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Exhibit R-2, RDT&E Budget Item Justification: PB 2012 Navy **DATE:** February 2011

APPROPRIATION/BUDGET ACTIVITY			R-1 ITEM NOMENCLATURE								
1319: <i>Research, Development, Test & Evaluation, Navy</i> BA 4: <i>Advanced Component Development & Prototypes (ACD&P)</i>			PE 0603573N: <i>Advanced Surface Machinery Sys</i>								
COST (\$ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
Total Program Element	17.319	5.459	18.249	-	18.249	28.345	25.745	18.654	15.651	Continuing	Continuing
2471: <i>Integrated Power Systems (IPS)</i>	5.370	5.459	18.249	-	18.249	28.345	25.745	18.654	15.651	Continuing	Continuing
9999: <i>Congressional Adds</i>	11.949	-	-	-	-	-	-	-	-	0.000	11.949

A. Mission Description and Budget Item Justification

The Electric Ship Office (ESO) is responsible for developing and executing the Next Generation Integrated Power System (NGIPS) Technology Development Roadmap (TDR) and transition plans, as well as providing power system solution alternatives to new and existing platforms. The ESO's initial efforts are to coordinate the ongoing electric power efforts of the PEOs and Office of Naval Research, establish the technical basis and strategic direction for Naval power system architectures, develop decision making tools, and establish technical standards.

This PE funds the development of specific and future electric ship technologies for all future surface ships, with the focus on integrated power systems, which provide total ship electric power, including electric propulsion, power conversion and distribution, and combat system and mission load interfaces to the electric power system.

B. Program Change Summary (\$ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Previous President's Budget	20.553	5.459	5.408	-	5.408
Current President's Budget	17.319	5.459	18.249	-	18.249
Total Adjustments	-3.234	-	12.841	-	12.841
• Congressional General Reductions		-			
• Congressional Directed Reductions		-			
• Congressional Rescissions	-	-			
• Congressional Adds		-			
• Congressional Directed Transfers		-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.194	-			
• Program Adjustments	-	-	12.930	-	12.930
• Section 219 Reprogramming	-0.012	-	-	-	-
• Rate/Misc Adjustments	-	-	-0.089	-	-0.089
• Congressional General Reductions	0.012	-	-	-	-
Adjustments					
• Congressional Add Adjustments	-3.040	-	-	-	-

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APPROPRIATION/BUDGET ACTIVITY
 1319: *Research, Development, Test & Evaluation, Navy*
 BA 4: *Advanced Component Development & Prototypes (ACD&P)*

R-1 ITEM NOMENCLATURE
 PE 0603573N: *Advanced Surface Machinery Sys*

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: 9999: *Congressional Adds*

- Congressional Add: *Integrated Power System Dense Harmonic Filter Design*
- Congressional Add: *High Density Power Conversion and Distribution Equipment*
- Congressional Add: *Surf Combatant Hybrid Propulsion/Power Generation*
- Congressional Add: *Next Gen Shipboard Int Pwr Fuel Efficiency Enhancer*
- Congressional Add: *Integrated Advanced Ship Control (IASC)*

Congressional Add Subtotals for Project: 9999

Congressional Add Totals for all Projects

	FY 2010	FY 2011
	1.593	-
	1.195	-
	6.373	-
	1.593	-
	1.195	-
Congressional Add Subtotals for Project: 9999	11.949	-
Congressional Add Totals for all Projects	11.949	-

Change Summary Explanation

FY12: Added funds (\$12.2M) to project 2471 for Tactical Energy Investments.

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Exhibit R-2A, RDT&E Project Justification: PB 2012 Navy								DATE: February 2011			
APPROPRIATION/BUDGET ACTIVITY 1319: <i>Research, Development, Test & Evaluation, Navy</i> BA 4: <i>Advanced Component Development & Prototypes (ACD&P)</i>				R-1 ITEM NOMENCLATURE PE 0603573N: <i>Advanced Surface Machinery Sys</i>				PROJECT 2471: <i>Integrated Power Systems (IPS)</i>			
COST (\$ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
2471: <i>Integrated Power Systems (IPS)</i>	5.370	5.459	18.249	-	18.249	28.345	25.745	18.654	15.651	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0		

A. Mission Description and Budget Item Justification

This project supports the Integrated Power Systems (IPS) program. IPS provides total ship electric power, including electric propulsion, and power conversion and distribution. The DDG 1000 will be an electric drive ship with an integrated power architecture. USS Makin Island (LHD 8) integrates an electric auxiliary propulsion motor for low speed operations and mechanical drive for higher speed operations. IPS reduces acquisition and operating costs of naval ships and increases military effectiveness. IPS leverages investments in technologies that will be useable by both military and commercial sectors.

