

UNCLASSIFIED

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N

PROGRAM ELEMENT TITLE: Air Systems and Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT

NUMBER & TITLE	FY 1998 ACTUAL	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	TO COMPLETE	TOTAL ESTIMATE
R0446 Advanced Avionics Subsystems (formerly Maritime Avionics & Subsystems Technology (MAST))	6,625	3,434	3,449	3,507	3,564	3,623	3,700	3,780	CONT.	CONT.
R0447 Weapons Advanced Technology	19,412	23,693	21,439	23,802	24,960	25,671	26,345	27,039	CONT.	CONT.
R2264 Air Systems Affordability	5,930	5,728	5,511	2,988	2,140	2,323	183	322	CONT.	CONT.
R2327 Integrated High Payoff Rocket Propulsion Technology (IHPRPT)	944	0	0	0	0	0	0	0	0	1,904
W2014 Integrated High Performance Turbine Engine Technology (IHPTET)	5,171	7,559	7,211	7,180	7,903	7,377	7,543	7,712	CONT.	CONT.
R2455 Vectoring Extremely Short Take-off and Landing (ESTOL) Control Tailless Operation Research (VECTOR)	0	4,989	4,436	492	0	0	0	0	0	9,917
R2487 DP-2 Thrust Vectoring System Proof of concept demonstration	0	1,995	0	0	0	0	0	0	0	1,995
TOTAL	38,082	47,398	42,046	37,969	38,567	38,994	37,771	38,853	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program element (PE) demonstrates concepts for future air platforms and surface/air weapons employed in Naval Warfare. The demonstrated concepts support the Joint Warfare Strategy Forward...from the Sea" and relate to the Joint Mission Areas of Strike, Littoral Warfare, and Intelligence Surveillance and Reconnaissance. Projects in this PE are jointly planned in the Defense Science and Technology Reliance process with the Air Force and Army through panels of the Director Defense Research and Engineering.

R-1 Line Item 17

Budget Item Justification
(Exhibit R-2, page 1 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N

PROGRAM ELEMENT TITLE: Air Systems and Advanced Technology

(U) Strike technology issues relevant to this PE include surgical lethality, platform survivability, affordability and increased Naval gunfire range and accuracy. Littoral Warfare technology issues relevant to this PE include air battlespace dominance, expeditionary forces air support, ship self-defense and increased Naval gunfire range and accuracy. Intelligence Surveillance and Reconnaissance technology issues relevant to this PE include platform mission endurance and survivability. Seven projects are executed within the PE:

(U) Advanced Avionics Subsystems (formerly Maritime Avionics and Subsystems Technology (MAST)): Initiated in FY 95 by Congress plus-up as MAST, Advanced Avionics Subsystems is a multi-faceted program maturing integrated modular avionics and software concepts towards providing new functionality, affordable, common avionics to future and legacy aircraft. Focused on advanced visualization and data fusion functionality through scalable, open, fault tolerant and common avionics architecture, advanced emulation and virtual prototyping, along with multifunction sensors and antennas. Program thrusts address either Navy-specific applications or technological areas where Tri-Services have agreed on a Navy lead. This becomes a core effort in FY 99.

(U) Weapons Advanced Technology: Demonstrates emerging sub-system/component level weapons concepts which promise affordable and significant performance improvements to both existing and next generation Naval Air and Surface launched weapons. These efforts in this area will demonstrate the achievement of the time-phased Air and Surface Weapons Technology (ASWT) goals, which will maintain and increase the Naval Air and Surface Weapons capability edge through the 21st century. In FY98 the Extending the Littoral Battlefield (ELB) Advanced Concept Technical Demonstration (ACTD) was added to this project. In FY99 this task was transferred to PE 0603238N, Project R2145.

(U) Integrated High Payoff Rocket Propulsion Technology (IHPRPT): This project supports the achievement of the IHPRPT program time-phased goals by conducting integrated component demonstrations of rocket propulsion technology developed under PE 0602111N. In FY99, this task was transferred to PE 0603217N, Project R0447.

(U) Integrated High Performance Turbine Engine Technology (IHPTET): Provides experimental engine testing of new gas turbine engine technologies to demonstrate readiness and reduce technical risk for entering engineering development. IHPTET is a Tri-Service program in which each Service contributes established shares of 6.2 and 6.3 funding and laboratory resources to meet specified goals of doubling thrust-to-weight ratio, halving fuel consumption by the year 2003 (relative to

R-1 Line Item 17

Budget Item Justification
(Exhibit R-2, page 2 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N

PROGRAM ELEMENT TITLE: Air Systems and Advanced Technology

a 1987 baseline) and reducing acquisition and maintenance costs. Additional emphasis has been incorporated to address High Cycle Fatigue issues, which may be associated with propulsion system design system deficiencies.

(U) Air Systems Affordability: Multi-faceted phased program to focus on improving the affordability of future major acquisition programs. This project will focus affordability research to support the delivered accuracy of future stand-off weapons and support the development of multi-function, analog-to-digital conversion and signal processing electronic modules.

(U) Vectoring ESTOL Control Tailless Operation Research (VECTOR) Program: A follow-on to a previous X-31 thrust vectoring demonstration with Germany. This international flight demonstration effort adds Sweden to the US/Germany Team to utilize the X-31 aircraft to develop and demonstrate thrust vectoring technologies using a multi-axis axisymmetric thrust vectoring nozzle with a fully integrated flight/engine/nozzle control system. The VECTOR effort will demonstrate, in flight, the concepts of: Extremely Short Takeoff and Landing (ESTOL) to allow short-field operations, reduced catapult/arresting gear requirements, increased payload and bring-back, reduced aircraft catapult and arresting loads, and, an Advanced Air Data System (AADS) that will provide the required air data accuracy at very high angles of attack. It will provide engineering analyses for reduced tail/reduced directional stability to validate directional control capabilities using with thrust vectoring. The program will also provide data with which to determine valuable operating efficiencies inherent with such a nozzle configuration. These efficiencies include reduced aerodynamic (induced) trim drag, increased engine exhaust recovery, and reduced aircraft weight.

(U) The DP2 Thrust Vectoring System: Initiated in FY 99 by Congressional plus-up, this program is a demonstration of a proof-of-concept of a reduced-scale flight test vehicle. The vehicle concept is a short take-off/vertical landing (STOVL) aircraft of advanced composite construction, utilizing thrust vector control. This air vehicle is envisioned as a vertical take-off transport for ship-to-shore operation and for ship/shore-based reconnaissance.

(U) The Navy Science and Technology (S&T) program includes projects that focus on or have attributes that enhance the affordability of warfighting systems.

