

# ARCHIVED REPORT

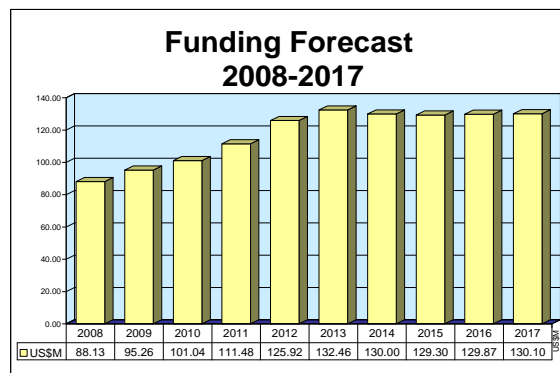
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## EW Technology (Navy) - Archived 2/2009

### Outlook

- Due to congressional approval and the importance of the program's research, funding should remain strong throughout the forecast period
- Program focuses on variety of RF technology developments that can be applied to electronic warfare applications
- In 2009, Forecast International will drop this report and replace it with separate reports focusing on each of the two programs contained in this report



### Orientation

**Description.** This program funds the development of electronic warfare technology in conjunction with the other services, but especially as needed for war-at-sea requirements. In FY02, the program transitioned to PE#0602271N and PE#0603271N, RF Systems Applied Research and RF Systems Advanced Technology.

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**Status.** Technology-based development.

**Application.** This develops a general electronic warfare technology base and focuses specifically on countermeasures for fleet operations.

### Technical Data

**PE#0602271N – RF Systems Applied Research.** The Radio Frequency (RF) Systems Applied Research Program addresses naval platform needs for new capabilities in RF surveillance, RF electronic warfare, communications, and navigation, and for new RF solid-state power amplifiers, vacuum electronics power amplifiers, and supporting RF electronics technologies.

The program supports development of technologies to enable capabilities in missile defense, directed energy, platform protection (including electric warship), time critical strike, and information distribution. RF Systems Applied Research developments directly support the Department of Defense Joint Warfighter Plan and the Defense Technology Area Plans.

## EW Technology (Navy)

Activities within this Program Element (PE) focus on enhancing the affordability of warfighting systems. The program also conducts technology efforts aimed at maintaining proactive connectivity and collaboration between the Department of the Navy Science and Technology and Joint Navy and Marine Corps commands worldwide.

There are a large number of efforts in this PE, so the programs described are representative of the work included.

PE#0603271N – RF Systems Advanced Technology. Work in this PE addresses technologies critical to the transformation to network-centric warfare, which utilizes multiple, simultaneous, and continuous

communications/datalinks between platforms, while at the same time performing the functions of electronic warfare and radar surveillance. The Radio Frequency Systems Advanced Technology Program addresses RF technology for Surface and Aerospace Surveillance sensors and systems, electronic warfare sensors and systems, RF communications systems, and multi-function sensor systems.

## Program Review

### **PE#0602271N – RF Systems Applied Research**

RF Electronic Warfare Technology. This project supports those technologies for the development of affordable, effective, and robust electronic warfare systems that could increase the operational effectiveness and survivability of U.S. naval units. Emphasis is on non-optical passive sensors and active and passive radio frequency (RF) countermeasure (RFCM) systems that exploit and counter a broad range of RF threats. The focus is on maintaining near perfect real-time knowledge of the enemy, countering the threat of missiles to deployed naval forces, and precision identification and location of threat emitters.

#### ***Countering Advanced Threats***

FY04 plans included technology development in the areas of Tactical Aircraft, Surface Ships, Submarines, Unmanned Aerial Vehicles (UAVs), and EW Enabling Technology. Efforts included demonstrating full radio frequency-to-pulse descriptor word system functionality under the Wideband EW Channelizer effort. It also conducted lab testing of near real-time processing of the ultra-wideband chirp subsystem under the Electronic Support Detection of the LPI Periscope Detection Radar effort. It developed and tested the frequency agile prediction algorithm for advanced seekers under the EA Techniques to Counter Advanced Threats effort. It performed ECM systems analysis and modeling for both onboard and offboard systems under the Countermeasures for Wideband Anti-ship Threats effort, and initiated analysis and modeling toward development and refinement of the “detailed direction findings (DF) antenna” for the Hybrid Interferometer Technology Development effort (this effort continued into FY06).

