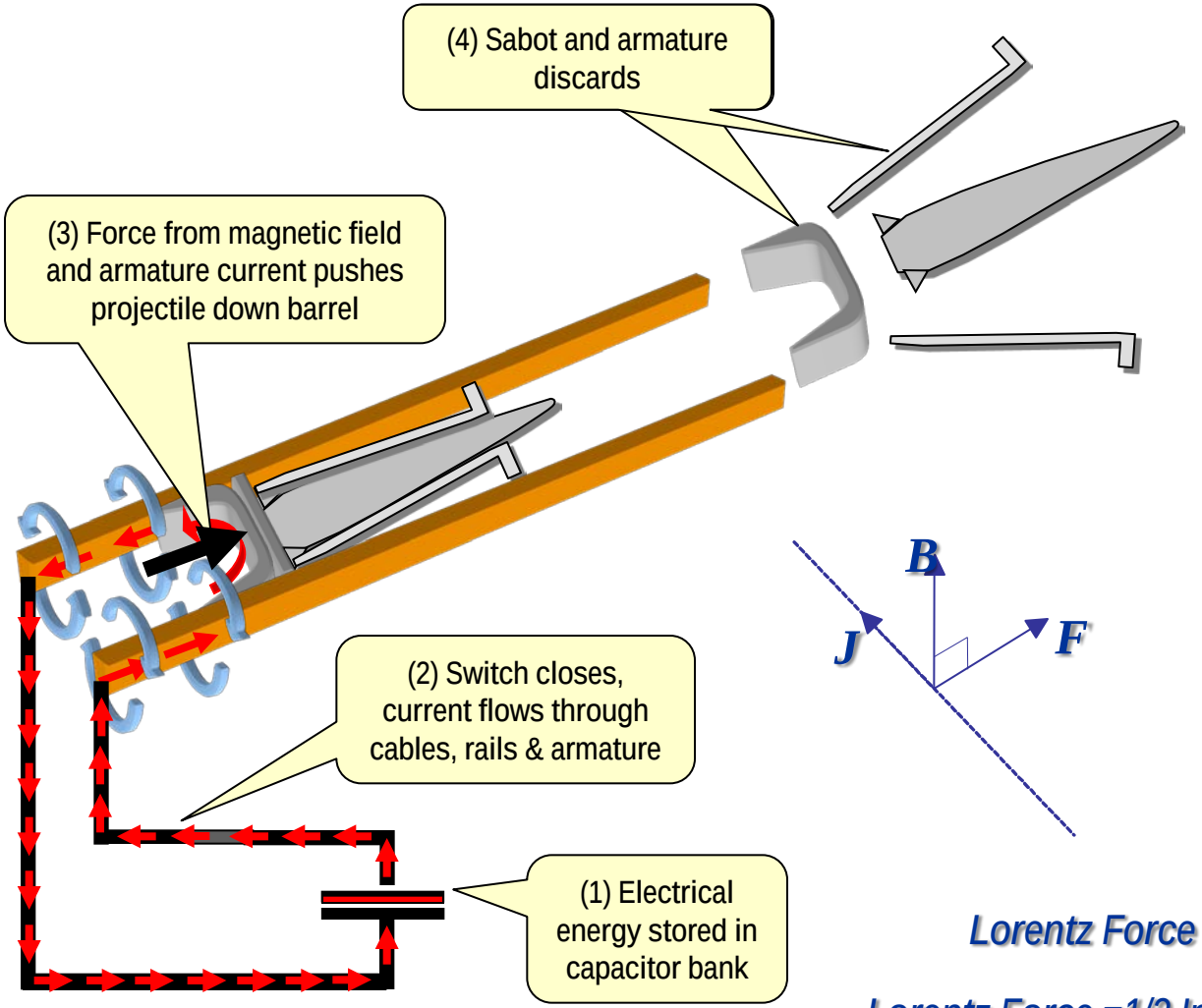
NDIA Joint Armaments Conference:
Unconventional & Emerging Armaments Session

16 May 2012

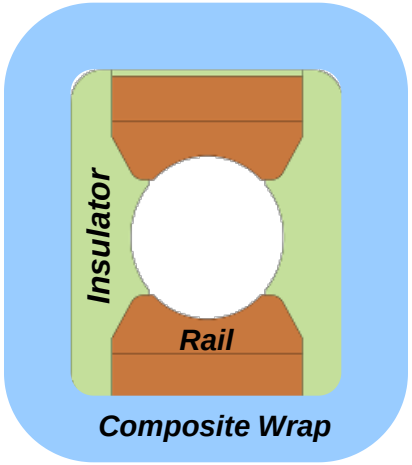
Mr. Charles R. Garnett
Program Manager, NSWC Dahlgren