IPS has the potential to revolutionize the design, construction, and operation of U.S. naval ships by using electricity as the primary energy transfer medium aboard ship. The flexibility of electric power transmission allows power generating modules with various power ratings to be connected to propulsion loads and ship service in any arrangement that supports the ship's mission at lowest overall cost. Systems engineering in IPS is focused on increasing the commonality of components used across ship types and in developing modules which will be integral to standardization, zonal system architectures, and generic shipbuilding strategies. The purpose of increased commonality is to reduce the total cost of ship ownership by using common modules composed of standard components and/or standard interfaces.

IPS addresses ship platform program goals through: reduced ship acquisition cost through integration of propulsion and ship's service prime movers; lower ship operational costs resulting from more flexible operating characteristics and more efficient components; reduced ship construction costs by allowing more extensive modular construction of power generation, distribution, and loads; improved ship survivability and reduced vulnerability through increased arrangement flexibility and improved electrical system survivability; reduced manning through improved power management systems and reduced on-board maintenance requirements; improved ship signature characteristics; improved design adaptability to meet future requirements of multiple ship types or missions; integrating power management and protection by fully utilizing the power electronics in the system to perform fault protection as well as power conversion and load management functions; simplified technology insertion which allows new technologies to be installed within IPS much less expensively than presently possible; and, reduced machinery system acquisition costs through utilization of commercially shared technologies and components.

B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)

	FY 2010	FY 2011	FY 2012
Title: IPS Component & System Development	2.500	2.175	9.649
Articles:	0	0	0
FY 2010 Accomplishments: System Development: Continue to conduct detailed design and prototype fabrication of power conversion equipment for advanced architecture. Continue to improve baseline power system performance by performing analysis, modeling and simulation, life cycle cost analysis, producibility studies, module development, ship integration, architecture design, ship electric architectures and high			

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2010	FY 2011
<p>power weapons systems requirements, and related efforts. Continue to evaluate emerging technologies for ship applications to determine future feasibility and development requirements. Emerging technologies include fuel cells, high-energy weapons, high power radars, and advanced power electronics.</p> <p>FY 2011 Plans: System Development: Continue to conduct detailed design and prototype fabrication of power conversion equipment for advanced architecture. Continue to improve baseline power system performance by performing analysis, modeling and simulation, life cycle cost analysis, producibility studies, module development, ship integration, architecture design, ship electric architectures and high power weapons systems requirements, and related efforts. Continue to evaluate emerging technologies for ship applications to determine future feasibility and development requirements. Emerging technologies include fuel cells, high-energy weapons, high power radars, and advanced power electronics.</p> <p>FY 2012 Plans: IPS Component & System Development: <ul style="list-style-type: none"> * Continue assessments of NGIPS alternate architectures to best meet emerging ship requirements. * Develop technical and operational concepts for improving shipboard energy management utilizing energy storage modules. * Continue to improve baseline power system performance by performing analysis, modeling and simulation, life cycle cost analysis, producibility studies, module development, and ship integration studies and planning. * Continue to evaluate emerging technologies for ship applications to determine future feasibility and development requirements. Emerging technologies include high-energy weapons including rail guns, high power radars including Air and Missile Defense Radar (AMDR), and advanced power electronics. * Complete source selection and award contract(s) for design, build, and test of an ESM Full Scale Engineering Demonstration Module (EDM). * Complete source selection and award contract(s) for design, build, and test of an Advanced Power Generation Module (4MW Generator / Propulsion Derived Ship Service (PDSS)). * Perform analysis and evaluate benefits of sub-component upgrades to LM2500 including, but not limited to: Compressor Airfoil Tip Lengthening; Non linear VSV scheduling; High Pressure Recoup (Orifice Optimization); Inlet/Exhaust Flow Optimization; and, thermal Barrier Coatings. * Analyze alternatives for supplying power to advanced radars, combat systems, and electric weapons power demands and potential interfaces to develop optimum alternative solutions. * Determine alternatives for energy management and fuel efficiency improvement, and power system upgrade options for ships in service. * Continue to develop / modify IPS ship configuration documentation including concepts of operations, system level descriptions, and module performance specifications as necessary to support power system requirements. </p>			