(U) JUSTIFICATION FOR BUDGET ACTIVITY: This program is budgeted within the ADVANCED TECHNOLOGY DEVELOPMENT Budget Activity because it encompasses design, development, simulation, experimental testing or prototype hardware. It is also necessary to

R-1 Line Item 17

Budget Item Justification
(Exhibit R-2, page 3 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N

PROGRAM ELEMENT TITLE: Air Systems and Advanced Technology

validate technological feasibility and concept of operations to reduce technological risk prior to initiation of a new acquisition program or transition to an ongoing acquisition program.

B. (U) PROGRAM CHANGE SUMMARY FOR TOTAL P.E.:

	<u>FY 1998</u>	<u>FY 1999</u>	<u>FY 2000</u>
FY 1999 President's Budget	34,562	48,143	40,034
Appropriated Value		48,143	0
Adjustments from FY 1999 PRESBUDG	3,520	-745	2,012
FY 2000 President's Budget	38,082	47,398	42,046

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1998 adjustments reflect Actual adjustment updates (+3,805); and small business Innovation Research adjustment (-\$285). FY 1999 adjustments reflect Congressional Undistributed reductions (-\$239); Congressional Directed reduction (-\$2,000); Congressional Plus-up DP-2 Thrust Vectoring (+\$2,000); and Minor adjustment (-\$506). FY 2000 adjustments reflect Non Pay Inflation adjustment (-\$611); Navy Working Capital Fund (-\$85); Civilian Pay rate adjustment (+\$208); and Realignment of Vector funding (+\$2,500).

(U) Schedule: Not Applicable.

(U) Technical: Not Applicable.

R-1 Line Item 17

Budget Item Justification
(Exhibit R-2, page 4 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: September 1998

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R0446 Advanced Avionics Subsystems (AAS) (formerly Maritime Avionics Subsystems & Technology (MAST))	6,625	3,434	3,449	3,507	3,564	3,623	3,700	3,780	CONT.	CONT.

(U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project has been supported by Congressional Plus-ups since FY 1995 and became a Navy budget effort beginning in FY 1999. This project demonstrates commercial-off-the-shelf (COTS) and non-development item (CANDI) technology that will facilitate the introduction of new functionality (e.g., 3 dimensional (3-D) perspective scene visualization, crew workload reduction, on/off-board sensor data fusion, telepresence to the battlespace, etc.) into existing Navy aircraft and future platforms in a cost-effective manner. The project includes elements responsive to the original Congressional guidance: (a) visualization and data fusion software; (b) scalable open architecture project (SOAP); (c) advanced interconnect technology; (d) avionics packaging and cooling technology; and (e) low cost sensors and connectivity. Individual performers and tasks are selected to maximize the probability of transfer of successful results to Navy and other systems. This project addresses the Joint Vision 2010, Navy Science and Technology (S&T) Requirements Guidance, ...Forward From The Sea, and the outyear plans of several naval aviation programs (e.g., F/A-18, Air Combat Electronics, Tactical Aircraft Mission Planning, AV-8B, Joint Strike Fighter (JSF) and others). Key objectives include providing better technology transparency, reducing software costs, opening currently closed avionics architectures, enabling earlier use of CANDI technologies, protocol-independent high-speed/high-bandwidth databases, and ability to introduce new functionality for effective joint warfighting.

R-1 Line Item 17

Budget Item Justification
(Exhibit R-2, page 5 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and
Weapons Advanced Technology

PROJECT NUMBER: R0446
PROJECT TITLE: Advanced Avionics
Subsystems (AAS)

A. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS: (\$7,132) includes \$3,461 FY 97 funding released in FY 98
 - (U) (\$2,070) Advanced Visualization and Data Fusion Software (AVDFS)
 - (U) Initiated:
 - (U) AVDFS software integration with version 6.2 of Tactical Aircraft Mission Planning System (TAMPS) for integrated mission planning and rehearsal capability.
 - (U) Demonstration of bringing off-board imagery from commercial source into a military cockpit by creating commercial imagery archive browser and retrieval software
 - (U) Continued:
 - (U) Mosaicing of off-board and on-board information into geospecific 3-D imagery. Includes ability to mosaic and fuse (overlay) camera video streams onto a 3-D scene rendered from the combination of archival Digital Terrain Elevation Data (DTED) and imagery.
 - (U) Refining image generation software for portability to multiple commercial-off-the-shelf (COTS) graphics engines. Migration of AVDFS to multiple platforms including the entire Silicon Graphics Inc. (SGI) product line and Windows New Technology (NT) INTEL-based processors.
 - (U) Completed:
 - (U) PowerScene Integration with TAMPS for integrated mission planning and rehearsal capability and application at Naval Air Station, Fallon, NV.
 - (U) F/A-18 integrated 2 dimensional (2-D) cockpit demonstration at Boeing's Advanced Avionics Center in St.Louis, MO.
 - Highlighted the tactical utility of AVDFS for several avionics scenarios.
 - (U) Demonstration of ability to import National Imagery and Mapping Agency (NIMA) standard format data for direct use in a geocentric representation with worldwide coverage.
- (U) (\$3,840) Scalable Open Architecture
 - (U) Initiated:

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 6 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and
Weapons Advanced Technology

PROJECT NUMBER: R0446
PROJECT TITLE: Advanced Avionics
Subsystems (AAS)

- (U) Integration of signal processing node and high speed multiprocessor node into the SOAP architected on COTS technology.
- (U) Implementation of 3-D perspective scene generation into embedded hardware. Initial investigation of using processing resources on the Optical Backplane Interconnect System (OBIS) backplane as the embedded resource for visualization algorithms.
- (U) Incorporation of Real-time Database Management System.
- (U) Fault tolerant/dynamic reconfiguration in a Real-time Common Object Request Broker Architecture (CORBA) environment.
- (U) Performance modeling process development to be used throughout project life.
- (U) Continued:
 - (U) Preliminary off-board interface definition.
 - (U) Performance analysis and development of common object request broker architecture in a real-time deterministic system.
 - (U) Definition of network requirements and capabilities for an information intensive unified system.
- (U) Completed:
 - (U) Implementation and integration of 2-D capability on embedded processing hardware.
 - (U) Initial design and virtual prototype of COTS-based single thread processor emulator chip capable of running existing code on a clock-cycle accurate basis.
- (U) (\$850) Advanced Avionics Interconnect Technology
 - (U) Initiated:
 - (U) Development of extremely high speed and high bandwidth protocol independent optical data network based on COTS technologies and techniques. Technology leverages fiber optic technologies developed by the commercial telecommunications industry. This effort seeks to multiplex multiple signals using various protocols over a single optical fiber to replace current MIL-STD-1553 bus technology. The goals of this effort seek to increase data transfer rates by a factor of 1000X (1MB vs. 1GB or more); demonstrate reduced Electromagnetic Interference (EMI) and Electromagnetic Vulnerability (EMV); and reduced life cycle and development costs for F/A-18, JSF, Close Air Support (CSA) and other advanced air vehicles.

