FY 2000 PRESBUDG RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N
PROGRAM ELEMENT TITLE: Air and Surface Launched Weapons Technology

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
Air & Surface Launched Weapons Technology	22,886	40,823	37,616	39,572	39,959	40,565	41,541	42,549	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program element (P.E.) develops new and innovative technologies which will support future weapons systems for surface and air platforms for Naval Warfare.

(U) The Air and Surface Weapons Technology (ASWT) program has been developed to implement a structured weapons technology program that will maintain the Naval air and surface weapons capability through the 21st century. The ASWT program provides technology traceability by identifying System payoffs and warfighter benefits and the quantitative goals that will provide those payoffs/benefits. Objectives, technical challenges, and approaches that will meet the goals are then identified for each of the four mission areas. The following paragraphs describe the time phased technology goals for each of the four mission areas.

(U) Air Superiority: The projects within the ASWT Air Superiority mission area are focused on the achievement of time-phased technology goals for the 2005, 2010, and 2015 time frame, which will reproduce a number of technology options for future air superiority weapons, significantly increase pilot survivability by allowing them to look first, shoot first, and kill first, while increasing air superiority weapon affordability. The 2005, 2010, and 2015 technology goals, which have been coordinated with N88, are to increase missile flyout range 25%, 50%, and 100%; increase missile average velocity 10%, 20%, and 30%; increase missile maneuverability 45%, 65%, and 85%; increase weapon launch angle 20%, 40%, and 60%, increase missile seeker acquisition range 100%, 250%, and 300%; increase seeker off boresight angle 135 degrees and 180 degrees; increase seeker probability of detect 10%, 20%, and 30%; decrease missile payload size 20%, 30% and 50%; and increase warhead control accuracy to centroid, image centroid, and edge detect. All improvements are relative to the

AIM-9x and AIM-120C system. Work being performed under the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) is supporting the achievement of the flyout range, average velocity, maneuverability, and weapon launch angle goals. As with the IHPRPT program, the ASWT program is an integrated Navy/industry program, comprised of government funded and industry funded projects. For FY 99 through FY04, the emphasis will be on the achievement of the Phase 1 goals. The technologies developed under this task will be transitioned to the Phase 1 air superiority demonstrator, which is funded under PE0603217N, R0447. After successful demonstration, these technologies are available for air superiority or ship-based defense weapon system demonstration/validation or Engineering and Manufacturing Development (EMD).

(U) Naval Surface Fire Support: The projects within the ASWT Naval Surface Fire Support mission area are focused on the achievement of time-phased technology goals for the 2005, 2010, and 2015 time frame. The achievement of these goals will produce a number of technology options for future naval fire support weaponry, significantly improving the probability of kill per round as well as the amount of sustained call fire while increasing the affordability of future naval fire weapon systems. The 2005, 2010, and 2015 goals, which have been coordinated with N86, are increase gun launched projectile flyout range to 70 nmi, 150 nmi, and 200 nmi; increased missile flyout range to 150 nmi, 250 nmi, and 350 nmi; achieve gun projectile flyout times for the range goals of 6 minutes or less, 14 minutes or less, and 10 minutes or less; achieve missile flyout times for the range goals of 5 minutes, 4 minutes, and 4 minutes; increase target aimpoint accuracy to 10m, 1m, and 1m for moving targets; increase payload density to 15%, 30%, and 45%; decrease rounds per kill to 3, 1.2(stationary target), and 1.2 (hard target); and develop improved warheads that can: deliver a variety of submunitions, operate in a dual or multifunction mode and, utilize high energy reactive materials for greater effectiveness. All these goals are relative to 1995 state-of-the-art. The projectile range and time of flight goals are being supported in part by the IHPRPT program. The emphasis of the FY99-FY04 program will be on the achievement of the Phase 1 (2005) goals. Technologies developed to support this phase will be transitioned to the phase 1 Land Attack demonstrator, funded by P.E. 0603217N, R0447. Upon successful demonstration, these technologies are available for Naval Fire Support or Land Attack weapon system demonstration/validation or EMD. As with the IHPRPT program, the ASWT program in an integrated Navy/industry program with tasks being funded and performed by government and industry.

