FY 2002 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: June 2001

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602271N
PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 2000 ACTUAL	FY 2001 ESTIMATE	FY 2002 ESTIMATE
	**	**	62,141

** The Science and Technology Program Elements (PEs) were restructured in FY 2002. The work described in FY 2000 & 2001 was funded in PEs 0602232N, 0602234N, and 0602270N.

(U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Radio Frequency (RF) Systems Applied Research Technology Program addresses technology deficiencies associated with naval platform needs for new capabilities in RF surveillance, RF electronic warfare, communications, navigation, RF solid state power amplifiers, vacuum electronics power amplifiers, and supporting 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 Technology developments directly support the Department of Defense Joint Warfighter S&T Plan and the Defense Technology Area Plans. Projects within this PE have attributes that focus on enhancing the affordability of warfighting systems. The program also provides for technology efforts of the Naval Fleet/Force Technology Innovation Office (NFFTIO) to maintain proactive connectivity and collaboration between DoN S&T and Joint, Navy, and Marine Corps commands worldwide.

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

(U) JUSTIFICATION FOR BUDGET ACTIVITY: This program is budgeted within the APPLIED RESEARCH Budget Activity because it investigates technological advances with possible applications toward solution of specific Naval problems short of a major development effort.

(U)PROGRAMS PLANS AND ACCOMPLISHMENTS:

(U) RF SURVEILLANCE. RF Surveillance technology emphasizes non-optical advanced sensor and sensor processing systems for continuous high volume theater-wide air, space, and surface surveillance, battle group surveillance, real time

reconnaissance and ship defense. Major technology goals include long-range target detection, discrimination, target identification (ID) and fire control quality target tracking in adverse weather, background clutter and electronic countermeasure environments.

RF Surveillance	FY00	FY01	FY02 ($13,251)
Initiate	• Advanced Airborne Early Warning (AEW) Space Time Adaptive Processing Algorithm Development	• Shipboard Digital Array • Affordable Ground Based Radar (AGBR) Technology Baseline	
Continue	• Passive Millimeterwave Radar • Digital Transmit/Receive (T/R) Modules • Littoral Small Craft Automatic Target Recognition (SCATR) • Ultra High Frequency (UHF) Electronically Scanned Array (UESA) Advanced AEW Radar • Radar Imaging • Wideband Digital Beamforming • AN/APY-6 Wideband Multi-Mode Air-	• Advanced AEW Space Time Adaptive Processing Algorithm Development • AN/APY-6 Wideband Multi-Mode Air-Ground Radar • UESA Advanced AEW Radar • Wideband Digital Beamforming	• Shipboard Digital Array • Advanced AEW Space Time Adaptive Processing Algorithm Dev • AN/APY-6 Wideband Multi-Mode Air-Ground Radar Advanced Algorithms • Wideband Digital Beamforming • UESA Advanced AEW Antenna

	Ground Radar Technology Testbed		
Complete		• Passive Millimeterwave Radar • Digital T/R Modules • Radar Imaging • Littoral SCATR	• AGBR Technology Baseline

(U) ELECTRONIC WARFARE TECHNOLOGY: Electronic Warfare technology emphasizes non-optical passive sensors and active and passive RF countermeasure systems including High Power Microwave (MW) which exploit and counter a broad range of electromagnetic threats. Program focus is on maintaining near perfect real-time knowledge of the enemy; countering the threat of cruise missiles to deployed Naval forces; and precision ID and location of threat emitters.