How Railgun Works

Operating Principle



Cross-Section



Lorentz Force = Current (J) X Magnetic Field (B)
or
*Lorentz Force =1/2 Inductance Gradient (L') * Current (I)^2*

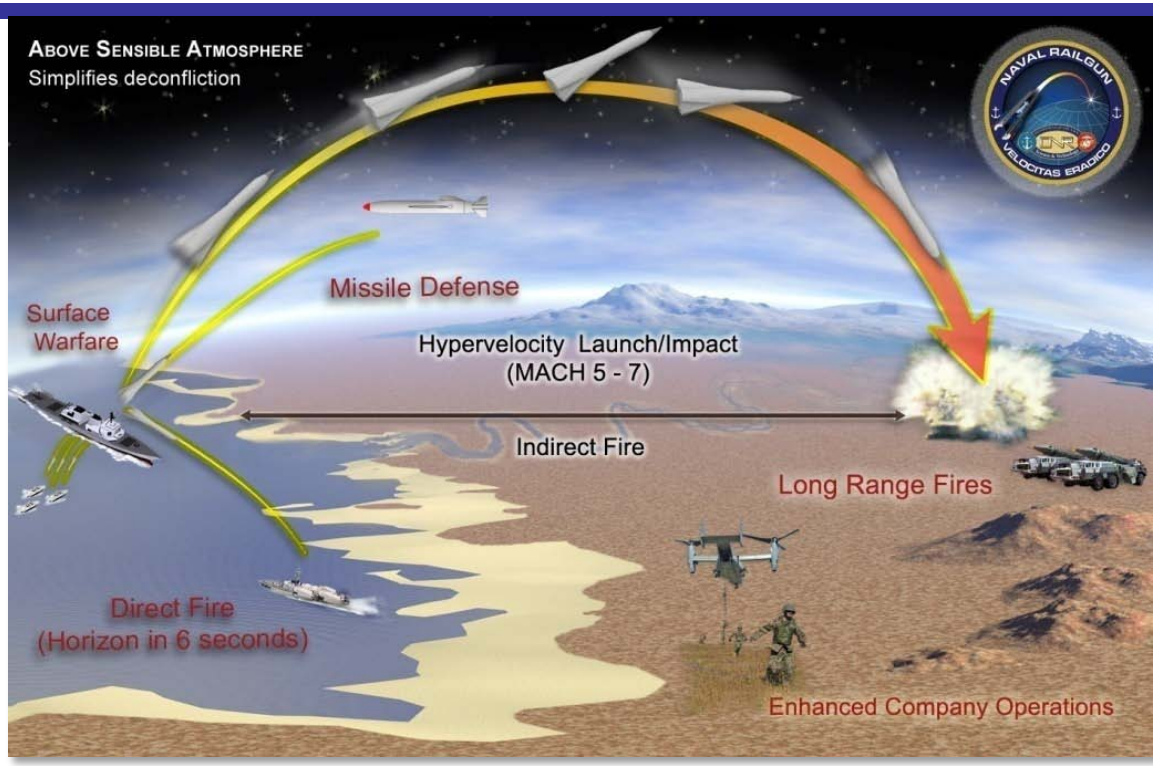
32MJ World Record Event

EMLF Dahlgren, VA – Dec 2010

Distribution A:
Approved for Public Release
Distribution is Unlimited

Railgun Operational Impact

- *Wide Area Coverage*
  - Increased speed to target
- *Reduces Cost per Kill*
  - Lower Unit Cost
  - Lower handling cost
- *Enhances Safety*
  - No risk of sympathetic detonation
  - Simplified storage, transportation and replenishment
  - Reduced collateral damage
  - No unexploded ordnance on battlefield
- *Reduces Logistics*
  - Eliminates gun powder trail
  - Deep magazines

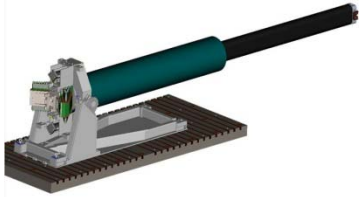


- *Multi-Mission Capability*
  - *Surface Warfare*
  - *Missile Defense*
  - *Long Range Fires*
  - *Direct Fire*
  - *ASuW*