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 7 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and
Weapons Advanced Technology

PROJECT NUMBER: R0446
PROJECT TITLE: Advanced Avionics
Subsystems (AAS)

- Joint Dual-Use program with Naval Sea Systems Command (NAVSEA) and Defense Advanced Resource Project Agency (DARPA) to establish commercial sources for military fiber optic systems applications Exploiting Commercial Sources and Technical Advantages to Insure Competitiveness (ECSTATIC Project).

Continued:

- (U) Optical Network effort discussed above to begin demonstration of critical components.
- (U) Optical backplane integration into SOAP architecture with multiprocessor real-time operating system.

- (U) (\$262) Low Cost Sensors and Connectivity

(U) Continued:

- (U) Evaluation of technology and concepts for real-time connectivity of on-board data bases and subsystems with off-board sources of data or information.

- (U) (\$110) Advanced Packaging

(U) Continued:

- (U) Evaluation of COTS packaging technology in naval avionics applications.

2. (U) FY 1999 PLAN: (\$6,388 includes \$2,954 FY 98 funding released in FY 99)

- (U) (\$1,775) Advanced Graphics and Data Fusion

(U) Initiate:

- (U) Development and demonstration of a portable 3-D rendering capability which can be executed in non-real-time on a scalable open architecture system prototype.
- (U) Preliminary investigation of calligraphic light sources and a range of atmospheric effects in the AVDFS to enhance realism in the avionics environment.

(U) Continue:

- (U) Development and demonstration of interoperability with operational avionics hardware through simulation and proposed flight-worthy hardware.
- (U) To develop the capability to execute 3-D perspective scene generation software in real-time on embedded avionics hardware. The development methodology will involve the iterative use of software simulation techniques in conjunction with the progressive use of proposed scalable open architecture avionics hardware.

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 8 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and
Weapons Advanced Technology

PROJECT NUMBER: R0446
PROJECT TITLE: Advanced Avionics
Subsystems (AAS)

- (U) Geo-registered image mosaicing techniques and data compression technology required to fuse imagery from multiple sources and bring in information from off-board.
(U) Complete:
- (U) Initial demo of bringing off-board imagery from commercial source into a military cockpit by creating commercial imagery archive browser and retrieval software.
- (U) Integration of AVDFS with TAMPS 6.2 mission planning software.
- (U) Migration of AVDFS software to Windows NT processors.

- (U) (\$3,155) Scalable Open Architecture
(U) Continue:
 - (U) Realtime common object request broker architecture evaluation.
 - (U) Evaluation of dynamic reconfiguration in a realtime CORBA environment.
 - (U) Demonstration of 3-D visualization in embedded hardware.
(U) Complete:
 - (U) Realtime Database Management System.
 - (U) Backplane and network protocol evaluations.
 - (U) Demonstration of off-board interfaces.
 - (U) Renewal of legacy software systems processor emulator prototype chip which is capable of emulating the AN/AYK-14 mission computer processor.

- (U) (\$858) Advanced Interconnect Technology
(U) Continue:
 - (U) Evaluation of optical interconnect components for ships and aircraft under joint NAVSEA/Naval Air Systems Command (NAVAIR) Dual-Use S&T project agreement.
 - (U) Integration of key components for High Speed Optical Networks.

- (U) (\$515) Low Cost Sensors and Connectivity
(U) Continue:

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 9 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and
Weapons Advanced Technology

PROJECT NUMBER: R0446
PROJECT TITLE: Advanced Avionics
Subsystems (AAS)

- (U) Millimeter-wave (MMW) antenna concept analysis.

- (U) (\$85) Small Business Innovation Research (SBIR). Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

3. (U) FY 2000 PLAN:

- (U) (\$1,200) Advanced Visualization and Data Fusion Software
 - (U) Continue:
 - (U) Development of controllable time-of-day effects in AVDFS-rendered 3-D scene.
 - (U) Development of extended graphical annotation and editing techniques.
 - (U) AVDFS man/machine interface analysis in airborne environment.
 - (U) Complete:
 - (U) Ground-based demo showing mosaicing and fusion of off-board Unmanned Aerial Vehicle (UAV) video streams with AVDFS and render resulting 3-D product on an embedded open system architecture in near real-time.
- (U) (\$1,299) Scalable Open Architecture
 - (U) Initiate:
 - (U) On-board/off-board/archival database information fusion.
 - (U) Continue:
 - (U) Demonstration of distributed real-time application integrated with actual F-18 Mission Software.
 - (U) Complete:
 - (U) Final demonstration of dynamic reconfiguration in a Real-time CORBA environment.
 - (U) Completion of 3-D visualization in embedded hardware.
- (U) (\$950) Advanced Interconnect Technology
 - (U) Continue:
 - (U) Development of Fiber-optic Avionics SubCarrier Modulation (SCM) Transfer (FAST) Network.
 - (U) Complete:
 - (U) Dual-use ECSTATIC hardware demonstrations.

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 10 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and
Weapons Advanced Technology

PROJECT NUMBER: R0446
PROJECT TITLE: Advanced Avionics
Subsystems (AAS)

B. (U) PROGRAM CHANGE SUMMARY: See total program change summary for P.E.

C (U) OTHER PROGRAM FUNDING SUMMARY: Not applicable.

(U) RELATED RDT&E: This program adheres to Defense Reliance Agreements for Sensors, Electronics and Battlespace Environment (Integrated Platform Electronics).

(U) Work in this Program Element (PE) is related to and fully coordinated with efforts in the following PEs:

- (U) PE 0601152N (In House Lab Independent Research)
- (U) PE 0601153N (Defense Research Sciences)
- (U) PE 0602111N (Air and Surface Launched Weapons Technology)
- (U) PE 0602122N (Aircraft Technology)
- (U) PE 0602202F (Human Systems Technology)
- (U) PE 0602204F (Aerospace Avionics)
- (U) PE 0602234N (Materials, Electronic, and Computer Technology)
- (U) PE 0602708E (Cockpit Autonomous Landing)
- (U) PE 0603231F (Crew Systems and Personnel)
- (U) PE 0603238N (Precision Strike and Air Defense Technology)
- (U) PE 0603792F (Advanced Technology Demonstrations)
- (U) PE 0603800N & 0603800F (Joint Strike Fighter (JSF) DEM/VAL)
- (U) PE 0603253F (Advanced Avionics Integration)

D. (U) SCHEDULE PROFILE: Not applicable.

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 11 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: PROGRAM ELEMENT: 0603217N
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(U) COST: (Dollars in Thousands)