Electronic Warfare	**FY00**	**FY01**	**FY02 ($11,145)**
Initiate		• Next Generation Specific Emitter Identification (SEI) and Signal Processing • RF EW Threat Characterization • Long Baseline Time Difference of Arrival (ANGUILA)	• Advanced Decoy Systems • Advanced Counter Measures Development • Digital Deception Technologies
Continue	• Electronic Attack (EA) for Coherent Complex Modern Emitters • RF Early Warning (EW) Sensor Miniaturization • Specific Emitter ID (SEI) Miniturization • Wavelet Signal Processing	• EA for Coherent Complex Modern Emitters • RF EW Sensor Miniaturization • SEI Miniaturization	• EA for Coherent Complex Modern Emitters • Next Generation SEI and Signal Processing • RF EW Threat Characterization • ANGUILA
Complete	• Adaptive Distributed EA	• Wavelet Signal Processing	• RF EW Sensor Miniaturization

			• SEI Miniaturization

(U) RF COMMUNICATIONS TECHNOLOGY: Communications Technology addresses critical Navy communications technology deficiencies and needs that are not addressed by the commercial technology sector. The program emphasis is on reliable interoperable communications between U.S and coalition forces at all levels of command and rapid and reliable utilization of government and commercial telecommunications assets worldwide, that are efficient and responsive to warfighting needs.

Radio Frequency Communications	**FY00**	**FY01**	**FY02 ($12,396)**
Initiate	• Submarine Extremely Low Frequency (ELF) Noise Mitigation • Buoyant Cable Antenna Technologies • UHF Demand Assigned Multiple Access (DAMA) for Submarine Communications	• Vertical Takeoff Unmanned Air Vehicle (VTUAV) Communications Payload • Co-Site Interference Cancellation	• Very High Frequency (VHF)/UHF/L-Band Antenna Technology • X/Ku-Band Antenna Technology • Littoral Mobile Wireless Networking
Continue	• Large Aperture Multifunction Submarine Antenna • K/Ka Band Satellite Communication (SATCOM) Antennas • Bandwidth Efficient Advanced Modulation • High Data Rate SATCOM	• Large Aperture Multifunction Submarine Antenna • K/Ka Band SATCOM Antennas • Submarine ELF Noise Mitigation • Buoyant Cable Antenna Technologies • UHF DAMA for Submarine Communications • Bandwidth Efficient Advanced	• VTUAV Communications Payload • Co-Site Interference Cancellation • K/Ka Band SATCOM Antennas • Submarine ELF Noise Mitigation • Buoyant Cable Antenna Technologies

	• Code Division Multiple Access (CDMA) for Military Radio Communications • Multifunction Communi-cations Antennas	Modulation	
Complete	• Advanced Submarine Mast Antenna	• High Data Rate SATCOM • CDMA for Military Radio Communications • Multifunction Communications Antennas	• Large Aperture Multifunction Submarine Antenna • Bandwidth Efficient Advanced Modulation • UHF DAMA for Submarine Communications

(U) RF NAVIGATION TECHNOLOGY: Develops key navigation technologies for Naval Battle Groups, Aircraft, Unmanned Air Vechiles (UAVs), Unmanned Underwater Vehicles (UUVs), Ships, Submarines and other Navy vehicles and platforms. This technical area applies leading-edge S&T to enhance Global Positioning Systems (GPS) capabilities in order to make GPS more resistant to noise and jamming. This effort is also concerned with the coupling of GPS with inertial systems. This effort generally does not cover guided munitions nor does it duplicate Defense Advanced Research Projects Agency (DARPA) developments in Micro Electromechanical Systems (MEMS) devices.

RF Navigation	**FY00**	**FY01**	**FY02 ($2,385)**
Continue	• Anti-Jam Antennas • Communications, Navigation & Intelligence (CNI) Integration	• Anti-Jam Antennas • CNI Integration	• Anti-Jam Antennas • CNI Integration

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(U) RF SOLID STATE POWER AMPLIFIERS. Provides for the generation of VHF, UHF, Microwave (MW), and Millimeter Wave (MMW) power amplifiers for Navy all-weather radar, surveillance, reconnaissance, electronic attack, communications, and smart weapons systems. The technology developed cannot be obtained through Commercial Off the Shelf (COTS) as a result of the simultaneous requirements placed on power, frequency, linearity, bandwidth, weight, and size.