(U) Precision Strike: The ASWT Precision Strike program is focused on the achievement of time-phased technology goals for the 2005, 2010, and 2015 time frame. The achievement of these goals will produce technology options to allow the warfighter to successfully engage time critical targets, improve weapon and platform survivability, significantly increase weapon hard target capability, and significantly increase single shot probability of kill while increasing the

affordability of future precision strike weapon systems. The 2005, 2010, and 2015 goals, which have been **coordinated** with N88, are to decrease target location error to 8m, 1m, and 1m; increase target/weapon pairing rate to 20/hr, 100/hr, and 500/hr; decrease mission planning and optimization time to less than 5 minutes, then to less than 1 minute; increase weapon based Automatic Target Recognition (ATR) capability to greater than 90% acquisition in limited clutter, greater than 90% acquisition in moderate clutter, and greater than 60% acquisition in heavy clutter; increase average weapon velocity to M4, M6, and M8; increase weapon flyout range 30%, 50%, and 100%; increase hard target penetration by 5x and 7x; and increase seeker Global Positioning System (GPS) antijam capability to +10db, +20db, and +30db. All goals are relative to 1995 state of the art. The weapon velocity and range goals are partially supported by the projects within the IHPRPT program. The emphasis of the FY99-FY04 projects are to achieve the Phase 1 goals. The technologies developed by the funded projects will be transitioned to the Land Attack demonstrator, funded by P.E. 0603217N, R0447. Upon successful demonstration, these technologies will be available for Precision Strike or Land Attack weapon system demonstration/validation or EMD. As with IHPRPT, the ASWT program is an integrated Navy/industry program with work being funded and performed by the government and industry.

(U) Ship Based Defense: The ASWT Ship-Based Defense program is focused on the achievement of time-phased technology goals for the 2005, 2010, and 2015 time frame. The achievement of these goals will produce technology options to significantly increase the effectiveness and affordability of future ship-based defense weapon systems. The 2005, 2010, 2015 goals, which have been coordinated with N86, are to increase the number of engagements per threat to 2-3, 6-7, and 6-7; increase the available command decision time to 15 sec, and 15 seconds in adverse conditions; increase the probability of catastrophic kill per intercept to 0.6, 0.8, and 0.95; increase the total number of targets simultaneously engagable to 2-4, 4-6, and 6-8; and increase maneuver counter capability to 15gs, 30gs, and 50gs. All goals are relative to 1995 state of the art. The emphasis of the FY99-FY04 projects are on the Phase 1 goals. The technologies developed to achieve these goals will be transitioned to a ship-based defense technology demonstrator, funded by P.E. 0603127N, R0447. Upon successful demonstration, these technologies will be available for Ship-Based Defense or Air Superiority demonstration/ validation or EMD. The ASWT program is an integrated Navy/industry program with projects being funded and performed by government and industry.

(U) Integrated High Payoff Rocket Propulsion Technology (IHPRPT): The projects within the IHPRPT program are focused on the achievement of time-phased technology goals for the 2000, 2005, and 2010 time frame, which will produce a number of rocket propulsion technology options to significantly increase the effectiveness of air superiority, naval fire support,

and precision strike weapon systems by increasing missile range 50%; increasing missile speed 20%, which results in shorter time to target, increased opportunity for shoot-look-shoot, allowing earlier disengagement of launch platforms, and allowing greater energy for maneuvering; increasing missile payload by 100%, decreasing propulsion size and weight by 25%, and doubling the missile no-escape zone and launch acceptability regions . The 2000, 2005, and 2010 goals, which have been coordinated with N86 and N88, and endorsed by DDR&E, are to improve the propulsion system delivered energy by 3%, 7% and 15%; improving motor mass fraction (without thrust vector control (TVC)/throttling) 2%, 5%, 10%; and improving motor mass fraction (with TVC/throttling) 10%, 20%, and 30%. IHPRPT is an integrated Department of Defense (DoD)/National Aeronautics and Space Administration (NASA)/Industry program with projects being funded and performed by government and industry.

(U) Due to the sheer volume of efforts involved in this P.E., the efforts described in the accomplishments and plans section are representative selections of the work included in this P.E..

(U) These efforts support the Joint Warfare Strategy "Forward...from the Sea". Programs in this P.E. are jointly planned in the Defense Reliance process with the Air Force and Army.

(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.