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R0447 Weapons Advanced Technology	19,412	23,693	21,439	23,802	24,960	25,671	26,345	27,039	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project will reduce technical risk by performing technology demonstrations in guidance and control, ordnance, Guns and Launchers, fire control air breathing propulsion and airframe aeromechanics sub-system/component concepts. It builds on the foundation of research emerging from Navy and Industry Applied Research projects funded by PE 0602111N programs which promise affordable performance improvements to existing and next generation Naval air and surface launched weapons. In FY98 the scope of this project was expanded to include the Extending the Littoral Battlespace (ELB) Advanced Concept Technical Demonstration (ACTD) which will demonstrate/exploit emerging technologies (commercial and government) for use in theater-wide, real time management of expeditionary forces operating within the littoral. In FY 99 ELB was funded in PE 0633238N and PE 0602315N. The elements of the project addresses Joint Mission Area (JMA) requirements for increased capabilities in surgical lethality of weaponry (Strike JMA), increased ship self defense capabilities (Littoral Warfare JMA) and increased accuracy and range for Naval Surface Fire Support (Strike and Littoral JMAS).

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 12 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology PROJECT NUMBER: R0447
PROJECT TITLE: Weapons Advanced Technology

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

- (U) (\$3,523) Cruise Missile Real Time Retargeting Demonstration:
 - (U) Produced Build 1 seeker.
 - (U) Established ground testing capability for Build 1 solid state Laser Detecting and Ranging Seeker (LADAR) in North Range Towers.
 - (U) Began flight testing of Build 1 solid state LADAR on T-39 aircraft.
 - (U) Modified the T-39 test aircraft to accept the Build 1 LADAR sensor. This task includes designing and fabricating the mechanical/electrical interface assemblies, wiring harnesses, and interface boards in Hardware in the Loop (HITL) lab.
 - (U) Produced Build 2 solid state LADAR components. Phase 3 will finalize the designs for the Tomahawk (Navy) and Small Smart Bomb (Air Force) tasks.
 - (U) Produced mission planning procedures and software for strike planning, targeting, and neural network training.
 - (U) Developed fixed target Autonomous Target Recognition Software.

- (U) (\$3,850) Surgical Strike Adaptive Weapon Control Video and Data Communication System:

This task develops and demonstrates advanced video compression and radio frequency (RF) modulation/coding technology for a podless digital weapon control data link system for use in joint strike operations.

 - (U) Designed, integrated, and lab tested RF modules, modem modules, network control processor modules, and central processor modules.
 - (U) Refined system level performance requirements.
 - (U) Performed prediction analysis of weapon control data link system.
 - (U) Designed, developed, and fabricated of RF, modem, network control, processor, and central processor submodules.
 - (U) Developed platform integration approach/design.

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 13 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology PROJECT NUMBER: R0447
PROJECT TITLE: Weapons Advanced Technology

- (U) Defined electrical and mechanical terminal interfaces.
- (U) Produced antenna design.

- (U) (\$1,200) Concentric Canister Launcher (CCL):
(U) This task will demonstrate a universal munitions launcher for Tomahawk, SM-2 Block IV, and Evolved Sea Sparrow Missile (ESSM). The technologies to be demonstrated involve missile fly out from a full scale launcher tube; validation, verification, computational design tools; and will demonstrate a distributed launch control system capable of simultaneous and coordinated launch of multiple missile types. This program is focused upon Affordability and will address reduced Life Cycle Costs through reducing manning, automated construction, and by utilizing a modular design.
 - (U) Designed and fabricated canister interface electronics unit.
 - (U) Developed fiber optic Local Area Network (LAN) architecture.
 - (U) Demonstrated all up distributed control system.
 - (U) Designed hardware for planned outyear SM2 Blk IV restrained firing tests.
- (U) (\$3,052) Concurrently Engineered (CE) Ball-Joint Gimbal for Joint Strike Weapon:
 - (U) Completed integrated CE seeker development and environmental demonstration.
 - (U) Finished Mechanical/electrical hardware design.
 - (U) Conducted CE seeker demonstration.
 - (U) Performed Ground, rooftop, HITL. Fabrication and flight clearance test preparation.
 - (U) Continued CE seeker integration and test.
- (U) (\$1,362) Shared Aperture:
(U) This task enables the development and demonstration of wideband multifunction RF systems with shared apertures and electronics to perform the functions currently performed by multiple RF systems, in particular radar, communications and electronic warfare systems.
 - (U) Constructed test prototype.
 - (U) Continued final design for open architecture multifunction RF system capable of meeting Navy requirements or a set of radar, communications and Electronic Warfare (EW) functions,

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 14 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology PROJECT NUMBER: R0447
PROJECT TITLE: Weapons Advanced Technology

-(U) Finished system requirements and performance specification.

- (U) (\$6,425) ELB:
 - (U) Continued fires and targeting definition for ELB ACTD system design.
 - (U) Conducted Exercises and feasibility demonstration definition.
 - (U) Performed ACTD systems engineering, development and integration.
 - (U) Completed design and initial outfitting of afloat testbed interface with Navy fires and targeting systems.

2. (U) FY 1999 PLAN:

- (U) (\$5,102) Cruise Missile Real Time Retargeting Demonstration:
 - (U) Demonstrate the Build 1 LADAR in the lab which includes the adaptive strike planning and fixed/mobile target automatic target recognition software, and Tomahawk 6 DOF simulation.
 - (U) Finish modification of the T-39 test aircraft to accept the Build 1 LADAR sensor. This task included design and fabrication of the mechanical/electrical interface assemblies, wiring harnesses, and interface boards to the lab.
 - (U) Conduct Flight testing of the Build 1 solid state LADAR on the T-39 aircraft.
 - (U) Fabricate Build 2 sensor for delivery in FY 2000.
 - (U) Modify the T-39 test aircraft to accept the Build 2 LADAR sensor. This task includes designing and fabricating the mechanical/electrical interface assemblies, wiring harnesses, and interface boards to the lab.
- (U) (\$3,204) Surgical Strike Adaptive Video Control and Data Communication System:
 - (U) This task develops and demonstrates advanced video compression and RF modulation/coding technology for a podless digital weapon control data link system for use in joint strike operations
 - (U) Start flight test planning for FY 2000 system verification and testing.
 - (U) Integrate terminals into ground test platforms.
 - (U) Ground test multiple terminals.