Solid State Amplifiers	FY00	FY01	FY02 ($4,888)
Initiate	• Wide Bandgap Pulse Power Amplifier	• Silicon Carbide (SiC) Bipolar Transistors	• Ku-Ka Band Power Amplifiers • Pseudomorphic GaN transistors
Continue	• MMW Wide Bandgap Linear Power Source • Efficient Broadband Amplifiers	• Wide Bandgap Pulse Power Amplifier • MMW Wide Bandgap Linear Power Source	• Wide Bandgap Pulse Power Amplifier • MMW Wide Bandgap Linear Power Source • SiC Bipolar Transistor

(U) RF VACUUM ELECTRONIC POWER AMPLIFIERS. Provides for the development of MW, MMW, submillimeter wave power amplifiers naval all-weather radar, surveillance, reconnaissance, EA, and communications weapons systems. The technology developed cannot be obtained through COTS as a result of the simultaneous requirements placed on power, frequency, bandwidth, weight, and size.

Vacuum Electronics	FY00	FY01	FY02 ($6,500)
Initiate	• Ka-Band Gyro-Traveling Wave Tube (TWT)	• Digital High Dynamic Range (HDR) Vac. Power Booster • 2D/3D Coupled Cavity (CC)-TWT Design Codes	• MMW Gyro-TWT • High Brightness Scandate Emitters

		• 2-D Klystron Design Codes • Time Dependent Helix TWT Codes For Digital Communications • High Brightness Scandate Emitters	
Continue	• MW Microwave Power Modules for EA • 1 Dimensional (D)/2D/3D Helix TWT Design Codes • MMW Gyro-Twystron • W-Band CC-TWT and Extended Interaction Klystron (EIK) • Noble Metal-Based Scandate Emitters • Aln-Sic Dielectric Material	• 2D/3D Helix TWT Design Codes	• Digital HDR Vacuum Power Booster • 2D/3D CC-TWT Design Codes
Complete	• W-band, 10 kW Gyro-Klystron • Ion Noise Theory	• 1-D Helix TWT Design Codes • MMW Gyro-Twystron • Noble Metal-based Scandate Emitters	• 2D/3D Helix TWT Design Codes

(U) SUPPORTING TECHNOLOGIES. Provides for the radiation, reception, control and processing of VHF, UHF, MW, and MMW power for Navy all-weather radar, surveillance, reconnaissance, EA, communications, and smart weapons systems. The technology developed cannot be obtained through COTS as a result of the requirements placed on power, frequency, linearity, bandwidth, weight, and size.

Support Technology	FY00	FY01	FY02 ($9,778)
Initiate	• Channelized Filter Bank • High Power, Wide Band,	• High Speed Microelectronic Mechanical system (MEMs)	• Wide Bandgap Transistor Reliability

	Isolators • Electronic True Time Delay	• SiC Power Converter • DDS Integral Modulator	
Continue	• High Performance Analog to Digital Converters (ADCs) • Compact Tunable Filters and Filter Banks • 100 GHz Low Noise Digital Clock • MW Frequency Direct Digital Synthesizer (DDS) • Robust, Wide Bandgap Low Noise Amplifiers • Ultra Low Noise, Broad Band, High Linearity, Receiver Amplifiers • Giant Magneto-Resistance (GMR) Non-Volatile Memories • Silicon-Based Power Converters	• Channelized Filter Bank • High Power, Wide Band Isolators • Electronic True Time Delay • High Performance ADC's • Compact Tunable Filters and Filter Banks • 100 Ghz Low Noise Digital Clock • MW Frequency DDS • Robust, Wide Bandgap Low Noise Amplifiers • Ultra Low Noise, Broad Band, High Linearity Receiver Amplifiers • GMR Non-Volatile Memories	• High Power, Wide Band, Isolators • DDS Integral Modulator • Electronic True Time Delay • High Performance ADC's • Compact Tunable Filters and Filter Banks • 100 Ghz Low Noise Digital Clock • MW Frequency DDS • Robust, Wide Bandgap Low Noise Amplifiers • Ultra Low Noise, Broad Band, High Linearity, Receiver Amplifiers • GMR Non-Volatile Memories • High Speed Mems • SiC Power Converter
Complete		• Silicon-Based Power Converters	

(U) NFFTIO. The purpose of NFFTIO is to ensure the Fleet/Force (F/F) helps shape the DoN investment in S&T, develop teaming relationships to rapidly demonstrate and transition technology, support development of technology-based capability options for naval forces, and enable warfighting innovations based on technical and conceptual possibilities. This is accomplished through proactive connectivity and collaboration between DoN S&T and Joint, Navy, and Marine Corps commands worldwide. Projects executed by NFFTIO are typically six to eighteen months in duration. Therefore, most projects that are initiated are completed in the same or the next fiscal year.

