Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Navy											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 2: *Applied Research*					R-1 ITEM NOMENCLATURE PE 0602114N: *Power Proj Applied Research*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013[#]**	**FY 2014 Base**	**FY 2014 OCO [##]**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	98.452	89.189	104.513	-	104.513	83.428	113.997	131.055	179.199	Continuing	Continuing
0000: *Power Proj Applied Research*	0.000	98.452	89.189	104.513	-	104.513	83.428	113.997	131.055	179.199	Continuing	Continuing

[#] FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

[##] The FY 2014 OCO Request will be submitted at a later date

Note

FY 2013 funding associated with Future Naval Capability (FNC) efforts are transferring to a new Program Element titled Future Naval Capabilities Applied Research (PE 0602750N). This is to enhance the visibility of the FNC Program by providing an easily navigable overview of all 6.2 FNC investments in a single location.

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (Sep 2011). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE supports both advanced technology research and near to mid-term transition opportunities. The advanced research focus is primarily on High Energy Lasers (HEL), Electromagnetic railgun development, high speed weapon propulsion, and electro-optic/infrared (EO/IR) sensor technologies.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

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B. Program Change Summary ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014 Base**	**FY 2014 OCO**	**FY 2014 Total**
Previous President's Budget	104.796	89.189	86.793	-	86.793
Current President's Budget	98.452	89.189	104.513	-	104.513
Total Adjustments	-6.344	0.000	17.720	-	17.720
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-2.715	0.000			
• SBIR/STTR Transfer	-3.629	0.000			
• Program Adjustments	0.000	0.000	-5.170	-	-5.170
• Rate/Misc Adjustments	0.000	0.000	22.890	-	22.890

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Navy			DATE: April 2013
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COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
0000: *Power Proj Applied Research*	0.000	98.452	89.189	104.513	-	104.513	83.428	113.997	131.055	179.199	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project addresses the technology issues involving the Navy's capability to project naval power on the broad seas and in the littoral regions.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: DIRECTED ENERGY	50.477	31.686	40.350

Description: The goal of this activity is to develop Directed Energy (DE) technology for Navy applications. The DE program addresses the requirements of future Navy combatants to provide ship defense against the emerging threats that are proliferating throughout the Navies of the world. The Directed Energy portion of this activity consists of two elements. The first element involves applied research and development of technologies supporting advanced accelerators with applications to directed energy weapons. This activity also includes the Free Electron Laser (FEL) Innovative Naval Prototype (INP) which will deliver multi-mission capability.

FY 2012 to FY 2013 decrease in funding is primarily due to a revised directed energy portfolio focused on a diversified approach. FY 2013 to FY 2014 increase in funding is due to increased work on the Solid State Laser (SSL) program.

FY 2012 Accomplishments:

Directed Energy and Accelerator Research:

-Continue cryomodule and FEL component development at the FEL testing and integration facility.

-Continue investigation into the application of FEL technology to other areas including advanced materials, optics, bioscience, medical, manufacturing, weaponization, and solid state physics.

-Continue 1 micron filamentation, halo limitation, and short Rayleigh range studies.

-Continue testing of Radio Frequency (RF) gun High Voltage Power Supply (HVPS) components which are required for the 100 kW high current injector.