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 15 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology PROJECT NUMBER: R0447
PROJECT TITLE: Weapons Advanced Technology

- (U) Integrate terminals into flight test platforms.
- (U) Refine system level performance requirements.
- (U) Continue Performance prediction analysis of weapon control data link system.
- (U) Perform laboratory integration testing of terminals.
- (U) Finish design, development, and fabrication of RF, modem, network control, processor, and central processor submodules.
- (U) Complete platform integration approach/design.
- (U) Define electrical and mechanical terminal interfaces.
- (U) (\$5,370) CCL:
 - (U) Continue Tomahawk Computational Fluid Dynamics (CFD) model validation.
 - (U) Proceed with hatch design and fabrication.
 - (U) Maintain efforts for fabrication of prototype launch system hardware.
 - (U) Continue Design and fabrication of canister interface electronics unit.
 - (U) Complete demonstration of all up distributed control system.
 - (U) Development of fiber optical LAN architecture.
 - (U) Conduct SM2 Blk IV restrained firing.
- (U) (\$4,300) CE Ball-Joint Gimbal for Joint Strike Weapon:
 - (U) Start CE seeker flight tests and demonstration.
 - (U) Conduct CE seeker integration and test, ground, rooftop, HITL tests.
 - (U) Finish integration of CE gimbal hardware and flight test pod.
 - (U) Complete ground, rooftop, HITL, flight tests, and program documentation.
- (U) (\$1,160) Shared Aperture:
 - (U) This task enables the development and demonstration of wideband multifunction RF systems with shared apertures and electronics to perform the functions currently performed by multiple RF systems, in particular radar, communications and EW systems.
 - (U) Construct test prototype.

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 16 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology PROJECT NUMBER: R0447
PROJECT TITLE: Weapons Advanced Technology

- (U) Finish final design for open architecture multifunction RF system.
- (U) (\$1,560) High Speed Missile Technology (Formerly Hypersonic):
This task will demonstrate airframe propulsion guidance & control and ordnance technologies of the dual combustion ramjet for potential next generation Navy high speed strike missiles.
 - (U) Begin initial design of dual combustion ramjet test vehicle.
 - (U) Develop test plan for free jet testing of the ramjet.
 - (U) Develop preliminary design of the test stand.
- (U) (\$1,465) Land Attack and Deep Strike (LADS) Weapon Technology: This task will demonstrate the capability to substantially improve the mission planning and execution times for land attack and deep strike missions for both surface and submarine launched tactical strike weapons such as Tactical Tomahawk, Fasthawk, Navy Tactical Missile System (NTACMS), and the Land Attack Standard Missile (LASM). The demonstration uses the following technology developed in the 6.2 Weapons program (PE 0602111N): Weapon/target pairing, Bomb Damage Identification (BDI) from Synthetic Aperture Radar (SAR) processing, Global Positioning System (GPS)/Inertial Measurement Unit (IMU) attitude accuracy for 3 dimensional (3-D) precision targeting, algorithms for rapid Tomahawk mission planning, and rapid tactical area mapping.
 - (U) Define preliminary operational concept for the LADS weapon demonstration
 - (U) Produce an initial top level architecture for the mission planning system
 - (U) Identify components of the previous 6.2 program products that will be transitioned to the LADS weapon demonstration.
 - (U) Review software and hardware components of the 6.2 the elements (e.g. GPS/IMU, BDI SAR, etc) transitioning to the LADS demonstration. Identify the modifications required to integrate the components into the demonstration.
- (U) (\$1,400) IHRPRT:
(U) This task will demonstrate high kinetic performance air launched rocket motor technologies. These technologies will be integrated into a 5'-8' diameter flight weight rocket motor and demonstrated in ground

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 17 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology PROJECT NUMBER: R0447
PROJECT TITLE: Weapons Advanced Technology

tracking. Technologies demonstrated will include aluminized and non-aluminized reduced smoke propellants; light weight, high strength/stiffness component case; high pressure combustion; thrust vector control(TVC)(integrated aero/TVC and aft mounted jet reaction control); and a light weight, low erosion nozzle.

- (U) Optimize reduced smoke solid propellant grain geometry and burn rate characteristics.
- (U) Conduct static firing of subscale rocket motors at increasing chamber pressures to verify propellant specific impulse.
- (U) Analytically evaluates composite case strength.

- (U) (\$132) Small Business Innovation Research (SBIR). Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

3. (U) FY 2000 Plan:

- (U) (\$4,905) Cruise Missile Real Time Retargeting Demonstration:
 - (U) Complete flight testing of Build 1 LADAR
 - (U) Finish development of critical mobile target algorithm.
 - (U) Conduct synthetic scene generation work for hardware in the loop testing.
 - (U) Demonstrate adaptive strike planner executive allocator.
 - (U) Conduct ground test of Build 2 LADAR
 - (U) Begin flight testing of Build 2 LADAR
- (U) (\$3,300) Surgical Strike Adaptive Video Control and Data Communication System:
 - (U) Finish F/A-18 system integration studies.
 - (U) Complete Flight testing of Surgical Strike system. Demonstrate real time video and high bandwidth capacity in F/A-18 flight test aircraft.
- (U) (\$4,235) CCL:
 - (U) Complete Standard Missile II, Block IV restrained firing test.
 - (U) Finish CCL conceptual design for ship integration

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 18 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology PROJECT NUMBER: R0447
PROJECT TITLE: Weapons Advanced Technology

- (U) Conclude CCL life cycle cost study.
- (U) Produce final report.

- (U) (\$3,540) High Speed Missile Technology
 - (U) Perform component and subsystem integration for dual combustion ramjet propulsion system testing
 - (U) Fabricate test stand for free jet testing
 - (U) Conduct subsystem verification testing for dual combustion ramjet free jet testing
 - (U) Develop final design of dual combustion ramjet test vehicle.
- (U) (\$2,579) LADS weapon demonstration:
 - (U) Develop a detailed architecture and system design for the mission planning system configuration
 - (U) Define the interface requirements between the software interfaces of the rapid mission planning, tactical area mapping, and weapon/target pairing components.
 - (U) Test the coupled GPS/IMU attitude accuracy for 3-D precision targeting
 - (U) Begin implementation of planning system in testbed.
- (U) (\$780) Ship Based Defense Demonstration: This task will demonstrate the technologies for increasing the effectiveness of ship based defense systems in tracking and killing supersonic, maneuvering cruise (U) missiles. The task builds on the following PE 0602111N tasks: interactive adaptation of fire control to the environment, Non-Uniformity Compensated Focal Plane Array (NUCFPA), and clutter processing. Three technology demonstrations will be comprised of two components. The Adaptive weapon control demonstration will demonstrate the feasibility of increasing weapon performance by improving the ability of the weapon to adapt to changing propagation environments. The other component will improve the performance of the weapon warhead against maneuvering targets by implementing alternative warhead concepts.
 - (U) Evaluate and analyze the effectiveness of two alternative warhead designs, the reactive material warhead and the miniature aimed warhead. These warhead designs were developed in the PE 0602111N Air and Surface Weapons Technology (ASWT) program. A down select will be made to select the best alternative for a kill mechanism against a maneuvering threat.