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Exhibit R-2A, RDT&E Project Justification: PB 2012 Navy		DATE: February 2011		
APPROPRIATION/BUDGET ACTIVITY 1319: <i>Research, Development, Test & Evaluation, Navy</i> BA 4: <i>Advanced Component Development & Prototypes (ACD&P)</i>		R-1 ITEM NOMENCLATURE PE 0603573N: <i>Advanced Surface Machinery Sys</i>		PROJECT 2471: <i>Integrated Power Systems (IPS)</i>
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)				
				FY 2010
				FY 2011
				FY 2012
* Continue to upgrade ship power system smart product model to support cost / performance tradeoffs of alternative IPS ship configurations and evaluation of emerging electric power system and component technologies.				
Title: IPS Component & System Test				
				Articles:
				2.720
				3.134
				6.000
				0
				0
				0
FY 2010 Accomplishments: System Test: Continue to conduct land based testing of power conversion equipment at NSWCCD, Philadelphia, PA to mitigate potential risks associated with a fielded IPS system and reduce ship's signature, improve survivability and efficiency by fabricating components, inserting into the IPS test site or an appropriate test platform. Continue to conduct demonstrations to maintain and develop the critical engineering capability and capacity to insert future high power weapon systems (radars, lasers and electromagnetic launch weapons) into DDG-1000, future flights of the DDG 51 class, future amphibious ships, and other ship classes. Continue to conduct demonstrations to show improved performance and potential to reduce combat system costs.				
FY 2011 Plans: System Test: Continue to conduct land based testing of power conversion equipment at NSWCCD, Philadelphia, PA to mitigate potential risks associated with a fielded IPS system and reduce ship's signature, improve survivability and efficiency by fabricating components, inserting into the IPS test site or an appropriate test platform. Continue to conduct demonstrations to maintain and develop the critical engineering capability and capacity to insert future high power weapon systems (radars, lasers and electromagnetic launch weapons) into DDG-1000, future flights of the DDG 51 class, future amphibious ships, and other ship classes. Continue to conduct demonstrations to show improved performance and potential to reduce combat system costs.				
FY 2012 Plans: IPS Component & System Test: * Continue to conduct land based testing of NGIPS modules in order to increase energy efficiency and fuel savings, improve survivability and enable advanced sensors and weapons (i.e., AMDR, Railgun). * Complete land based testing of a Functional Equivalent (FE) Energy Storage Module (ESM). FE ESM will validate interface requirements, employ an open architecture, and utilize components from multiple sources. * Participate in the At-Sea demonstration of the ESM onboard the Green Fleet demonstration ship in conjunction with the Fleet Readiness Research and Development program. * Take delivery of the ONR developed compact power components, (Bi-direction Power Converter and Multi-Functional Power Converter). Conduct land based testing of compact power components and transition into platform applications per the signed Technology Transition Agreements (TTAs) between ONR and PMS-320.				
Title: Platform Transition				0.150
				0.150
				2.600
				0
				0