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PROGRAM ACCOMPLISHMENTS AND PLANS:

1. FY 1998 ACCOMPLISHMENTS:

- (U) (5,280) SHIP BASED DEFENSE IN SUPPORT OF SURFACE BATTLESPACE: The efforts in Ship Based Defense will develop weapons technologies to achieve minimum and maximum intercept ranges of 100 meters to 3 nmi, decreased reaction time of 10 seconds and increased probability of robust kills of 0.3 and 0.6.
  - (U) Initiated:
    -- (U) Testing and measurements for low altitude propagation by remote sensors for sensor adaptation.
    -- (U) Low altitude fuze technology assessment using a high power short pulse laser Target Detection Device (TDD) for improved performance in low visibility aerosol and smoke conditions.
  - (U) Continued:
    -- (U) Ram Accelerator technology development experiments at high fill (50 Atm) pressure.
  - (U) Completed:
    -- (U) Infrared Focal Plan Array (IRFPA) test bed tracker effort by field testing tracker and by successfully demonstrating non-uniformity signal processing compensation technique. Submitted and under review by Naval Sea Systems Command (NAVSEA) for potential transition to Electro Optic (EO) track AN/SWY-1 Thermal Imagery Sensor Systems (TISS) and MK-46 EO site. Proposed as an EO tracker for Theater Ballistic Missile Defense (TBMD) application.
    -- (U) Conformal aperture antenna characterization to be used for wideband and conformal seeker technology prototype.
    -- (U) Reactive Material air target warhead technology development. Transitioned **technology** to 6.3 Reactive Materials ATD.

- (U) ($2,210) AIR SUPERIORITY:
  - (U) Initiated:
    -- (U) Joint technology development effort with the Air Force for next generation air to air missile capabilities. Navy efforts include high-pressure rocket motor and Infrared (IR) seeker performance improvements.
  - (U) Continued:

-- (U) Radio Frequency (RF) Guidance-integrated Fuse (GIF) high range resolution lethality improvement assessment.
-- (U) Development of insensitive, high performance solid rocket propulsion components from screening of emerging energetic materials, scale-up and propellant formulation, through characterization of subscale performance.
-- (U) Propellant formulation investigations started in FY96 with Integrated High Payoff Rocket Propulsion Technology (IHPRPT) Congressional plus-up funding and expanded ingredients base to include CL-20 and poly gamma Cyclodectrin Nitrate (CDN).
-- (U) Investigation of aimable ordnance to increase missile lethality equal to or less than 80% of the current weight/volume of Advanced Medium Range Air to Air Missile (AMRAAM) warhead. Prioritize recommendations among the fireset, reactive materials and explosive kills provided.

- (U) Completed:
  -- (U) Diamond dome strength improvements and polishing efforts.
  -- (U) Aerodynamic advanced prediction code development for applications including non-axisymetric body configurations, nonlinear modes and core aeroprediction studies. Transition to Aero Prediction (AP)-98 aero codes for use by industry and government.

• (U) ($2,180) IHPRPT:
- (U) Initiated:
  -- (U) Award on-command pintle thrust magnitude control contract that helps achieve the Phase II goals of delivered energy and mass fraction.
  -- (U) Award low erosion nozzle material contract that investigates nozzle insert materials to meet Phase II delivered energy and improved mass fraction goals.
  -- (U) Award dual-movable nozzle throat vector control concepts to meet Phase II mass fraction with TVC/throttling goals.
- (U) Continued:
  -- (U) Develop plateau propellant ingredient test matrix to determine most appropriate ingredients for air-launched missiles and develop candidate propellant formulations.

-- (U) Develop ammonium dinitramide (ADN) propellant formulation test matrix to determine optimal formulation for highest delivered energy and processability to meet Phase II IHPRPT delivered energy goals.
-- (U) Develop aluminum hydride test matrix to determine optimal formulations for highest delivered energy and processability to meet IHPRPT Phase II delivered energy goals.
-- (U) Slow cook-off methodology task to develop a consistent methodology to determine the insensitive munition compliance of the develop IHPRPT Phase II and Phase III propellants.
-- (U) Hydrostatic testing of gun-launched projectile propellant grains and case design to meet IHPRPT Phase II mass fraction goals.

- (U) Completed:
  -- (U) Demonstrate Innovative Vector (INOVEC) flexible nozzle TVC concept, preparing the component for possible Phase I air-launched motor demonstrator, showing achievement of the Phase improved mass fraction goal of 10%.
  -- (U) Documentation for the combustion instability task, which provides the data for understanding of designing high-pressure solid propulsion motor which achieve the IHPRPT delivered energy performance goals.

