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THE SENATE ARMED SERVICES COMMITTEE
SEAPOWER SUBCOMMITTEE

STATEMENT OF

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BEFORE THE

SEAPOWER SUBCOMMITTEE

OF THE

SENATE ARMED SERVICES COMMITTEE

ON

DEPARTMENT OF THE NAVY'S AVIATION PROGRAMS

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INTRODUCTION

Mr. Chairman, Senator Hirono, and distinguished members of the Subcommittee, we thank you for the opportunity to appear before you today to discuss the Department of the Navy's (DoN) Aviation programs. Our testimony will provide background and rationale for the Department's Fiscal Year 2018 aviation programs budget request aligned to our strategic priorities and budgetary goals.

The United States is a maritime nation with global responsibilities. Our Navy and Marine Corps' persistent presence and multi-mission capability represent U.S. influence across the global commons. We are an agile maritime strike, amphibious and expeditionary power projection force in readiness, and such agility requires that the aviation arm of our naval strike and expeditionary forces remain strong. Our budget submission ensures Naval Aviation possesses the capability, capacity and readiness to deliver five essential functions outlined in our maritime strategy – All Domain Access, Deterrence, Sea Control, Power Projection and Maritime Security. These key, essential functions are missions that depend upon Naval Aviation to enable their success.

Global connections continue to multiply, fueled by rapid advances and proliferation of technology, particularly cyber and other information technologies. Our competitors are pursuing advanced weapon systems at a development pace we have not seen since the mid-1980s, and because of these focused pursuits; both near-peer nations and non-state actors pose credible threats to our security. As such, it is imperative that we fund a force with the capability and capacity to fight and win against any of our five major challengers (China, Iran, North Korea, Russia, and Violent Extremism) by investing in advanced systems that increase lethality for both the current and future force.

Our ability to respond to this dynamic strategic environment, high operational tempo and evolving Combatant Commander (CCDR) requirements continues to be constrained by current fiscal realities. The Department is still recovering from appropriations that were significantly lower than the budget requests for Fiscal Years 2013-2016. We strive to improve efficiency in our own internal business practices to make every dollar count, but our efforts are undermined by the absence of stable, timely

budgets and resources aligned to stay ahead of the threats. We encourage Congress to re-evaluate the Budget Control Act caps, as outlined by our President's Budget request. Timely passage of a full year appropriation as at requested level will provide for the most efficient execution of the resources provided by Congress, while bringing stability to our workforce and the industrial base.

This fiscal context drives difficult choices to best balance between capability, capacity, readiness and the industrial base. Our Fiscal Year 2018 budget supports the five essential functions outlined in our maritime strategy, the operational context we as a Nation find ourselves in, and the current fiscal environment.

Our investments are focused, balanced and prioritized to deliver and support a global sea-based and expeditionary force. Our budget is based on the transition of major components of the Carrier Air Wing (CVW), Expeditionary Strike Group and land-based Expeditionary Wings, and includes: manned and unmanned aviation system teaming; integration of warfighting capabilities to ensure multiple systems operate together across platforms, weapons, networks and sensors; advanced computing; and incorporation of commercially driven technology and additive manufacturing to provide a technological advantage over adversaries.

The Department continues to pursue acquisition and business process reform measures to deliver capability faster at reduced cost. New measures include implementation of accelerated acquisition policies for Rapid Prototyping, Experimentation and Demonstration; establishment of Maritime Accelerated Capability Office programs; and the use of Rapid Deployment Capability processes. We are actively promoting innovation and the transition of key manufacturing technologies and processes with investments focused on affordability and those most beneficial to the warfighter. There is also a continuing transition from a hardware-centric world to a software-centric world by leveraging common development standards and requirements for modular weapon system components.