-Continue applied directed energy and accelerator research in: Compton radiation scattering, multiple dielectric thin film coatings, bunch characteristics of electron beam emittance, high grade electromagnetic field generators, electron beam lattice configuration, novel electron beam generation, novel high flux subatomic particle emission, high gain photonic amplification, fundamental power efficiency conversion.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Navy		DATE: April 2013
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
-Continue the development of physics based models for: characterization of subatomic particle interaction and propagation and modeling for validation of photon control structures. -Continue development of components required for the successful testing of the 100 kW FEL, to support the scale up of the 100 kW FEL into a megawatt class weapon, and to reduce the overall footprint of the system to support the eventual ship integration of the FEL, including normal conducting and super conducting RF electron beam injectors, advanced high power cathode technologies, high power compact amplifiers, and advanced mirrors, coatings and optical components capable of handling the significantly higher energies that are present in a 100 kW level FEL. -Complete execution of Phase 1B of 100 kW FEL demonstration program. -Initiate Phase II of the 100 kW FEL program. Phase II will include the fabrication, integration, and acceptance testing of a 100 kW FEL system. Applied Electromagnetics for High Power Weapons: -Continue a program to conduct applied research into applied electromagnetics as it relates to lasers, high power microwaves, and advanced sensors for Directed Energy Weapons. -Initiate the development of Gallium Nitride as an advanced nonlinear optic material.			
FY 2013 Plans: Directed Energy and Accelerator Research: -Continue all efforts of FY 2012 unless completed above. Applied Electromagnetics for High Power Weapons: -Continue the development of Gallium Nitride as an advanced nonlinear optic material. -Complete applied research into applied electromagnetics as it relates to lasers, high power microwaves, and advanced sensors for Directed Energy Weapons. Solid State Laser - Technology Maturation (SSL-TM): -Initiate the development of technologies suitable for a solid state laser weapon system, including technologies for maritime beam director, targeting and laser subsystems, which are capable of supporting future Navy missions to defeat small boat swarms, UAV swarms, and provide potential ISR disruption and/or defeat. This work supports future prototype developments and will include laser subsystem (potentially both slab and fiber solid state systems) and required beam director scientific studies. The focus of the effort will be to support the development and advancement of future Navy Solid State Laser prototypes, including the development of lethality studies and atmospheric characterization. These scientific studies are critical to understand and support missions identified for a layered defensive capability, in the maritime environment, which shall include robust modeling and simulation of atmospheric absorption and turbulence.			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
-Initiate and conduct lethality testing for notional designs of proposed solid state laser designs. This will include scientific studies of laser erosion, pitting, and ablation of various target materials for improved modeling and simulation, that will support development of the governing technical requirements for a beam director and targeting system capable of performing Navy surface ship self defense missions. -Initiate and conduct studies of atmospheric absorption and turbulence, suitable for use to evaluate notional maritime beam director subsystems, and shall include studies in adaptive optics for improved lethality performance in low altitude, maritime surface conditions. These scientific studies are critical to understanding the impact of boundary layer and sea-water-air turbulent mechanics on future laser weapons systems and interfaces. -Initiate and conduct trade studies on innovative solid state laser subsystems designs, based off industry available technologies or those technologies which are supported through planned investments by the High Energy laser Joint Technology Office (HEL JTO). These investments will be considered "break through" type of investments, which require additional scientific study to determine their potential for near term capability improvements in a future naval prototype system. -Initiate and conduct scientific studies on laser subcomponents, including laser pump diodes and laser gain media, which have the potential to support future acquisition programs, but are based in a solid state laser technologies. Efforts in this area will focus on emerging commercial technologies and government sponsored research, which are suitable for use in a maritime domain. Research and technology developments will include advancements suitable for use by either solid state slab or solid state fiber optic laser subsystems - and which if matured, would enable rapid scientific advancements and improve specific systems performance in identified key performance parameters. -Initiate and conduct scientific trade studies of notional predictive avoidance systems, which examine the control interfaces between sensors and future prototypical naval laser weapons, which would provide an inherent "safe-arm" function for the projecting of laser power at long range (potentially beyond typical visible, line of sight distances.) Of particular concern is the designs for safety in future laser weapons to halt laser energy propagation, while performing Navy surface ship self defense missions, and avoid inadvertent illumination of non-threat forces (e.g. friendly sensors or platforms.)			
FY 2014 Plans: Directed Energy and Accelerator Research: -Continue all efforts of FY 2013. Applied Electromagnetics for High Power Weapons: -Continue all efforts of FY 2013 unless completed above. Solid State Laser - Technology Maturation (SSL-TM): -Continue all efforts of FY 2013.			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
-Initiate land based testing and evaluation of SSL Advanced Beam Director prototypes which have been ruggedized and suitable for long term exposure to a maritime environment as will be seen by naval combatants.			
Title: HIGH SPEED PROPULSION AND ADVANCED WEAPON TECHNOLOGIES	1.857	18.134	16.427
Description: The high speed weapons work in this activity is focused on demonstrating propulsion and vehicle technologies for Mach3+ to Mach8 capable weapons. The solid rocket motor Integrated High Performance Rocket Propulsion Technology (IHPRPT) development activities will provide improved rocket based weapon performance. The rocket technologies apply to both air dominance and strike weapons and will provide both improved range and speed. This work includes technologies associated with high acceleration capable projectile structures, high temperature and high strength materials to enable projectiles to survive high speed launch environment, improved thermal prediction methodologies and test techniques, wide dynamic pressure adaptable projectile controls and non-explosively launched lethal mechanisms. The high speed projectile technologies are intended to support long range Naval Surface Fire Support weapons. FY 2012 to FY 2013 increase is primarily due to increased work to develop a projectile capable of surviving high G/High Temperature environments. FY 2013 to FY 2014 decrease is due to reduced efforts for ship integration. ***FY 2012 Accomplishments:*** -Continue high speed projectile technology development. -Continue effort to develop advanced guidance and control technologies for high speed weapons. -Initiate investigations into advanced material solutions to high speed airframes and air systems operating in maritime environments. Areas of research will include advanced lightweight structures, high thermal conductivity materials, corrosion resistant components and systems, and high temperature resistant materials and structures. -Initiate high speed propulsion and integrated airframe technology development to enhance system range, responsiveness and reliability. ***FY 2013 Plans:*** -Continue all efforts of FY 2012. -Initiate high temperature capable thermal management, insulator and ablative technology investigations. ***FY 2014 Plans:*** -Continue all efforts of FY 2013. -Initiate technology maturation of advanced airframes and controls, high gee components and miniaturization of electronics.			
Title: NAVIGATION, ELECTRO OPTIC/INFRARED (EO/IR), AND SENSOR TECHNOLOGIES	3.034	8.841	4.432