• (U) ($7,290) STRIKE AND ANTI SURFACE WARFARE (ASUW) WEAPONRY:
- (U) Initiated:
  -- (U) Precision Target Handoff task to demonstrate precision target coordinate handoff for both airborne direct fire control and tactical standoff weapons including unguided and Global Positioning System (GPS)/Inertial Navigation System (INS) weapons.
  -- (U) Automatic Target Recognition (ATR) performance prediction task to develop a predictive capability for imaging seeker-based ATR systems.
  -- (U) Investigate and develop a low cost Millimeter Wave (MMW) antenna element using Micro Electronic Machine System (MEMS) technology that will provide a less expensive seeker with higher angular resolution using MMW radar.
  -- (U) Investigate advanced wavelet-based signal processing techniques to reject GPS jammers.
- (U) Continued:

-- (U) Assessment of optimized lifting body airframe technology for air launched supersonic strike weapon applications. Will investigate lightweight, low cost structural design concepts using composite materials and low cost/low temperature materials for high temperature applications.
-- (U) Laser Radar (Ladar) performance model development to identify optimal performance in mobile target engagements under a variety of background conditions.
-- (U) Tuned ATR extraction and registered data base that provides a feature set and algorithms for engaging the target using Ladar imagery within the constraints of operation (e.g. clutter, weather etc).
-- (U) Technology development in ATR/signal processing to include bio-vision techniques
-- (U) Fuzzy ATR characterization to develop Ladar seeker ATR algorithms that improve uncertainty management using fuzzy logic subprocesses. Improved noise cleaning using a context dependent filter for processing range anomalies.

- (U) Completed:
  -- (U) Parallel distributed processing techniques for routing and mission planning applications with transition to P.E. 0603217N, for captive flight test evaluations.
  -- (U) Techniques for Land Attack Bomb Damage Indication (LABDI) and classification developed for high resolution Synthetic Aperture Radar (SAR) imagery. Under review by Joint Surveillance Target Attack RADAR System (JSTARS), S3, and P3 programs for potential implementation. Created a DoD unique SAR Bomb Damage Indication (BDI) database of 10,000+ images that is to be delivered to multiple DoD locations.
  -- (U) In cockpit target scene predictor algorithm developed and reported in North Atlantic Treaty Organization (NATO) RSG-9 compendium of fuzed sensor activities.

- (U) ($5,926) Naval Surface Fire Support (NSFS): The efforts in NSFS will develop the weapons technologies to achieve the following goals: Probability of detection (Pd)=0.9, the Probability of decoy rejection (Pdr)=0.9, Lethality (rounds/kill)= 3/mobility kill, Warhead flexibility = Lethality submunitions, and <2 min sensor to weapon and fire control timeline.
  - (U) Continued:

-- (U) Electro Optic/Infrared and Quasi optical gun launched seeker to improve terminal guidance of projectiles and submunitions to place more ordnance on target and require less rounds for a target kill. Complete first order optimal designs and raydomes and initial output algorithms.
-- (U) Weapons modeling and simulation to provide tools for design of NSFS systems include Computational Fluid Dynamics (CFD) for vertical launchers and aeroprediction codes. Complete assessment of mid-body obdurator.
-- (U) Develop Mission Responsive Ordnance (MRO) technologies to enable a single ordnance package to produce a variety of kill effects to better match weapons against different target configurations. Complete evaluation of gun launched submunition designs.
-- (U) Investigate Image Video Analysis for near real time integrated ability to detect, track, classify, and precisely locate targets with image and video to increase targeting accuracy and provide a reduced response time for targeting. Finish architecture of demo processor.
-- (U) Hyperspectral decoy recognition to develop technology for low cost staring hyperspectral sensor to reject sophisticated land based decoys when viewed by air platforms such as Unmanned Air Vehicle (UAVs). Complete performance assessment of low cost hyperspectral sensor in laboratory.
-- (U) Precision targeting using GPS/IMU for altitude to provide 10m Target Location Error (TLE), providing required targeting accuracy required by Extended Range Guided Munition (ERGM), Best Buy, and other fire-on-coordinates weapons. Complete evaluation of effectiveness of GPS/IMU kinematic techniques on breadboard.
-- (U) Interferometric Synthetic Aperture Radar (IFSAR) to demonstrate and validate techniques for processing multipath IFSAR into digital elevation maps (DEMS) with techniques to control DEMS to GPS. These efforts will attempt to reduce the cost per kill through improved aimpoint accuracy as well as supporting mission planning and Bomb Damage Analysis (BDA). Evaluate precision of satellite denied DEMs relative to ground truth data from Germany.