Multi-Mission Capable for Offense and Defense

Naval Railgun – Key Elements

Launcher



BAE

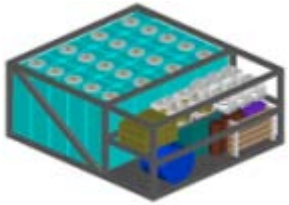
GA

- Multi-shot barrel life
- Barrel construction to contain rail repulsive forces
- Scaling from 8MJ (state of the art) to 32MJ
- Thermal management techniques
- M&S – Represent interaction between bore and projectile

Projectile

- Dispensing and Unitary Rounds
- Gun launch survivability
  - 20-45 kG acceleration
  - Thermal Risk Management
- Hypersonic guided flight for accuracy
- Lethality mechanics

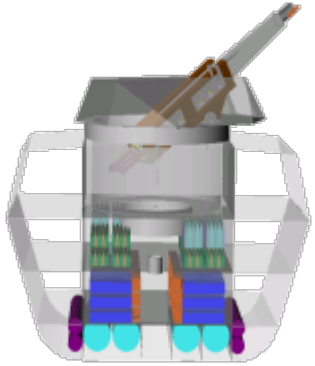
Pulse Forming Network (PFN)



Capacitors

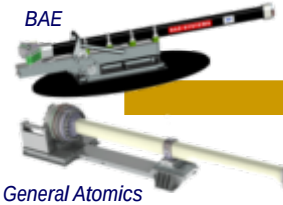
- Energy Density
- Rep rate operation & thermal management
- Switching

Ship Integration



- Dynamic Power Sharing
- Space and Weight
- Thermal and EM Field Management

EM Railgun INP Phase I

	FY05	FY06	FY07	FY08	FY09	FY10	FY11
Milestones		Program Initiation August 2005	Initial 8MJ Test Capability	World Record Launch 10MJ	Initial 16MJ Test Capability	S&T Go No-Go Decision Point	
Launcher Bore Life Development				32MJ Lab Gun Bore Life Development		32 MJ Launcher 100 Shot Bore Life Demo	
Advanced Containment Development	3 Concept Designs	Demo Selections	 BAE General Atomics	Technology Development and Preliminary Design	Detail Design	Fabrication	32 MJ Launcher 100 Shot Bore Life Demo
Pulsed Power System Development			For Launcher Testing 100MJ Capacitor Bank	 General Atomics 	Alternative Studies Rep Rate Capacitor Test Bed	 Pulsed Power Recommendation	
Integrated Launch Package Development	 Boeing Draper Government Concept Trades		Projectile Baseline Design & Critical Component Development	Unitary Lethality Demo	Baseline Design Dispense Demo	Critical Component Demos	Integrated Launch Package (ILP) Demos