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014

Description: This activity describes Navy Science and Technology (S&T) investments in the areas of EO/IR devices and advanced sensors and includes investment/performance in the technology areas of Electronics, Electronic Warfare, and Communications.

FY 2012 to FY 2013 increase is due to initiation of the RF EW payload effort for compact Land Attack Unmanned Aerial System (LA UAS) related to the Netted Emulation of Multi-Element Signatures against Integrated Sensors (NEMESIS) technology launch.

The decrease from FY 2013 to FY 2014 is due to transfer of funding and associated efforts supporting the NEMESIS development of RF EW payloads for unmanned aerial systems to PE 0602271N, and transfer of NEMESIS development of distributed control, coordination, and networking of payloads and platforms to PE 0602235N.

FY 2012 Accomplishments:
Electro Optic/Infrared:
-Continue effort to develop power scaling of interband and quantum cascade lasers for mid-wave and long-wave infrared spectral bands.

Electronic Warfare:
-Continue development of ultra low noise uncooled nanotechnology infrared sensors.
-Continue development nanoatomic sensor nonvolatile memories.
-Continue development of electronic field of view and zoom imagers.
-Continue the development of an active optics system that can survey a wide area and instantly, non-mechanically zoom-in on an area of interest for target tracking/identification.
-Continue development of new processes/methodologies to enable construction of composite countermeasures that fit the engagement timeline while maintaining effectiveness against existing and emerging IR guided threats.
-Continue effort to develop mid & long wave IR focal plane arrays using graded-bandgap W-type-II. Superlattices with much higher detectivity than that of state-of-the-art HgCdTe (MCT).
-Initiate development and prove a method of more efficiently transporting EW sensors using a low Reynolds Number regime boundary layer control system.

FY 2013 Plans:
Electro Optic/Infrared:
-Complete effort to develop power scaling of interband and quantum cascade lasers for mid-wave and long-wave infrared spectral bands.