The Navy/Marine Corps "Vision for Naval Aviation 2025" provides the framework for determining investment priorities across the triad of warfighting

capability, capacity, and Naval Aviation wholeness. There are several central themes to our 2018 Naval Aviation budget plan: next generation fighter/attack capability; unmanned systems; netted persistent multi-role intelligence, surveillance, reconnaissance (ISR) and targeting; advanced strike and networked enabled weapons programs; supporting capabilities such as electronic attack and electromagnetic spectrum superiority, maritime patrol, and vertical lift; readiness; and targeted modernization of the force for relevance and sustainability.

The best way for pilots to train for combat is by flying their aircraft in live, scenario-based training missions against live opposition. However, many elements of combat cannot be replicated in the training environment. The Department is committed to augment aircraft flight hours by providing high-end virtual training. To do that, we are making investments in Live, Virtual, and Constructive Training that enable our aircrews to link across the country and train in high fidelity simulators. As we develop these technologies, the Department plans to connect aircrews in live flying aircraft against synthetic adversaries. We are also dedicated to leveraging the Science of Learning into all levels of aviation training. To do this, we are exploring innovative ways to leverage big data/analytics and flexible training systems that will maintain the nation's competitive advantage.

At its foundation, as core unpinning principals, Naval Aviation is actively pursuing and seizing innovation and advantage wherever it can. We are implementing our vision toward greater tactical and technical innovation to provide the right capability in the hands of the warfighter, on schedule, and in the most affordable manner possible.

TACTICAL AVIATION

F/A-18 Overview

There are four Navy and eleven Marine Corps F/A-18A-D active strike fighter Hornet squadrons with a total inventory of 546 aircraft. There are 30 Navy Super-Hornet (F/A-18E/F) strike fighter squadrons with a total inventory of 544 aircraft. Combined,

F/A-18A-D Hornets and F/A-18E/F Super-Hornets have conducted more than 219,454 combat missions since September 11, 2001.

F/A-18 A/B/C/D Hornet

Based on inventory modeling, a portion of the existing inventory of 546 Navy and Marine Corps F/A-18 A-D aircraft will be flown through the mid-2030 timeframe. The DoN will continue to meet Navy active F/A-18A-D squadron operational commitments until 2027, Marine Corps active and reserve squadrons until 2030, and Navy reserve squadrons through 2034.

To support this Fleet plan, the Fiscal Year 2018 President's Budget requests $294 million in APN to implement aircraft commonality programs, enhance relevant capability, improve reliability, and ensure structural safety of the inventory of 546 F/A-18 A-D Hornets; $31.4 million is for a Service Life Extension Program (SLEP). The funding priorities for F/A-18 A-D Hornet will be safety, reliability, and capability.

Service life management efforts have extended the F-A-18 A-D beyond its original service life of 6,000 flight hours to 8,000 flight hours with select aircraft that may be extended up to 10,000 flight hours. Discovery of unanticipated corrosion on these legacy jets complicates depot throughput, and service life extensions for aircraft with more than 8,000 flight hours require High Flight Hour inspections, which furthers increases maintenance-man hours. These inspections assess the material condition of each aircraft and apply a unique combination of inspections and airframe modifications to maintain airworthiness certification. As of April 2017, 92 percent of the F/A-18 A-D fleet has over 6,000 flight hours and 24 percent have flown more than 8,000 flight hours; the highest flight hour airframe has attained over 9,799 hours. The Department endeavors to return the required number of aircraft to the flight line with the necessary capability upgrades, but remains concerned that low reliability rates will affect our ability to train and fight.

In addition to the flight hour extension strategy, these aircraft require capability upgrades in order to maintain warfighting relevancy. The Department will continue to

procure and install advanced systems such as mission computers, aircraft survivability equipment, radios, radars and targeting pods on select F/A-18 A-D aircraft to counter evolving threats. However, while the DoN continues investing in warfighting upgrades in order to maintain tactically relevant aircraft, the Services are challenged to improve the reliability of this aged airframe.

F/A-18E/F Super Hornet

The F/A-18E/F Super Hornet will be the numerically predominant aircraft in the Navy's CVW Strike Fighter force through 2035. The F/A-18E/F began Full Rate Production (FRP) in 2000. Continued investment in capability upgrades significantly improves the lethality of the CVW.