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Exhibit R-2A, RDT&E Project Justification: PB 2012 Navy		DATE: February 2011		
APPROPRIATION/BUDGET ACTIVITY 1319: <i>Research, Development, Test & Evaluation, Navy</i> BA 4: <i>Advanced Component Development & Prototypes (ACD&P)</i>	R-1 ITEM NOMENCLATURE PE 0603573N: <i>Advanced Surface Machinery Sys</i>	PROJECT 2471: <i>Integrated Power Systems (IPS)</i>		
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2010	FY 2011	FY 2012
<p><i>FY 2010 Accomplishments:</i> Platform Specific: Continue to develop IPS configurations in support of all future surface ship programs. Continue to develop / modify IPS ship configuration documentation including concepts of operations, System Level description / Requirements, and module performance specifications as necessary to support power system requirements for the DDG-51and other future ships. Continue to improve ship power system smart product model to support cost / performance tradeoffs of alternative IPS ship configurations and evaluation of emerging electric power system and component technologies.</p> <p><i>FY 2011 Plans:</i> Platform Specific: Continue to develop IPS configurations in support of all future surface ship programs. Continue to develop / modify IPS ship configuration documentation including concepts of operations, System Level description / Requirements, and module performance specifications as necessary to support power system requirements for the DDG-51and other future ships. Continue to improve ship power system smart product model to support cost / performance tradeoffs of alternative IPS ship configurations and evaluation of emerging electric power system and component technologies.</p> <p><i>FY 2012 Plans:</i> Platform Transition: * Continue to develop IPS configurations in support of future surface ship acquisition programs. * Develop alternative power and propulsion solutions for future flights of the DDG 51 Class and near term large amphibious ships. * Develop alternative solutions to decrease shipboard energy usage and improve fuel efficiency.</p>				
Accomplishments/Planned Programs Subtotals		5.370	5.459	18.249
C. Other Program Funding Summary (\$ in Millions)				
N/A				
D. Acquisition Strategy				
IPS is included in the DDG 1000, and is a candidate for all other future surface ships. The NGIPS Technology Development Roadmap is based on the Navy's 30 year shipbuilding plan and candidate systems developed to support near term ship opportunities.				
E. Performance Metrics				
The Integrated Power System (IPS) project within the Electric Ships Office (ESO) will: mitigate 20% of Next Generation IPS (NGIPS) Technology Development Roadmap activities/risks; Address 20% of the relevant specs and standards written addressing components and subsystems on the NGIPS roadmap; Execute 100% of the signed Technology Transition Agreements with ONR; Complete 100% of the advanced developments currently planned for the Energy Storage Module and Power Generation Module.				

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Exhibit R-3, RDT&E Project Cost Analysis: PB 2012 Navy **DATE:** February 2011

APPROPRIATION/BUDGET ACTIVITY 1319: <i>Research, Development, Test & Evaluation, Navy</i> BA 4: <i>Advanced Component Development & Prototypes (ACD&P)</i>	R-1 ITEM NOMENCLATURE PE 0603573N: <i>Advanced Surface Machinery Sys</i>	PROJECT 2471: <i>Integrated Power Systems (IPS)</i>
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Product Development (\$ in Millions)				FY 2011		FY 2012 Base		FY 2012 OCO		FY 2012 Total			
Cost Category Item	Contract Method & Type	Performing Activity & Location	Total Prior Years Cost	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Cost To Complete	Total Cost	Target Value of Contract
Primary HW Development	C/CPFF	Alion Science Corp:Fairfax VA	5.925	0.900	Oct 2010	0.600	Oct 2011	-		0.600	0.000	7.425	
Primary HW Development	C/CPFF	Curtiss-Wright EMD:Pittsburgh, PA	10.750	-		-	Oct 2011	-		-	0.000	10.750	
Primary HW Development	C/CPFF	Compact Power FNC Transition:TBD	-	0.500	Feb 2011	1.000	Oct 2011	-		1.000	6.700	8.200	
Primary HW Development	WR	NSWCCD-SSES:Phila, PA	27.741	1.200	Oct 2010	1.249	Oct 2011	-		1.249	0.000	30.190	
Primary HW Development	C/CPFF	Syntek:Arlington, VA	-	0.900	Oct 2010	0.900	Oct 2011	-		0.900	0.000	1.800	
Primary HW Development	C/CPFF	Bath Iron Works:Bath, ME	-	0.250	Oct 2010	0.250	Oct 2011	-		0.250	0.000	0.500	
Primary HW Development	C/CPFF	NGSB:Pascagoula, MS	-	0.250	Oct 2010	0.250	Oct 2011	-		0.250	0.000	0.500	
Primary HW Development	C/CPFF	ESM/Adv PGM:TBD	-	-		8.000	Mar 2012	-		8.000	0.000	8.000	
Subtotal			44.416	4.000		12.249		-		12.249	6.700	67.365	

Test and Evaluation (\$ in Millions)				FY 2011		FY 2012 Base		FY 2012 OCO		FY 2012 Total			
Cost Category Item	Contract Method & Type	Performing Activity & Location	Total Prior Years Cost	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Cost To Complete	Total Cost	Target Value of Contract
Developmental Test & Evaluation	WR	NSWCCD-SSES:Phila, PA	22.581	1.459	Oct 2010	4.400	Oct 2011	-		4.400	0.000	28.440	
Developmental Test & Evaluation	C/CPFF	Compact Power:TBD	-	-		1.600	Oct 2011	-		1.600	0.000	1.600	
Subtotal			22.581	1.459		6.000		-		6.000	0.000	30.040	

Project Cost Totals	Total Prior Years Cost	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	Cost To Complete	Total Cost	Target Value of Contract
	66.997	5.459	18.249	-	18.249	6.700	97.405	

Remarks
IPS efforts funded as part of PE 0603513N Project 2471 in FY 2009 and earlier.