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Electronic Warfare: -Continue all efforts of FY 2012. -Complete evaluation of long-range power beaming capabilities using high-power CW fiber lasers and advanced laser power converters to increase the flight duration and operational capabilities of EW UAVs. -Complete the development of technologies for autonomous in-flight reconfiguration to increase flight endurance of EW UAS. -Complete effort to develop germanium optical detectors on silicon substrates for high power density, high frequency applications. -Initiate efforts for LA - Unmanned Aerial System (UAS) Based EW: The objective is to develop a System of Systems (SoS) able to artificially create the appearance of a realistic naval force to many adversary surveillance and targeting sensors simultaneously. It will benefit the warfighter by providing battlespace confusion to adversary surveillance and targeting systems both above and below water, creating seamless cross-domain countermeasure coordination, and enabling rapid advanced technology/capability insertion to counter emerging threats. Technology developments will include reconfigurable and modular EW payloads, Distributed Decoy and Jammer Swarms (DDJS), effective acoustic countermeasures (CM), and Multiple Input/Multiple Output Sensor/CM (MIMO S/CM) for false force generation to both above and below water sensors. ***FY 2014 Plans:*** Electronic Warefare: -Continue all efforts of FY 2013 unless completed above. -Complete development and prove a method of more efficiently transporting EW sensors using a low Reynolds Number regime boundary layer control system.			
Title: STRIKE AND LITTORAL COMBAT TECHNOLOGIES ***Description:*** The focus of this activity is on those technologies that will support Naval Precision Strike Operations and provide the Navy of the future the ability to quickly locate, target, and strike critical targets ashore. FY 2012 to FY 2013 decrease is due to the funding associated with Future Naval Capability (FNC) efforts being transferred to a new Program Element titled Future Naval Capabilities Applied Research (PE 0602750N). This is to enhance the visibility of the FNC Program by providing an easily navigable overview of all 6.2 FNC investments in a single location. ***FY 2012 Accomplishments:*** Increased Capability Against Moving and Stationary Targets: -Complete the (DASH) and (MMSS) projects. -Initiate development of multistatic electronic protection techniques against advanced jamming systems. Enhanced Weapon Technologies:	19.999	0.706	0.769

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
-Continue three new products to expand current Counter Air / Counter Air Defense capabilities by providing improved range and end-game maneuverability while decreasing Time-of-Flight. Specific tasks to begin design and development phase are: Counter Air Advanced Medium- Range Air-to-Air Missile (AMRAAM) Improvements / Counter Air Defense / Improvement / High Speed Components. -Continue development and apply emerging technologies that support delivery of Technology Oversight Group approved FNC enabling capabilities structured to close operational capability gaps in power projection; package emerging power projection technologies into deliverable FNC products and ECs that can be integrated into acquisition programs within a five year period; and mature power projection technologies that support naval requirements identified within the Sea Strike and FORCEnet naval capability pillars. Strike Accelerator: -Continue Strike Accelerator program. This effort will provide an advanced airborne capability to accurately identify targets using Advanced Target Recognition (ATR). These capabilities are utilizing the F/A-18 E/F, AESA (Active Electronically Scanned Array) Radar and ATFLIR (Advanced Targeting Forward Looking Infrared) sensors. Multi-Target Laser Designator: - Continue research for advanced optical techniques to defeat SWARM attacks. Selectable Output Weapon: - Continue Selectable Output Weapon Sea Strike Project High Energy Fiber Laser System: - Initiate development an advanced laser beam control, pointing mechanism and power subsystem to support an airborne laser weapon system. This system will provide the detection and defeat of current and future threats. ***FY 2013 Plans:*** -Continue all efforts of FY 2012 unless completed above. -Initiate the development and demonstration of new Electronic Protection (EP) techniques that can discriminate advanced jamming false targets from true targets and also suppress false targets so that true targes can be readily detected. ***FY 2014 Plans:*** -Continue all efforts of FY 2013.			
Title: WMD DETECTION	8.512	3.988	1.955