The Fiscal Year 2018 President's Budget requests $1.25 billion in APN for 14 F/A-18E/F Super Hornet aircraft and $251.2 million of RDT&E for F/A-18 Block III, IRST Block II, F/A-18E/F Service Life Assessment Program (SLAP), radar upgrades and improvements. With the support of Congress, we will also procure a minimum of 80 additional Super Hornets across the Future Years Defense Program (FYDP) and continue modernization plans to address continuing warfighter demand for advanced tactical aircraft. These additional procurements begin to mitigate the decline in DoN's strike fighter inventory and enable older aircraft to be pulled from service for mid-life upgrades and rework to extend their service life.

The Super Hornet modernization plan features an incremental approach to add conformal fuel tanks to extend range and replace outdated electronics. Other modernization efforts will incorporate new technologies and capabilities, to include, Digital Communication System Radios, Advanced Targeting Forward Looking Infrared (with shared real-time video), Accurate Navigation Distributed Targeting System, Infrared Search and Track, and continued advancement of the APG-79 Active Electronically Scanned Array Radar.

Due to high utilization rates, the F/A-18E/F fleet has flown approximately 47 percent of the total flight hours available within the 6,000 hour limit design life. The

remaining fleet flight hour capacity will be inadequate to meet operational commitments starting in the early 2020s. As a result, the Department initiated a phased F/A-18E/F SLAP to determine requirements to extend the airframe service life beyond 6,000 flight hours. The F/A-18E/F SLAP incorporates lessons learned from the F/A-18A-D SLAP and SLEP analysis and was initiated earlier in the F/A-18E/F life-cycle. Super Hornet SLAP commenced in 2008 with completion expected in 2018. The SLAP goal is to analyze actual Fleet usage versus structural test data to support the design of Service Life Modifications (SLM) that will ultimately extend F/A-18E/F service life from 6,000 to 9,000 flight hours. The initial phases of the F/A-18E/F SLM began in 2014 with the development and fielding of Engineering Change Proposal kits to upgrade life-limited areas of the F/A-18E/F that were revealed by SLAP analysis.

EA-18G Growler

The EA-18G Growler is a critical enabler for the Joint force. EA-18G brings fully netted warfare capabilities to the fight, providing unmatched agility in the Electromagnetic Maneuver Warfare environment. The Fiscal Year 2018 President's Budget requests $173.5 million of RDT&E for modernization.

To date, 136 EA-18G aircraft have been delivered, representing 85 percent of the funded inventory objective. Initial Operational Capability (IOC) occurred in September 2009 and the Fleet Response Plan was approved in November 2009. Since their initial deployment, Growlers have flown more than 2,300 combat missions and have expended approximately 16 percent of the 7,500 flight hour life per aircraft. Electronic attack capabilities, both carrier-based and expeditionary, continue to mature with development of the Next Generation Jammer (NGJ). NGJ Increment 1 is scheduled to begin replacing the legacy ALQ-99 Tactical Jamming System in Fiscal Year 2021. Additionally, we continue to invest in the EA-18G passive detection and identification capabilities while improving network connectivity to provide overall battlespace awareness and targeting for the carrier strike group.

The recent authorization of seven additional EA-18Gs will extend aircraft deliveries into Fiscal Year 2018. With the seven additional aircraft, the total procurement quantity of 160 EA-18Gs fulfills Navy requirements for carrier-based Airborne Electronic Attack (AEA) and expeditionary EA-18G squadrons.

Additional EA-18Gs, above the funded procurement objective of 160, may be explored by the Department of Defense as it considers options to support an AEA force structure that meets the Joint Warfighter requirement.

AV-8B Harrier

Since the beginning of the war on terror, the AV-8B Harrier has been a critical part of the strike fighter inventory for the Joint force. This aircraft has flown more than 60,000 hours in combat since 2003, an average of over 475 hours per aircraft, with zero losses from the enemy in the air, but six losses on the ground when the enemy broke through our perimeter at Bastion Air Base in 2012.