2. FY 1999 PLAN:

- (U) ($7,865) SHIP BASED DEFENSE IN SUPPORT OF SURFACE BATTLESPACE: The efforts in Ship Based Defense will develop weapons technologies to achieve minimum and maximum intercept ranges of 100 meters to 3 nmi, to reduce reaction time to 10 seconds, and to increase the probability of robust kills of 0.3 and 0.6.
  - (U) Initiate:
    - (U) Assessment of low cost seeker components in the MMW spectral region.
    - (U) Lethality assessments for high-energy lasers applied to ship self-defense.
    - (U) Conformal aperture seeker technology assessment for wideband terminal homing on low altitude threats.
    - (U) Surface launched propulsion investigations for increasing missile average velocity.
  - (U) Continue:
    - (U) Assessment of low altitude propagation and major demonstrations supporting interactive adaptation of radar sensors. Document technical results and conclusions from FY98 experiments
    - (U) Low altitude fuze technology assessment using a high power short pulse laser TDD for improved performance in low visibility aerosol and smoke conditions. Document FY98 technical assessment, select technologies for further investigation.
    - (U) Reactive materials warhead lethality investigation by testing baseline warhead design and conducting gas gun tests to facilitate development of shock induced reaction models, evaluate new lethal mechanisms, and improve predictive tools.
    - (U) Testing of infrared clutter suppression techniques for low altitude tracking.
  - (U) Complete:
    - (U) Demonstrate the terminal accuracy of a 60mm projectile attainable with low cost strapdown W-band seeker in a track-via-projectile mode.
    - (U) Ram Accelerator technology by conducting preliminary concept design studies for high-pressure gas management. Computational fluid dynamic modeling of in-bore high-pressure combustion processes. Documentation of results of experimental and computational high-pressure investigations.

- (U) ($4,377) AIR SUPERIORITY:
  - (U) Initiate:
    - (U) Development of weapon control and warhead burst methodologies for lethality refinements in cross geometry encounters.

-- (U) Establish objectives and candidate approaches to deal with emerging tuned decoy countermeasures.
-- (U) Precision intercept task to decrease payload size by 20% with equal or greater lethality. Evaluate functional allocation of lethality factors among the warhead fragments, timing, and missile kinematic subsystems.
-- (U) Seeker counter-counter measure (CCM) technology and IR seeker performance tasks to increase IR seeker performance by 100% over current state-of-the-art.

- (U) Continue:
  -- (U) Development of high pressure rocket motor technology efforts begun in FY98 supporting the coordinated air-to-air missile technology investigations with the Air Force.
  -- (U) RF GIF investigation by demonstrating algorithms to provide real time estimates of warhead firing commands under a range of high-speed air-to-air encounters.
  -- (U) Quantify technology objectives and parameter matrix for clutter rejection in IR terminal seeker performance task.
  -- (U) Investigation of aimable ordnance to increase missile lethality equal to or less than 80% of the current weight/volume of AMRAAM warhead.

• (U) ($2,868) IHPRPT:
- (U) Initiate:
  -- (U) Advanced Composite Case rocket motor task which will develop technologies to meet the Phase III mass fraction improvement goals
- (U) Continue:
  -- (U) Develop test matrix and actuation system design trades for on-command pintle task.
  -- (U) Conduct subsystem testing on dual movable nozzle task, preparing the components for a full scale motor firing in FY00
  -- (U) Begin ballistic evaluation of candidate plateau propellant formulations.
  -- (U) Begin ballistic evaluation of candidate aluminum hydride propellant formulations
  -- (U) Continue ballistic and processing evaluation of ADN propellant formulation, preparing for large scale ballistic testing in FY00.

-- (U) Conduct subscale component gun-launch rocket case and propellant grain testing to determine optimal designs for high-g launches

- (U) Complete:
  -- (U) Testing of materials for low-erosion nozzle task complete. The results will be analyzed and documented.
  -- (U) Candidate nozzles will be fabricated for a Phase I improved delivered energy and improved mass fraction goals.
  -- (U) Validate slow cook-off engineering model, completing slow cook-off technology task.