FY05 efforts focused on technology development in the areas of Tactical Aircraft, Surface Ships, Submarines, UAVs, and EW Enabling Technology. Plans were to include performing at-sea testing of the ultra-wideband chirp subsystem under the ES Detection of LPI Periscope Detection Radar effort and to perform shore-based field-testing against advanced seekers using the advanced techniques generator under the EA Techniques to Counter Advanced Threats effort. It also conducted vulnerability analysis of seeker discrimination and home-on-jam (HOJ) subsystems and performed lab demonstrations of the DF antenna for the Hybrid Interferometer Technology Development effort.

Plans for FY06 emphasized technology development in the areas of tactical aircraft, surface ships, submarines, UAVs, and EW enabling technology. Plans included completing the development and demonstration of key technologies for the creation of an air-launched unmanned platform carrying an advanced EW payload to suppress enemy air defense (SEAD) missions and the development of key capabilities of an autonomous millimeter wave (MMW) receiver and coherent techniques to counter 18-40 GHz airborne threats. Plans also called for fabricating a hardware breadboard incorporating range/phase correction algorithms that will offset synthetic aperture radar countermeasures.

#### ***Processing Power for Sensors and Weapons***

Supporting Technologies. This effort deals in technologies used in the processing of very-high-frequency (VHF), ultra-high-frequency (UHF), microwave (MW), and MMW power for Navy all-weather radar surveillance and reconnaissance, electronic attack, communications, and smart weapons systems. For the most part, the technology developed cannot be provided using commercial off-the-shelf (COTS) equipment

## EW Technology (Navy)

because of the requirements placed on power, frequency, linearity, bandwidth, weight, and size.

FY04 plans called for fabricating and testing linearizers with 2 GHz bandwidth and performing full RF life tests of SiC discrete devices and Monolithic Microwave Integrated Circuits (MMICs). This effort continued into FY05. The project also broadened the database in order to address infant mortality issues associated with GaN discrete devices and to begin to establish approaches to RF life testing of GaN High Electron Mobility Transistors (HEMTs). It demonstrated the power-handling channelizer in the laboratory and demonstrated increased power handling (up to 20 watts) and reduced losses (<1 dB) of the high-power wideband isolators. It increased the performance and yield of devices used in the DDS frequency source. It also demonstrated a superconducting analog-to-digital converter (ADC) with a 5 GHz center frequency and programmable bandwidth in the 20-400 MHz range and explored technical approaches critical to the development of digitally programmable RF electronics components for electronically scanned arrays (this effort continued into FY05).

### *Integrated EW, EA, ES Suite*

FY05 plans were to fabricate and test linearizers with 4 GHz of bandwidth, transfer the results of initial SiC RF life tests into the manufacturing technology, and initiate a second round of testing and the development of specifications for a next-generation, high-power channelizer. It initiated the development of an integrated digital electronic warfare, electronic attack, and electronic support suite using a tightly coupled common architecture. It also initiated vulnerability analysis of seeker discrimination and home-on-jam (HOJ) subsystems to the ECM system as part of the Countermeasures for Wideband Anti-ship Threats effort. It performed lab demonstration of the DF antenna for the Hybrid Interferometer Technology Development effort.

The FY06 plan was to complete development of the miniature, low-cost electronic warfare devices for tactical unmanned vehicles or unattended ground sensors, complete the development of advanced wireless communication countermeasures systems technology and algorithms, and complete field-testing of the offset SAR countermeasures hardware breadboard. It also initiated development of a simulation capability for the analysis and evaluation of future countermeasure techniques. It developed advanced signal processing architectures to assist in the identification and classification of low probability of intercept (LPI) and other advanced emitters, and explored methods for

improving pulse de-interleaving. This effort will improve the detection and identification of complex emitters and allow sorting of multiple tracks, and will begin investigating MMW technologies to support the development of offboard and onboard countermeasures.

### **PE#0603271N – RF Systems Advanced Technology**

R2913 RF Systems Advanced Technology. The Advanced Multi-function Radio Frequency (AMRF) technology effort emphasizes the development, demonstration, and transition of wideband, high-performance multifunction radio frequency apertures capable of transmitting and receiving multiple, simultaneous, independent RF beams, while providing reduced signature and number of apertures. These efforts were funded at \$24.264 million in FY03, \$18.458 million in FY04, and \$43.609 million in FY05. The remaining PE funding in those years supported several radar and sensor efforts that were no longer included after FY05.

FY04 plans were to initiate development of a Multifunction Electronic Warfare System (MFEW)/Advanced Multi-function Radio Frequency Concept (AMRF-C) Version 2, complete the multifunction RF technology hardware, architecture, and component testing for the AMRF-C effort, and demonstrate the initial capability of the multifunction RF technology testbed. This effort was to include initial designs for wideband technology with power and linearity sufficient to support communications, EW, and limited radar functions.