The Fiscal Year 2018 President's Budget requests $48.8 million in RDT&E funds to continue Design, Development, Integration and Test of various platform improvements. These improvements include an Engine Life Management Program, Escape Systems, Joint Mission Planning System updates, Link 16 Digital Interoperability (DI) integration, Operational Flight Program (OFP) block upgrades to mission and communication systems, navigation equipment, weapons carriage, countermeasures, and the Obsolescence Replacement/Readiness Management Plan. Additionally, the Department is requesting $43.6 million in APN funds to continue the incorporation of Obsolescence Replacement/Readiness Management Plan systems, electrical and structural enhancements, inventory sustainment and upgrade efforts to offset obsolescence and attrition, LITENING Pod upgrades, F402-RR-408 engine safety and operational changes, and DI upgrades that include Link 16.

The AV-8B continues to deploy in support of operational contingencies and each Marine Expeditionary Unit (MEU) deploys with embarked AV-8Bs. The AV-8B equipped with LITENING targeting pods and a video downlink to ROVER ground

stations, precision strike weapons, Intrepid Tiger II Electronic Warfare (EW) pods and beyond visual range air-to-air radar guided missiles, continues to be a proven, invaluable asset for the Marine Air Ground Task Force (MAGTF) and Joint commander across the spectrum of operations. AV-8B squadrons, both land- and sea-based, have flown more than 10,000 hours of strike sorties against Islamic State in Iraq and Syria with an average combat radius of 900 miles. Digital Improved Triple Ejector Racks have allowed us to load up to six precision guided munitions per aircraft, with fuel tanks, guns, and LITENING Pods, exponentially increasing the combat viability of this platform. Airborne Variable Message Format terminals are currently being installed in AV-8B to replace the current digital-aided Close Air Support (CAS) technology. The program will continue development of the H6.2 OFP which includes initial integration of Link 16 message sets. Additionally, this OFP will integrate Federal Aviation Administration compliant Navigation Performance/Area Navigation capability, an update to the LITENING Common OFP to implement improvements to moving target tracking, and correction of software deficiencies identified through combat operations. The program will also work on the H7.0 OFP which will integrate full Link 16 functionality. As an out-of-production aircraft, the AV-8B program continues to focus on sustainment efforts to mitigate significant inventory shortfalls, maintain airframe integrity, achieve full Fatigue Life Expended, and address reliability and obsolescence issues of avionics and subsystems.

Operations ODYSSEY DAWN, ODYSSEY LIGHTNING, ENDURING FREEDOM, FREEDOM SENTINEL, and today's Operation INHERENT RESOLVE confirm the expeditionary advantages of Short Take-Off and Vertical landing (STOVL) capabilities. Placing the Harrier as the closest multi-role fixed-wing asset to the battlefield greatly reduces transit times to the fight and enables persistent CAS without strategic tanking assets. Airframe sustainment initiatives, capability upgrades, and obsolescence mitigation is essential and must be funded to ensure the AV-8B remains lethal and relevant.

F-35 Lightning II

The F-35 Lightning II will form the backbone of U.S. air combat superiority for decades to come. The F-35 brings unprecedented low observable technology, modern weaponry, and electronic warfare capability to the Navy and Marine Corps. Delivering this transformational capability to front-line forces as soon as possible remains a top priority. The F-35 will replace legacy tactical fighter fleets of the Navy and Marine Corps with a dominant, multirole, fifth-generation aircraft, capable of projecting U.S. power and deterring potential adversaries. The Fiscal Year 2018 President's Budget requests $550 million in RDT&E to support system design and development close-out and ramp-up Follow-on Modernization and $3.9 billion in APN for 20 F-35B aircraft, 4 F-35C aircraft, modifications and spares.