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Exhibit R-4, RDT&E Schedule Profile: PB 2012 Navy		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 1319: <i>Research, Development, Test & Evaluation, Navy</i> BA 4: <i>Advanced Component Development & Prototypes (ACD&P)</i>	R-1 ITEM NOMENCLATURE PE 0603573N: <i>Advanced Surface Machinery Sys</i>	PROJECT 2471: <i>Integrated Power Systems (IPS)</i>

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Exhibit R-4A, RDT&E Schedule Details: PB 2012 Navy		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 1319: <i>Research, Development, Test & Evaluation, Navy</i> BA 4: <i>Advanced Component Development & Prototypes (ACD&P)</i>	R-1 ITEM NOMENCLATURE PE 0603573N: <i>Advanced Surface Machinery Sys</i>	PROJECT 2471: <i>Integrated Power Systems (IPS)</i>

Schedule Details

Events by Sub Project	Start		End	
	Quarter	Year	Quarter	Year
Proj 2471				
System Engineering & Concept Development	1	2010	3	2012
Technology Development & Risk Reduction	1	2010	4	2012
System Design & Ship Impact	1	2010	4	2015
System Advanced Development	1	2012	4	2016
Advanced Power Generation	3	2010	4	2016
Energy Storage	1	2010	4	2016
Turbine Efficiency Upgrades	1	2012	4	2014

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COST (\$ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
9999: <i>Congressional Adds</i>	11.949	-	-	-	-	-	-	-	-	0.000	11.949
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0		

A. Mission Description and Budget Item Justification

Congressional Adds

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2010	FY 2011
Congressional Add: Integrated Power System Dense Harmonic Filter Design <i>FY 2010 Accomplishments:</i> N/A	1.593	-
Congressional Add: High Density Power Conversion and Distribution Equipment <i>FY 2010 Accomplishments:</i> High density power conversion and distribution equipment: Develop the requirements and associated designs for high-density electric power architectures including electric power distribution and conversion equipment for the development of subscale proof of concept prototype hardware for evaluation.	1.195	-
Congressional Add: Surf Combatant Hybrid Propulsion/Power Generation <i>FY 2010 Accomplishments:</i> Surface Combatant Hybrid Propulsion/Power Generation: Develop requirements, perform trade studies, design and fabricate hardware to validate the design parameters in support of a prototype Hybrid Electric Drive (HED) for surface combatants.	6.373	-
Congressional Add: Next Gen Shipboard Int Pwr Fuel Efficiency Enhancer <i>FY 2010 Accomplishments:</i> Next Generation Shipboard Integrated Power Fuel Efficiency Enhancer: Continue the development of power dense Integrated power System (IPS) and Hybrid Electric Drive (HED) technologies suitable for surface combatant and submarine propulsion, enhanced power generation, and power conversion. Power dense electric machines and power conversion solutions enable hybrid propulsion systems that save fuel and provide increased critical power for additional payload capabilities. These developments allow advanced IPS or HED system to be incorporated in future and existing warships, including the re-started DDG51 line. Specifically, develop requirements, perform trade studies, design hardware, and fabricate any hardware necessary to validate the design parameters.	1.593	-
Congressional Add: Integrated Advanced Ship Control (IASC)	1.195	-

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APPROPRIATION/BUDGET ACTIVITY 1319: <i>Research, Development, Test & Evaluation, Navy</i> BA 4: <i>Advanced Component Development & Prototypes (ACD&P)</i>	R-1 ITEM NOMENCLATURE PE 0603573N: <i>Advanced Surface Machinery Sys</i>	PROJECT 9999: <i>Congressional Adds</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2010	FY 2011
<i>FY 2010 Accomplishments:</i> Continue the technical enhancement which includes the standardization of hardware and software interfaces, evolving to a fully-open architecture configuration that will apply to all US Navy ships. The primary focus will be to standardize interconnecting interfaces. Software development that supports commonality across the US Navy fleet will be integrated into the system, in accordance with the common Navy data library of components, for graphical user interface (GUI) requirements. To support system development, initial prototype and operational testing was accomplished in a land-based environment.		
Congressional Adds Subtotals	11.949	-

C. Other Program Funding Summary (\$ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Congressional Adds