Progress FY05 – FY11

Lab Launcher

GA Med-Cal Blitzer

Rep-Rate Test Bed

BAE 5M Prototype

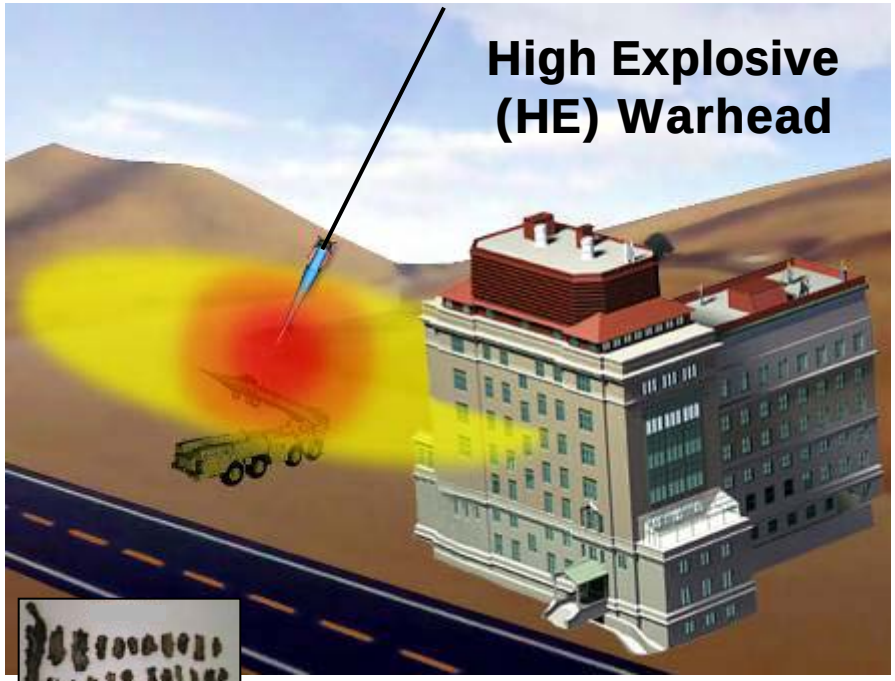
Dispense Test

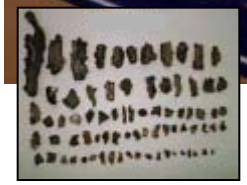
- Muzzle energy:
  - From 6MJ to 32MJ
- Bore Life
  - From 10s to 100s
  - Multiple configurations & materials
- Industry Launcher Prototypes
  - From concept to hardware
- Pulsed power
  - 2.5X increase in energy density
  - Multi-shot capable design
- Projectile
  - From slugs & sand catch
  - Flight bodies on open range
- Mission
  - From Land Attack
  - To Multi-Mission Initiative

Industry Launcher Prototypes

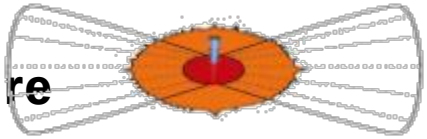
BAE Systems ACL
Full Cross Section, Half Length (5m)