• (U) ($11,384) STRIKE AND ASUW WEAPONRY:
  - (U) Initiate:
    -- (U) Thermal management technology development for high speed missiles
    -- (U) Development of weapon control and sensor approaches for high speed weapon configurations.
    -- (U) Preliminary investigation into the design of an autonomous attack and weaponeering capability for Uninhabited Combat Air Vehicles (UCAV).
    -- (U) Investigation and development of autonomous mission planning package for UCAV applications. Mission planning capability to include path planning, obstacle avoidance, and resource allocation.

  - (U) Continue:
    -- (U) ATR performance prediction task for imaging seeker-based ATR systems.
    -- (U) Development of a low cost MMW antenna element using MEMS technology using MMW radar.
    -- (U) Investigation of advanced wavelet-based signal processing techniques to reject GPS jammers.
    -- (U) Assessment of supersonic lifting body airframe technology with emphasis on high-speed propulsion/airframe integration issues.
    -- (U) Technology development in ATR signal processing to include bio-vision techniques.
    -- (U) Tuned ATR extraction and registered data base
    -- (U) Fuzzy ATR characterization to develop seeker ATR algorithms.
    -- (U) Assessment of low cost seeker components in the MMW spectral region.
  - (U) Complete:

-- (U) Portable Ladar performance model to identify optimum performance against mobile targets.
-- (U) Development of automatic target acquisition algorithms for standoff weapon seekers utilizing linear fracture correlation techniques.

- (U) ($10,043) NSFS:
  - (U) Initiate:
    -- (U) Investigation of real time retargetting, weapon control and target sensing techniques coupled with mission responsive ordnance concept as a means to improve responsiveness for time critical called fires.
  - (U) Continue:
    -- (U) Electro Optic/Infrared and Quasi optical gun launched seeker investigation. Conduct joint data collection with Direct Attack Munition Affordable Seeker (DAMASK) project (P.E. 0603238N).
    -- (U) Weapons modeling and simulation tools for NSFS including Computational Fluid Dynamics (CFD). Detailed definition of test sets and geographical layout.
    -- (U) Development of Mission Responsive Ordnance (MRO). Complete assessment of MRO submunition performance when operated as a unitary warhead.
    -- (U) Precision targeting using GPS/IMU to provide a 10m Target Location Error (TLE), supporting the requirements for fire control weapons. Design demo system and project altitude error of same using kinematic alignment algorithms. Finish in the field, direct measurements of breadboard GPS/IMU altitude determination system.
    -- (U) Image Video Analysis for near real time integrated detection, tracking, and location of targets with image. Complete fabrication of demo hardware and begin software modifications for rehost on the weapon host computer.
    -- (U) Hyperspectral decoy recognition technologies for use by air platforms such as UAVs. Perform field measurements against decoys and targets from aircraft.
    -- (U) Investigation of IFSAR technologies to reduce the cost per kill through improved aimpoint accuracy and supporting mission planning and BDA. Test using L-band and X-band IFSAR in aircraft.

- (U) ($2,926) Pulse Detonation Engine (PDE) – Congressional Plus-up:
  - (U) Initiate:

-- (U) Investigate pre-detonator to reduce on-board oxidizer and/or initiator volume requirements.
-- (U) Investigate rotary and butterfly valve concepts.
-- (U) Perform fuel management system definition.

- (U) ($975) Explosives – Congressional Plus-up:
  - (U) Initiate:
    - -- (U) Investigation of environmentally friendly processing methods for gradient explosives formulations used in variable output explosives.
    - -- (U) Development of formulations of survivable internal blast and metal accelerating explosives with high temperature resistant binders.
    - -- (U)Development and evaluation of the effect of fluorine containing materials on the reaction rate of nanoaluminum formulations.
    - -- (U) Develop continuous processing technologies to increase the content of fine particle size ingredients in explosive compositions.