NFFTIO	**FY00**	**FY01**	**FY02 ($1,798)**
Initiate	• Virtual Information Processing	• Submarine Platform Avoid Close	• Develop and demonstrate specific

	Agent Research (VIPAR) • Robust Systems for HF and Land-line Data Transfer • Anti-terrorist Water Monitoring System • Autonomous Self-contained Acoustic Classifier • Passive Acoustic Sensor for Submarine Hull Application • Next Generation Improved Phone Distance Line for Underway Replenishment • Helicopter Vortex Ring-State Warning System • Shipboard Visual Navigation Aid for Vessels in Formation • F/A-18 Fast Tactical Imagery	Encounters/SPACE • Radiant Argon Hyperspectal Imaging • Air Warfare Training Technology Development (AWTTD) • Remote Water Craft Project/ RWC • Amphibian Suit II • Shipboard Quality of Life/QOL • Shipboard Non-tactical Automated Data Processing/SNAP • Collaborative Digital Target Folders/DTF • Environment Analysis and Receiver Systems/EARS • Fusion Box Hardware & Software Systems • Roc-N-Rol Core Network System Smart Board Systems	solutions to known operational Command Capability Issues.
Continue	• Projects are typically six to eighteen months in duration. Therefore, all projects from previous years have either been completed or will be completed this fiscal year as indicated below.	• Projects are typically six to eighteen months in duration. Therefore, all projects from previous years have either been completed or will be completed this fiscal year as indicated below.	• Projects are typically six to eighteen months in duration. Therefore, all projects from previous years have either been completed or will be completed this fiscal year as indicated below.
Complete	• Development of Amphibian Suit for Special Operations • Low Frequency Active Intercept Receiver System	• VIPAR • Robust Systems for HF and Land-line Data Transfer • Next Generation Improved Phone Distance Line for Underway	• AWTTD

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		Replenishment	

(U) PROGRAM CHANGE SUMMARY:

	FY 2000	FY 2001	FY 2002
FY 2001 President's Budget			
PE Restructure			56,798
Inflation Adjustment:			65
Program Adjustment			-70
NWCF Adjustment			348
Additional Program Adjustment			5,000
FY 2002 PRESBUDG Submission	**	**	62,141

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(U) CHANGE SUMMARY EXPLANATION:
(U) Funding: Not Applicable.
(U) Schedule: Not Applicable.

(U) OTHER PROGRAM FUNDING SUMMARY: The Navy’s 6.1 program contributes to this effort.

(U) NAVY RELATED RDT&E:
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602114N (Power Projection Applied Research)
(U) PE 0602123N (Force Protection Applied Research))

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(U) PE 0603271N (RF Systems Advanced Technology)
(U) PE 0603114N (Power Projection Advanced Technology)
(U) PE 0603123N (Force Protection Advanced Technology)

(U) NON NAVY RELATED RDT&E:
(U) PE(s) 0601102A, 0601102F (Defense Research Sciences)
(U) PE(s) 0602204F (Aerospace Avionics)
(U) PE(s) 0602782A, 0602702F (Command, Control and Communications (C^3) Technology)
(U) PE(s) 0602705A (Electronics and Electronic Devices)
(U) PE(s) 0602303A (Missile Technology)
(U) PE(s) 0602270A, 0602270F (Electronic Warfare Technology)
(U) PE(s) 0603270A, 0603270F (Advanced Electronic Warfare Technology)

(U) SCHEDULE PROFILE: Not Applicable.