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 19 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology PROJECT NUMBER: R0447
PROJECT TITLE: Weapons Advanced Technology

-(U) Conduct weapon system integration study of shipboard electro-Optic (EO) trackers, weapons control systems, and miniature command/link receivers. This will result in a down select between command guidance and command waypoint guidance.

- (U) (\$2,100) IHRPT Technology:
 - (U) Develop high strength, light weight, high pressure composite case rocket motor
 - (U) Develop and test low/no erosion nozzle throat insert materials and test to determine suitability
 - (U) Static test subscale low erosion nozzles at high pressure to determine erosion characteristics

B. (U) PROGRAM CHANGE SUMMARY: See total program change summary for P.E.

C. (U) OTHER PROGRAM FUNDING SUMMARY: Not Applicable

(U) RELATED RDT&E:

- (U) PE 0601152N (In House Lab Independent Research)
- (U) PE 0601153N (Defense Research Sciences)
- (U) PE 0602111N (Air and Surface Launched Weapons Technology)
- (U) PE 0602122N (Aircraft Technology)
- (U) PE 0602234N (Materials, Electronic, and Computer Technology)
- (U) PE 0602602F (Conventional Munitions)
- (U) PE 0603238N (Precision Strike and Air Defense Technology)
- (U) PE 0603609N (Conventional Munitions)
- (U) PE 0603601F (Advanced Weapons)
- (U) PE 0207133F (F-16 Squadrons)
- (U) PE 0203730A (Chaparral Missile)

D. (U) SCHEDULE PROFILE: Not applicable.

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 20 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N

PROGRAM ELEMENT TITLE: Air Systems and Weapons Advance Technology

(U) COSTS: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2264 Air Systems Affordability	5,930	5,728	5,511	2,988	2,140	2,323	183	322	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project demonstrates affordability concepts for future air platforms and surface/air weapons employed in Naval Warfare. The demonstrated concepts will support the development and implementation of a phased program to focus a portion of the Science and Technology (S&T) programs on improving the affordability of future major acquisitions programs.

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 21 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N

PROGRAM ELEMENT TITLE: Air Systems and
Weapons Advance Technology

PROJECT NUMBER: R2264

PROJECT TITLE: Air System Affordability

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

- (U) (\$5,930) Precision Strike Navigator (PSN)
 - (U) Continue wafer material & structure development and characterization
 - (U) Continue wafer fabrication.
 - (U) Begin fabrication of Inertial Measurement Unit (IMU).
 - (U) Begin test preparation for IMU testing
 - (U) Complete wafer fabrication process development

2. (U) FY 1999 PLAN:

- (U) (\$5,728) PSN:
 - (U) Continue test preparation and integration.
 - (U) Continue IMU fabrication
 - (U) Complete wafer material & structure development and characterization
 - (U) Complete wafer fabrication

3. (U) FY 2000 PLAN:

- (U) (\$1,400) PSN:
 - (U) Complete wafer fabrication
 - (U) Complete IMU fabrication and testing.
 - (U) Document results of demonstration

- (U) (\$4,111) Advanced Common Electronic Modules (ACEMs):
 - (U) Initiate:
 - (U) Development of ACEMs that will be smaller, and have less power consumption and higher performance than their analog counterparts, while accomplishing all the requisite acquisition, transmission and digital processing of Radio Frequency (RF) signals over a very wide frequency range (50 MHz to 45 GHz). The family of ACEMs consists of advanced analog-to-digital technology and will be integrated to create systems capable of performing multiple

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 22 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N

PROGRAM ELEMENT TITLE: Air Systems and
Weapons Advance Technology

PROJECT NUMBER: R2264

PROJECT TITLE: Air System Affordability

functions. This enhances affordability through a 10-fold projected decrease in systems weight and power consumption, a 15-fold increase in systems performance, and substantial Life Cycle Cost savings. This program & technology is scheduled to transition from PE 0602122N by the end of FY99.

B. (U) PROGRAM CHANGE SUMMARY: See total program change summary for P.E.

C. (U) OTHER PROGRAM FUNDING SUMMARY: Not applicable.

(U) RELATED RDT&E:

- (U) PE 0601152N (In House Lab Independent Research)
- (U) PE 0601153N (Defense Research Sciences)
- (U) PE 0602111N (Air and Surface Launched Weapons Technology)
- (U) PE 0602122N (Aircraft Technology)
- (U) PE 0602234N (Materials, Electronic, and Computer Technology)
- (U) PE 0602602F (Conventional Munitions)
- (U) PE 0603238N (Precision Strike and Air Defense Technology)
- (U) PE 0603609N (Conventional Munitions)
- (U) PE 0603601F (Advanced Weapons)
- (U) PE 0207133F (F-16 Squadrons)
- (U) PE 0203730A (Chaparral Missile)

D. SCHEDULE PROFILE: Not applicable.

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 23 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N

PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	TO COMPLETE	TOTAL PROGRAM	
W2014	Integrated High Performance Turbine Engine Technology (IHPTET)	5,171	7,559	7,211	7,180	7,903	7,377	7,543	7,712	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project covers the Navy's share of the demonstrator engine efforts under the Department of Defense (DoD)/Naval Aeronautics and Space Administration (NASA) Industry IHPTET program, ensuring that Navy unique design and operational requirements are met. Full scale integrated technology demonstration is essential to validate and transition technologies from applied research through advanced development and into system demonstration/validation, engineering and manufacturing development or product lines. Without technology demonstrators, system acquisition cost/schedule risk would have an unacceptably higher level or programs would have to settle for less operational capability. The lack of technology demonstrator efforts could result in system development schedule increases of five or more years along with the associated increase in cost. The technology sets integrated into and demonstrated in the IHPTET demonstrator engines are closely related to the system requirements for the Joint Strike Fighter (JSF), F-18E/F, Common Support Aircraft (CSA), Multi-mission Maritime Aircraft (MMA), V-22 and SH-60R so that the transition of these high risk and high payback technologies may be effectively accomplished. A strong and viable U.S. propulsion program also provides a dual-use benefit to our country by enhancing our competitiveness in the international commercial engine market. This long term project coordinated through Reliance, will provide for the future needs in air battlespace dominance and expeditionary forces support (Littoral Warfare Joint Mission Area (JMA)), increased platform mission endurance.