- (U) ($385) Small Business Innovation Research (SBIR): Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

3. FY 2000 Plan:

- (U) ($7,885) SHIP BASED DEFENSE IN SUPPORT OF SURFACE BATTLESPACE:
  - (U) Initiate:
    - -- (U) Weaponization assessment for High Energy Density Materials (HEDM) applied to ship defense weapons to improve probability of catastrophic kills
    - -- (U) Investigation of technologies designed to reduce command decision time in littoral environments.
  - (U) Continue:
    - -- (U) Lethality assessment for solid state High Energy Laser (HEL) self defense-investigate aerokill and critical component kill.
    - -- (U) Conformal seeker technology development. Complete design of conformal seeker breadboard.
    - -- (U) Low altitude TDD technology development.

- (U) Complete:
  - -- (U) Evaluation and testing of IR clutter suppression techniques. Documentation of results. Potential transitions to TISS, or MK56 Electro Optic sight, SM-2, Blk IV B.
  - -- (U) Evaluation of low altitude propagation sensing techniques applied to sensor real-time adaptation. Incorporate into P.E. 0603217N technology demonstration.
  - -- (U) Surface launched, high-speed propulsion investigations

- (U) ($4,665) AIR SUPERIORITY:
  - (U) Initiate:
    - -- (U) Systems investigation of medium to long range target acquisition and track capabilities in conjunction with projected missile kinematic improvements.
  - (U) Continue:
    - -- (U) Seeker CCM technology and IR seeker performance algorithm development based on wavelet transforms.
    - -- (U) Precision intercept task that evaluates functional allocation of lethality factors among the warhead fragments, timing, and missile kinematic subsystems.
  - (U) Complete:
    - -- (U) Investigation of aimable ordnance to increase missile lethality equal to or less than 80% of the current weight/volume of AMRAAM warhead. Prioritize recommendations among the fireset, reactive materials and explosive kills provided.

- (U) ($2,905) IHPRPT:
  - (U) Initiate:
    - -- (U) Propellant formulation tasks to identify and evaluate propellant ingredients to meet Phase III IHPRPT delivered energy and mass fraction goals.
    - -- (U) Surface launched propulsion task to develop innovation case, insulation, and liner technologies to meet Phase II IHPRPT mass fraction goals.
  - (U) Continue:
    - -- (U) Conduct full-scale, “hot” testing of on-command pintle TVC components.
  - (U) Complete:

-- (U) Complete “hot” testing of full-scale dual movable nozzle, demonstrating Phase I IHPRPT mass fraction goals.
-- (U) Complete ballistic and mechanical evaluation testing on dual plateau propellants, achieving Phase I delivered energy and mass fraction goals
-- (U) Conduct full scale firing of gun-launch rocket, using “optimal” grain and case design, which completes the gun-launched rocket task by demonstrating Phase II IHPRPT goals
-- (U) Complete ballistic characterization testing of aluminum hydride propellants, showing possible achievement of Phase II IHPRPT delivered energy goal.
-- (U) Complete ballistic characterization testing of ADN propellants, showing possible achievement of Phase II IHPRPT delivered energy goal.

- (U) ($11,679) STRIKE AND ASUW WEAPONRY:
  - (U) Initiate:
    -- (U) Precision auto weaponeering task that generates a desired meanpoint of impact (DMPI) in support of the achievement of ASWT fire control accuracy goal of <3m Circular Error Probability (CEP).
    -- (U) Develop investment strategy for autonomous system weapon control capability.
  - (U) Continue:
    -- (U) Tuned ATR extraction and registered data base
    -- (U) Fuzzy ATR characterization to develop seeker ATR algorithms.
    -- (U) Assessment of low cost seeker components in the MMW spectral region.
    -- (U) Counterflow TVC task to increase mass fraction performance.
    -- (U) ATR performance prediction task for imaging seeker-based ATR systems.
    -- (U) Development of a low cost MMW antenna element using MEMS technology using MMW radar.
    -- (U) Investigation of advanced wavelet-based signal processing techniques to reject GPS jammers.
    -- (U) Investigation into the design of an autonomous attack and weaponeering capability for Uninhabited Combat Air Vehicles (UCAV)
    -- (U) Investigation and development of autonomous mission planning package for UCAV applications. Mission planning capability to include path planning, obstacle avoidance, and resource allocation.

-- (U) Precision Target Handoff and Advanced Data Assimilation for precision targeting tasks. These tasks are developing technology tasks to support the ASWT goals of 10m fire control accuracy and a 20/hr target/weapon pairing rate.
-- (U) Configurable ATR system and ATR performance prediction tasks supporting the weapons based ATR and Rapid planning ASWT goals.
-- (U) GPS Anti-jam and MEMS aperture tasks addressing the robust CEP and target detection goals.