FY05-FY07 plans called for MFEW/ES core software development, and initiating the development of a high-band-array antenna and a mid-band-array antenna capable of simultaneously supporting multiple electronic support measures (ESM) surveillance functions for the MFEW/ES advanced development model (ADM). The program also initiated development of back-end analog receiver equipment supporting MFEW/ES ADM and started a systems integration, risk reduction, and Navy critical subsystem development effort leading to the demonstration of MFEW/ES ADM in a relevant operational environment and supporting MFEW/ES hardware/component testing within the AMRF-C testbed. All of these efforts were to be completed in FY07.

### ***Rapid Technology Insertion***

FY07 plans also called for initiating “Shipboard EW Improvement and Electronic Attack Transmitter” projects to develop an EW/EA capability for rapid technology insertion into DD(X) and other ship classes

## EW Technology (Navy)

utilizing MFEW/ES ADM components and architecture and AMRF-C testbed technology. Project funds for FY07 also covered the development of shipboard

electronic warfare and electronic attack capabilities for the DD(X).

## Funding

		U.S. FUNDING							
		FY06	FY06	FY07	FY07	FY08	FY08	FY09	FY09
		<u>QTY</u>	<u>AMT</u>	<u>QTY</u>	<u>AMT</u>	<u>QTY</u>	<u>AMT</u>	<u>QTY</u>	<u>AMT</u>
<b>RDT&amp;E (U.S. Navy)</b>									
PE#0602271N									
	Applied Research	-	61.25	-	50.33	-	45.45	-	45.69
<b>RDT&amp;E (U.S. Navy)</b>									
PE#0603271N									
	Advanced Technology	-	98.75	-	98.07	-	22.68	-	29.57
		FY10	FY10	FY11	FY11	FY12	FY12	FY13	FY13
		<u>QTY</u>	<u>AMT</u>	<u>QTY</u>	<u>AMT</u>	<u>QTY</u>	<u>AMT</u>	<u>QTY</u>	<u>AMT</u>
<b>RDT&amp;E (U.S. Navy)</b>									
PE#0602271N									
	Applied Research	-	47.79	-	48.41	-	48.74	-	49.59
<b>RDT&amp;E (U.S. Navy)</b>									
PE#0603271N									
	Advanced Technology	-	53.25	-	63.07	-	77.18	-	82.87

All \$ are in millions.

Source: FY2008 U.S. Budget Documents

## Worldwide Distribution/Inventories

This is a **United States**-only program at this time.

## Forecast Rationale

### *Funding to Remain Stable over 10 Years*

The EW Technology report covers two programs, with each expected to receive significant funding over the next 10 years. The U.S. Navy funds electronic warfare projects to increase the survivability of its fleet, as well as aircraft. Projects in this program will transition into other equipment-specific programs as they mature and new developments take their place. This is a very busy program – it deals with a large number of small-money efforts that have the potential for big payoffs in the future.

Congressional interest in protecting the U.S. R&D base favors this type of program, which has resulted in plus-ups for particular efforts beginning in FY03. Due to congressional approval, as well as the importance of the program's research, funding should remain strong throughout the forecast period. Forecast International expects Congress to boost spending for the RF Systems Advanced Technology program in 2008 and 2009.

Over the next 10 years, \$1.2 billion is projected to be spent on these two programs. Next year, Forecast International will archive this report and issue separate reports tracking each program.

## EW Technology (Navy)

## Ten-Year Outlook

ESTIMATED CALENDAR YEAR RDT&E FUNDING (in millions \$)												
Designation or Program	High Confidence					Good Confidence			Speculative			Total
	Thru 2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
<b>MFR Varies</b>												
<b>RF Systems Advanced Technology &lt;&gt; United States &lt;&gt; Navy</b>												
	196.82	42.68	49.57	53.25	63.07	77.18	82.87	80.00	79.80	80.12	80.50	689.04
<b>RF Systems Applied Research &lt;&gt; United States &lt;&gt; Navy</b>												
	111.58	45.45	45.69	47.79	48.41	48.74	49.59	50.00	49.50	49.75	49.60	484.52
<b>Subtotal</b>	308.40	88.13	95.26	101.04	111.48	125.92	132.46	130.00	129.30	129.87	130.10	1173.56
<b>Total</b>	308.40	88.13	95.26	101.04	111.48	125.92	132.46	130.00	129.30	129.87	130.10	1,173.56