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 24 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N

PROGRAM ELEMENT TITLE: Air Systems and
Weapons Advanced Technology

PROJECT NUMBER: W2014

PROJECT TITLE: Integrated High Performance
Turbine Engine Technology

(Intelligence, Surveillance, and Reconnaissance JMA) and provide technology for increased affordability and platform survivability and increased mission effectiveness (Strike JMA). The program funds three demonstrator engine classes. Each engine class has specific performance goals that are divided into multiple phases. Following from the initial IHPTET goal of doubling the propulsion capability by the year 2003, additional goals were recently approved to address future concepts, i.e., Phase IV (2009). Phase I has been completed and demonstrated for each of the three classes of demonstrators. Phase II is currently progressing to the engine demonstration phase, for all of the advanced component technologies, in the current fiscal year. The Phase III concepts were developed and are currently in the source selection process. The phase goals of each engine class are listed as follows and are referenced to a 1987 baseline (additional affordability goals have been developed for fighter/attack and turboprop/shaft classes):

- (U) Fighter/attack (Joint Technology Demonstrator Engine (JTDE)):
Phase I - 1993: +30% thrust/weight (Fn/Wt), +100 °F combustor inlet temperature (CIT), +300 °F turbine inlet temperature (TIT), -20% fuel burn.
Phase II - 1997: +60% Fn/Wt, +200 °F CIT, +600 °F TIT, -20% acquisition cost, -20% maintenance cost, -30% fuel burn.
Phase III - 2003: +100% Fn/Wt, +400°F CIT, +900°F TIT, -35% acquisition cost, -35% maintenance cost, -40% fuel burn.
- (U) Turboprop/shaft (Joint Turbine Advanced Gas Generator (JTAGG)):
Phase I - 1993: +40% shaft horsepower/weight (SHP/Wt), -20% specific fuel consumption (SFC), +300 °F TIT.
Phase II - 1997: +80% SHP/Wt, -30% SFC, +600 °F TIT, -20% acquisition cost, -20% maintenance cost.
Phase III - 2003: +120% SHP/Wt, -40% SFC, +1000 °F TIT, -35% acquisition cost, -35% maintenance cost.
- (U) Missile/expendable engines (Joint Expendable Turbine Engine Concepts (JETEC)):
Phase I - 1991: +35% thrust/airflow (Fn/Wa), -20% SFC, +1100 °F CIT, +500 °F TIT, -30% Cost.
Phase II - 1997: +70% Fn/Wt, -30% SFC, +1200 °F CIT, +900 °F TIT, -45% Cost.
(U) Phase III - 2003: +100% Fn/Wa. -40% SFC, +1400 °F CIT, +1400 °F TIT, -60% Cost.
(U) Phase IV - 2009: +140% Fn/Wa, -40% SFC, +1800 °F CIT, +1800 °F TIT, -60% production cost, -30% development cost

(U) Each engine company (Allison Advanced Development Company (IN), AlliedSignal Engines (AZ), General Electric (OH & MA), Pratt & Whitney (CT & FL), Teledyne Ryan Aeronautical (OH) and Williams International (MI)) attempts to utilize at least two engine builds or demonstrator tests within each Phase to demonstrate the performance goals. The JETEC

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 25 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N

PROGRAM ELEMENT TITLE: Air Systems and
Weapons Advanced Technology

PROJECT NUMBER: W2014

PROJECT TITLE: Integrated High Performance
Turbine Engine Technology

Phase II goals are divided into demonstrating SFC and Cost for a subsonic demonstrator and Fn/Wa, CIT, TIT and Cost for a supersonic demonstrator.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

- (U) (\$4,956) Continued:
 - (U) Phase II JTDE: Completed fabrication, assembly and instrumentation of demonstrator engines.
- (U) (\$215) Initiated:
 - (U) Phase III JTDE: Source selection.
 - (U) Phase III JTAGG: Source selection.
 - (U) Phase III JETEC: Source selection.

2. (U) FY 1999 PLAN:

- (U) (\$4,642) Continue:
 - (U) Phase II JTDE: Demonstration of progress to Phase II goals with P&W demonstration engine. Complete fabrication, assembly and instrumentation of General Electric (GE)/ Allison Advanced Development Company (AADC) demonstrator engine. Phase II goals with GE/AADC demonstration engine.
 - (U) Phase II JTAGG: Initial Allied Signal Engines demonstrator engine test. Component optimization and demonstrator engine testing to meet Phase II goals.
 - (U) Phase II JTAGG: Design, component development and fabrication for demonstrator engine and assembly and test of demonstrator engine.
 - (U) Phase II JETEC: Supersonic Phase II demonstrator test of a non-metallic core turbojet meeting Fn/Wa and cost goals.
- (U) (\$2,917) Continue:
 - (U) Phase III JTDE: Contract award and initiate design of Phase III demonstrator engines.
 - (U) Phase III JTAGG: Contract award and initiate design of Phase III demonstrator engines.
 - (U) Phase III JETEC: Contract award and initiate design of Phase III demonstrator engines.

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 26 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N

PROGRAM ELEMENT TITLE: Air Systems and
Weapons Advanced Technology

PROJECT NUMBER: W2014

PROJECT TITLE: Integrated High Performance
Turbine Engine Technology

3. (U) FY 2000 PLAN:

- (U) (\$7,211) Continue:
 - (U) Phase II JTDE: Demonstration of Phase II goals with GE/AADC demonstration engine
 - (U) Phase II JTAGG: Demonstration of Phase II goals with Allied Signal demonstration engine.
 - (U) Phase III JTDE: Fabrication, assembly and instrumentation of demonstrator engines.
 - (U) Phase III JTAGG: Design, component development and fabrication for demonstrator engine and initiate demonstrator engine testing to meet Phase III goals.
 - (U) Phase III JETEC: Design, component development and fabrication of Phase III demonstrator test of a non-metallic core turbojet meeting Fn/Wa and cost goals and an advanced demonstrator to meet SFC goals.