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Description: The Chief of Naval Operations (CNO) in the Navy Strategic Plan (NSP) has directed that the Navy be able to combat Weapons of Mass Destruction (WMD) at sea and Maritime domain. This activity addresses the development of key technologies for standoff detection of WMD's and component nuclear materials on ships at sea. The program will develop and demonstrate technology for actively detecting fissile material and other weapons of mass destruction. FY 2012 to FY 2013 funding decrease is due to the completion of the test exercises and re-alignment of funds for higher priority requirements. FY 2013 to FY 2014 decrease is due to realignment of funds to high priority requirements. ***FY 2012 Accomplishments:*** Weapons Mass Destruction Detection: -Continue modeling and simulation efforts to determine the ability to use neutron activation analysis to locate smuggled nuclear weapons and material through underwater detection. -Continue using particle beam (neutrons, gamma rays, muons, and others) to perform standoff detection of fissile material. -Continue development of hand held and portable detector technology for maritime interdiction. -Continue the development of technologies for remote real time imaging of suspected WMD in a maritime environment for both Passive Detection and Active Interrogation, including laboratory and field testing. -Continue the development of technology for and conduct radiological WMD Detection from Naval aviation platforms. -Complete investigations into the use of Free Electron Laser (FEL) accelerator technologies for the detection of WMD's and nuclear components & materials. Conducted experiments to determine the ability of the FEL to perform remote detection of nuclear material on surfaces, and chemical biological agents in aerosol clouds. -Complete standoff detection of fissile materials with a demonstration in a maritime environment from a suitable Naval vessel or surrogate. Demonstration will involve a team from DoD, Department of Energy (DOE), interagency, and academia partners to support the full demonstration. -Complete examination of system human dose limits and health effects of various Remote Stand Off Detection techniques. -Complete the acquisition of WMD Special Nuclear Materials (SNM) simulator from DOE. -Complete the technical development and testing of solid state high energy neutron detector without Helium 3. -Complete a laboratory demonstration of short range active interrogation for WMD detection. -Complete the development of technology for "at sea" testing of in-water radiological WMD Detection from unmanned underwater vehicles (UUVs). -Complete the development of a compact Neutron Generator without need for cryogenic cooling. Detection from unmanned underwater vehicles (UUVs).			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
-Initiate the development of a compact Neutron Generator without need for cryogenic cooling. -Initiate the development of technology for and conduct radiological WMD Detection from Naval aviation platforms. -Initiate examination of system human dose limits and health effects of various Remote Stand Off Detection techniques. -Initiate acquisition of WMD Special Nuclear Materials (SNM) simulator from DOE. -Initiate high fidelity field testing. ***FY 2013 Plans:*** -Continue all FY 2012 plans unless completed above. -Complete radiological testing and active interrogation -Initiate testing of 3 Helium free silicon based replacement radiological detectors -Initiate field experiments for Passive Interrogation of SNM stimulants using UUV's ***FY 2014 Plans:*** -Continue all FY 2013 plans unless stated as completed. -Complete field experiments for Passive Interrogation of SNM stimulants using UUV's			
Title: ELECTROMAGNETIC GUNS	14.573	25.834	40.580
Description: This activity is the Electro Magnetic (EM) railgun program that is focused on developing the technology to launch a long range projectile from Navy ships. EM railgun is being considered for multi-mission applications including USMC Naval Surface Fire Support, anti-surface warfare (ASUW) and ship self defense from missiles and small boat threats. FY 2012 to FY 2013 increase is a planned realignment from the 0603114N PE as the EM gun program Phase II efforts initiate. FY 2013 to FY 2014 increase is due to planned pulsed power development and fabrication required to support repetitive rate testing. ***FY 2012 Accomplishments:*** -Continue launcher and projectile development. -Continue material, physics and thermal property research for single shot launchers, pulsed power and projectiles for 32MJ muzzle energy launch; and initiate assessments from next generation, rep rate, and operational environments. -Continue IPT and Bore Life Consortium collaborations for 32 MJ launchers. -Complete lethality studies of projectile. -Complete design studies of next generation pulse power systems. -Complete analysis to verify the models and simulations correlate to results achieved in single shot testing for launchers, pulsed power and			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
projectiles at 32MJ launch. -Complete analysis of modeling and simulation capability to support bore life development and testing for single shot bore life assessments. -Initiate material applications and component design assessments for next generation repetitive fires ***FY 2013 Plans:*** -Continue all FY 2012 efforts unless completed above. -Initiate development of modeling and simulation capability to support bore life development and testing for rep rate bore life development assessments ***FY 2014 Plans:*** -Continue all FY 2013 efforts. -Initiate additional next generation pulsed power fabrication as part of a multi-module, multi-year build to increase full scale rep rate capability from 20MJ to 32MJ muzzle energy capability.			
Accomplishments/Planned Programs Subtotals	98.452	89.189	104.513

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

This PE develops early components technologies that can be integrated into weapon systems that meet warfighter requirements. Most of the work in this PE can be classified between Technology Readiness Level (TRL) 2 (technology concept and/or application formulation) and TRL 4 (component and/or breadboard validation in laboratory environments). The metrics used to evaluate 6.2 programs are necessarily less precise than those used in 6.3 programs.

The metrics for this PE can be divided into two categories: technological and organizational/functional. Technological metrics address the success of the work performed. The primary technological metrics used in this PE involve laboratory experiments/tests demonstrating proof of the concept for the technology. This demonstration is frequently a hand-assembled functioning breadboard of the concept. The organizational/functional metrics applied to this PE include: transition of the technology to advanced development in a 6.3 PE and applicability of the technology to documented warfighter problems or requirements. Successful implementation of these categories would result in the application of a pass/fail metric and further evaluation for possible transition to a 6.3 development/demonstration program.