HE versus KE Projectiles

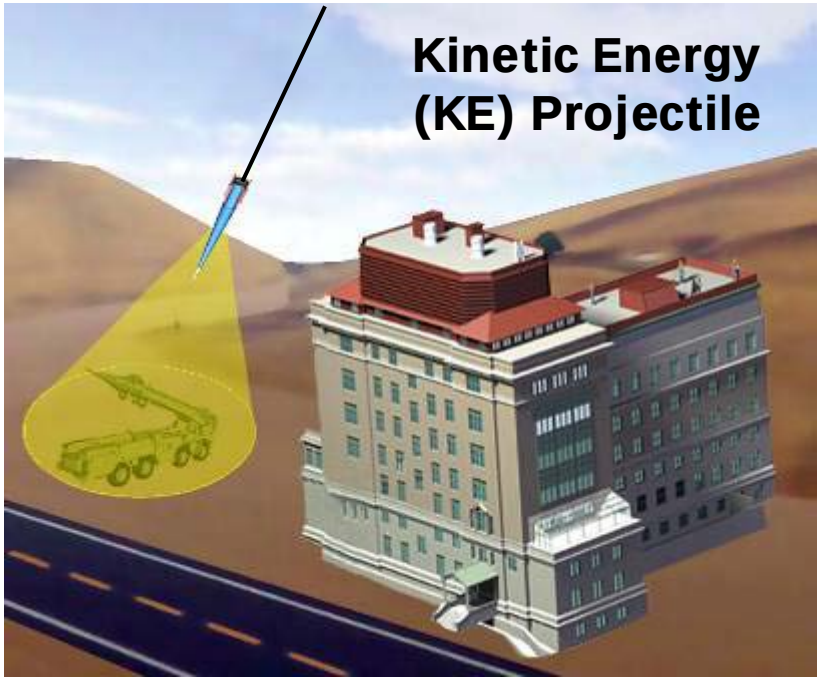




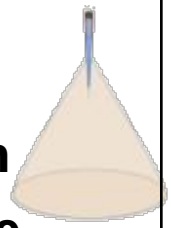
Non-uniform frags



- Blast Overpressure
- Large Area of Fragment Spray
- High Collateral Damage



Uniform frags



- No Blast Overpressure
- Focused Fragment Pattern
- Minimal Collateral Damage

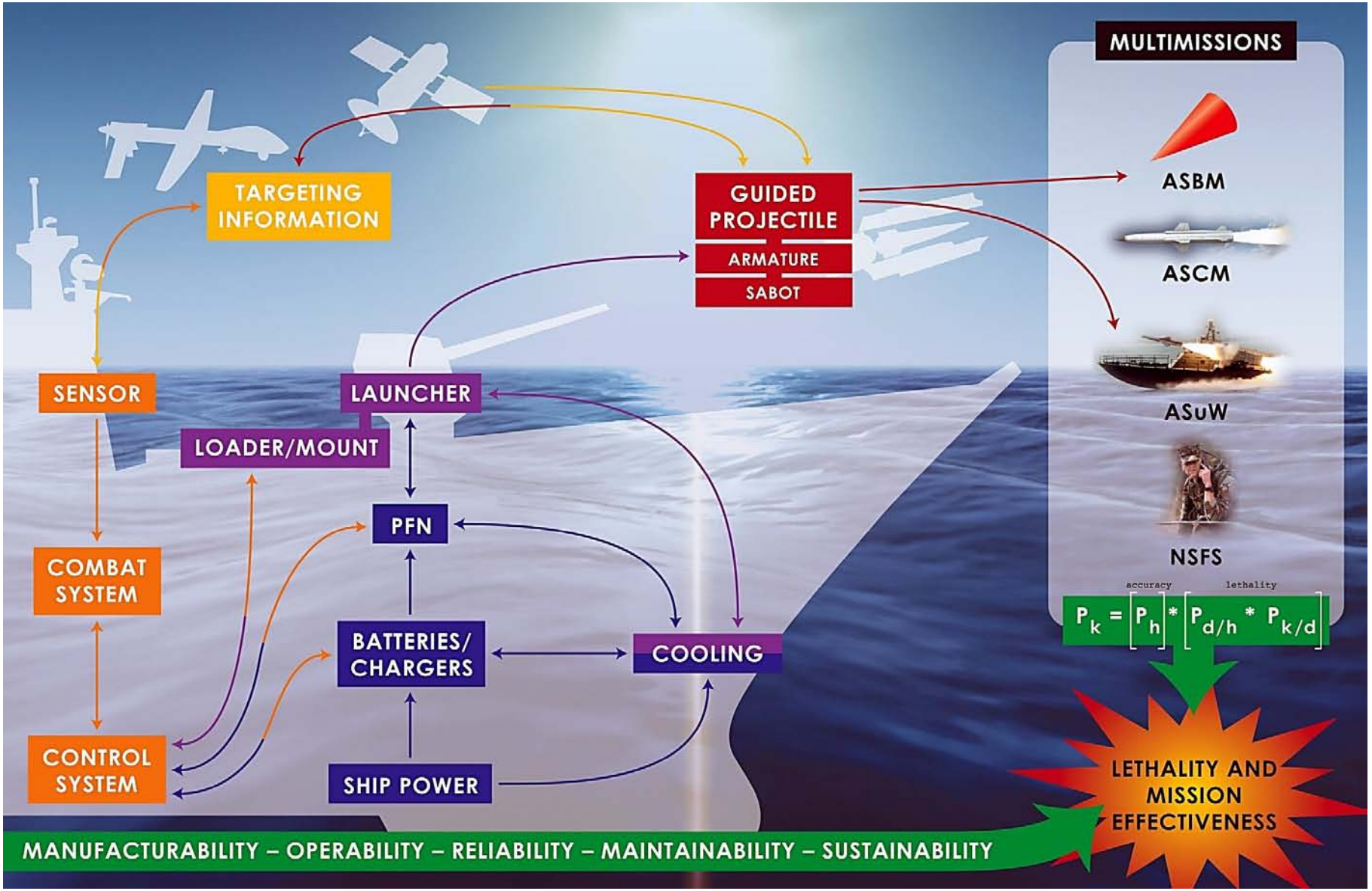
UNCLASSIFIED

Projectile Dispense

Power & Energy

Pulsed Power at the Electromagnetic Launch Facility, Dahlgren, VA

Railgun System



EM Railgun INP Phase II

	FY12	FY13	FY14	FY15	FY16	FY17
Rep-Rate Pulsed Power	 Prototype	Fabrication & Install				Demo
Rep Rate Lab Launcher with Auto-Loader	 Design	Fabrication & Install		Initial Rep-Rate	 Rep-Rate Demo (Enables 100+ NM application)	
	 5MJ Rep-Rate Testing					
Rep Rate Industry Launcher	 Concept Design		Preliminary – Detail Design and Fabrication		 Industry Launcher Rep-Rate Demo	

INP II Focused on Rep-Rate and Thermal Management

Summary

- Naval EM Railgun is a “Navy after Next” Game Changer

- Risk Mitigation
  - Barrel Life Development
  - Advanced Containment Launchers – Competitive solutions
  - Critical Projectile Components
  - Understanding Ship and Weapons System Integration Requirements

Challenges Understood and Being Addressed

Contact Information

Mr. Charles R. Garnett (Program Manager)
Naval Surface Warfare Center, Dahlgren
6210 Tisdale Road, Suite 134
Dahlgren, VA 22448
(540) 653-7113
charles.r.garnett@navy.mil

Ms. Vanessa Lent
Naval Surface Warfare Center, Dahlgren
6210 Tisdale Road, Suite 134
Dahlgren, VA 22448
(540) 653-1478
vanessa.lent@navy.mil