B. (U) PROGRAM CHANGE SUMMARY: See total program change summary for P.E.

C. (U) OTHER PROGRAM FUNDING SUMMARY: Not applicable.

(U) RELATED RDT&E:

- (U) PE 0601152N (In House Lab Independent Research)
- (U) PE 0601153N (Defense Research Sciences)
- (U) PE 0601102F (Defense Research Sciences)
- (U) PE 0601102A (Defense Research Sciences)
- (U) PE 0602122N (Aircraft Technology)
- (U) PE 0602234N (Materials, Electronic & Computer Technology)
- (U) PE 0602203F (Aerospace Propulsion)
- (U) PE 0602211A (Aviation Technology)
- (U) PE 0603202F (Aircraft Propulsion Subsystem Integration)
- (U) PE 0603216F (Advanced Turbine Engine Gas Generator)
- (U) PE 0603003A (Aviation Advanced Technology)

D. (U) SCHEDULE PROFILE: Not applicable.

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 27 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N

PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology

(U) COSTS: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2455 Vectoring Extremely Short Take-off and Landing (ESTOL) Control Tailless Operation Research (VECTOR)	0	4,989	4,436	492	0	0	0	0	0	9,917

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Vectoring ESTOL Control Tailless Operation Research (VECTOR) effort is an international cooperative program with Germany and Sweden. This task is a follow-on to a previous X-31 thrust vectoring flight demonstration with Germany as our partner. That effort utilized engine exhaust thrust vectoring vanes (TVV) to produce thrust vectoring and was limited to medium and high altitude fighter maneuvering. ESTOL and Reduced tail/directional control were not addressed. VECTOR will utilize the X-31 aircraft to develop, demonstrate and provide quality metrics and operational concept formulation and validation of ESTOL. The program will also explore reduced tail/directional controls using multiaxis, axisymmetric nozzle thrust vectoring with a first-ever fully integrated flight, engine and nozzle control with the AVEN® multiaxis axisymmetric engine nozzle and an Advanced Air Data System (AADS). Pay-offs for such technologies and concepts include reductions in requirements for runways for expeditionary operations, reductions of catapult and arresting gear and wind-over-the deck requirements, decreased aircraft catapult and arresting loads, and decreased aircraft weight, observability, and maintenance costs. Other benefits include significantly increased performance and decreased operating costs (due to weight and aerodynamic drag reduction), significantly lower take-off and landing energy (which would reduce aircraft fatigue), and increased safety of flight (due to significantly reduced out-of-control flight incidents). VECTOR results will be applicable to tactical aircraft and unmanned aerial vehicles. Foreign candidates include JAS39 GRIPEN (Sweden) and EF2000 (Germany). In addition, applicability to Foreign Military Sales (FMS) F/A-18 could be realized through F-400 series engine engine upgrades in FMS aircraft and engine rework in foreign depots (e.g., Spain/Integrated Product Team (IPT)).

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 28 of 31)

UNCLASSIFIED

UNCLASSIFIED

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and
Weapons Advanced Technology

PROJECT NUMBER: R2455
PROJECT TITLE: Vectoring ESTOL Control
Tailless Operation Research (VECTOR)

1. (U) FY 1998 ACCOMPLISHMENTS: Not applicable.
2. (U) FY 1999 PLAN):
 - (U) (\$4,866) Initiate:
 - (U) Aircraft reactivation.
 - (U) ESTOL concept and requirements definition.
 - (U) ESTOL modeling and simulation.
 - (U) Wind tunnel testing, supporting concept and requirements definition.
 - (U) Update of ESTOL aerodynamics data set.
 - (U) AVEN® nozzle preliminary design.
 - (U) Flight control law development.
 - (U) System design for installation and integration of X-31 flight controls, engine controls and exhaust nozzle controls.
 - (U) Extensive wind tunnel testing of X-31 integrated systems. This testing will be performed at various sites throughout the U.S. Germany and Sweden.
 - (U) Requirements definition, design and fabrication of a multiaxis axisymmetric exhaust vectoring nozzle.
 - (U) Modifications to X-31 flight control software.
 - (U) Modifications to X-31 exhaust nozzle controls.
 - (U) Modifications to X-31 engine controls.
 - (U) Requirements analysis, design and integration requirements for reduced tail/directional control.
 - (U) Design and fabrication of an Advanced Air Data System (flush port).
 - (U) Ground test and aircraft integration of an Advanced Air Data System.
 - (U) Development of ESTOL and reduced tail concepts and conduct simulation and ground tests, including wind tunnel testing.
 - (U) (\$123) Small Business Innovation Research. Portion of extramural program reserved for small business Innovation research assessment in accordance with 15 USC 638.

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 29 of 31)

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FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and
Weapons Advanced Technology

PROJECT NUMBER: R2455
PROJECT TITLE: Vectoring ESTOL Control
Tailless Operation Research (VECTOR)

3. (U) FY 2000 PLAN (\$4,436):

(U) Continue: (additional work funded in previous years in PE 0603790N):

- (U) Modifications to X-31 flight control software.
- (U) Modifications to X-31 exhaust nozzle controls.
- (U) Ground and flight test of Advanced Air Data System

(U) Continue:

- (U) System design installation and integration of X-31 flight controls, engine controls and exhaust nozzle controls.
- (U) Design fabrication and testing, of a multiaxis axisymmetric exhaust vectoring nozzle.
- (U) Ground and flight test of ESTOL systems.
- (U) Extensive wind tunnel testing of X-31 integrated systems.
- (U) Requirements analysis, design and integration requirements engineering for reduced tail/directional control.

(U) Complete (additional work funded in previous years in PE 0603790N):

- (U) Design-fabrication, and integration of an Advanced Air Data System (flush port)

(U) Complete:

- (U) Design of multiaxis axisymmetric exhaust vectoring nozzle aircraft modifications requirements.
- (U) Design of multiaxis asymmetric exhaust vectoring nozzle.

B. (U) PROGRAM CHANGE SUMMARY: See total program change summary for P.E.

C. (U) OTHER PROGRAM FUNDING SUMMARY: Not applicalbe.

(U) RELATED RDT&E: This program adheres to Defense S&T Reliance Agreements for Air Platforms (Fixed Wing Vehicles).

(U) PE 0601101F (Geophysics)

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 30 of 31)

UNCLASSIFIED

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FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: January 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and
Weapons Advanced Technology

PROJECT NUMBER: R2455
PROJECT TITLE: Vectoring ESTOL Control
Tailless Operation Research (VECTOR)

- (U) PE 0601102F (Materials)
- (U) PE 0601153N (Defense Research Sciences)
- (U) PE 0602122N (Aircraft Technology)
- (U) PE 0602201F (Aerospace Flight Dynamics)
- (U) PE 0602203F (Aerospace Propulsion)
- (U) PE 0602204F (Aerospace Avionics)
- (U) PE 0602234N (Materials, Electronic and Computer Technology)
- (U) PE 0603112F (Advanced Materials)
- (U) PE 0603202F (Aerospace Propulsion Subsystems Integration)
- (U) PE 0603205F (Flight Vehicle Technology)
- (U) PE 0603211F (Aerospace Structures)
- (U) PE 0603216F (Aerospace Propulsion and Power Technology)
- (U) PE 0603245F (Advanced Flight Technology Integration)
- (U) PE 0603790N (NATO Research and Development)
- (U) PE 0603800N & 0603800F (Joint Advanced Strike Technology Program)

D. (U) SCHEDULE PROFILE: Not applicable.

R-1 Line Item 15

Budget Item Justification
(Exhibit R-2, page 31 of 31)

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