- (U) Complete:
  -- (U) Demonstration of Suppression of Energy Air Defenses (SEAD) fuze discrimination techniques for masted targets inclutter.
  -- (U) Evaluation of laser radar image processing algorithms based on fuzzy logic and variational principal processing techniques supporting ATR of relocatable targets.
  -- (U) Assessment of supersonic lifting body airframe technology with emphasis on high-speed propulsion/airframe integration issues.

• (U) ($10,482) NSFS:
  - (U) Initiate:
    -- (U) Surface target lethality assessment.
    -- (U) Development of tunable explosives for controlled lethality effects.
  - (U) Continue:
    -- (U) Investigation of weapon control and target sensing techniques comparable with mission responsive ordnance concept. Complete direct capability analysis in selected weapons.
    -- (U) Finalize algorithm and packaging design of seeker for the Electro Optic/Infrared gun launched seeker to improve terminal guidance of projectiles.
    -- (U) Weapons modeling and simulation to provide tools for design of NSFS systems include CFD for vertical launchers and aero-prediction codes.
    -- (U) Complete missile warhead feasibility analysis for the MRO technology task. Continue MRO effort to improve warhead capabilities.
    -- (U) Investigate Image Video Analysis for near real time integrated ability to detect, track, classify, and precisely locate targets with image and video to increase targeting accuracy and provide a reduced response time for targeting.

-- (U) IFSAR to demonstrate and validate techniques for processing multi-path IFSAR into DEMS with techniques to control DEMS to GPS. These efforts will attempt to reduce the cost per kill through improved aimpoint accuracy as well as supporting mission planning and BDA. Evaluate optical computing for real time performance.
-- (U) Precision targeting with GPS/IMU for precise attitude. Demonstrate sub-milliradian attitude measurement accuracy.

- (U) Complete:
  -- (U) Hyperspectral seeker tasks supporting target detection and location by air platforms.

B. (U) PROGRAM CHANGE SUMMARY

	FY 1998	FY 1999	FY 2000
(U) FY 1999 President's Budget:	28,379	37,140	38,064
(U) Appropriated Value:		41,140	0
(U) Adjustments from FY 1999 PRESBUDG:	-5,493	+3,683	-448
(U) FY 2000 PRESBUDG Submission:	22,886	40,823	37,616

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1998 adjustments include Small Business Innovation Research (SBIR) reduction (-$3,058); and Actual update adjustments (-$2,435). FY 1999 adjustments include Congressional Plus Ups of (+3,000) for Pulse Detonation Engine Research and (+1,000) for Energetic Explosives Development; and Congressional Undistributed adjustments (-$317). FY 2000 adjustments includes an Outsourcing adjustments (-$90) Navy Working Capital Fund (NWCF) rate adjustment (+$12), Civilian pay adjustment (+$175); and Non Pay Inflation adjustment (-$545).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

C. (U) OTHER PROGRAM FUNDING SUMMARY: Not Applicable
(U) RELATED RDT&E: This P.E. adheres to Defense S&T Reliance agreements with oversight provided by the JDL. This P.E.
(U) CONVENTIONAL AIR/SURFACE WEAPONRY:
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602203F (Aerospace Propulsion)
(U) PE 0602232N (Communications, Command and Control, Intelligence, Surveillance & Reconnaissance)
(U) PE 0602234N (Materials, Electronics and Computer Technology)
(U) PE 0602302F (Rocket Propulsion and Astronautics Technology)
(U) PE 0602303A (Missile Technology)
(U) PE 0602601F (Advanced Weapons)
(U) PE 0602602F (Conventional Munitions)
(U) PE 0602618A (Ballistics Technology)
(U) PE 0602624A (Weapons and Munitions Technology)
(U) PE 0603004A (Weapons and Munitions Advanced Technology)
(U) PE 0603216F (Aerospace Propulsion and Power Technology)
(U) PE 0603609N (Conventional Munitions)
(U) PE 0603640M (Marine Corps Advanced Technology Demonstration)
(U) PE 0603790D (NATO Research and Development)
(U) This is in accordance with the ongoing Reliance joint planning processes.

D. (U) SCHEDULE PROFILE: Not applicable.