The F-35 has flown over 70,000 flight hours, including approximately 27,000 for the F-35B and 7,000 hours for the F-35C. Marine Fighter Attack Squadron (VMFA) 121, the first IOC squadron, is now forward deployed in Japan defending the Nation's interests abroad. In 2018, the Navy and Marine Corps team will deploy two MEUs with a detachment of F-35Bs aboard ship marking the first extended at sea deployments for F-35. The fielding of the Marine Corps' F-35B STOVL variant continues to make excellent progress due to the combined efforts of the Department, industry, and Congress. Critical Military Construction (MILCON) at our bases and air stations is underway both at home and overseas to support this fifth generation capability. Due to the level of effort, funding, and timely MILCON, the Marine Corps' transition plan remains on-track. VMFA-211 stood up in July 2016 on Marine Corps Air Station, Yuma, AZ and the Marine Corps' will transition its third operational squadron, VMFA-122, to the F-35B in 2018.

The F-35B achieved a number of operational and training milestones. Operationally, the Marine Corps has permanently stationed an F-35B squadron in Japan, conducted trans-oceanic flights across both the Atlantic and Pacific, and exercised the expeditionary capability of the aircraft both aboard ship and in austere environments. In

training, Marine Corps has seen return on training investments. The first two F-35B pilots graduated flight school and have conducted sustained training operations across the range of military operations, including participation in large-scale joint exercises like "Red Flag". Pilots and instructors continue to praise the F-35 situational awareness and lethality as it achieves mission success previously unrealized in legacy platforms.

The Navy's first F-35C squadron begins transition in 2018. Navy IOC is event-driven and expected in the late 2018 to early 2019 timeframe. The first F-35C aircraft carrier deployment is planned for 2021. The Marines begin their first F-35C squadron transition, VMFA-314, in 2018, will be ready for expeditionary operations by 2020 and deploy aboard a carrier in 2022. Together, the Navy and Marine Corps will be operational in 2020 and replace our aging aircraft inventory with the greatest practical speed. The F-35B/F-35C aircraft will help recapitalize some of our oldest aircraft – our legacy F/A-18s – which are rapidly approaching the end of their service lives.

F-35 employs a block upgrade program to usher in new and advanced war-fighting capabilities. Whether the mission requires the execution of strike, CAS, counter air, escort, or EW, this aircraft is the key to our future. It empowers our maritime forces to fight from sea bases and expeditionary bases ashore anywhere in the world. However, to take full advantage of the aircraft's advanced capabilities and to keep the transition from legacy platforms on-track, this effort requires the continuation of the support received from Congress thus far.

The F-35 continues to mature and progress with programs in development and design, flight test, production, fielding, base stand-up, sustainment of fielded aircraft and stand-up of a global sustainment enterprise. The final system development and demonstration configuration, Block 3F, is finishing its final developmental test flights and our overall assessment is that steady progress continues to be made on all aspects of the program, although not without risk in software development and integration. This risk will continue to decline as the Department learns and makes adjustments. The discipline instilled several years ago in the method by which software is developed, lab tested, flight tested, measured and controlled has resulted in improved and more predictable outcomes.

The program has delivered over 230 aircraft to test, operational, and training sites, with the production line delivering F-35s on schedule. It remains a clear and prominent priority for the Department to complete the development phase on cost and schedule. DoN is committed to drive aircraft production cost and life-cycle costs down. As examples of cost reduction efforts, combined government and industry teaming has reduced aircraft production costs through "blueprint for affordability" initiatives and reduced F135 engine costs through ongoing engine "war on cost" strategies.

These affordability efforts include up-front contractor investments in cost reduction initiatives that are mutually agreed upon by the government and contractor team. This arrangement motivates contractors to accrue savings as quickly as possible in order to recoup their investment, and benefits the government by realizing cost savings at the time of contract award. The Department's goal is to reduce the flyaway cost of the USAF F-35A to between $80 and $85 million dollars by 2019, which is anticipated to also decrease the cost to the Marine Corps F-35B and Navy F-35C variants. The Department set a goal of decreasing overall operating and support life-cycle cost by 30 percent.

Next Generation Air Dominance (NGAD) Family of Systems

The Department initiated a Next Generation Air Dominance (NGAD) Analysis of Alternatives (AoA) in January 2016 to address the anticipated retirement of the F/A-18E/F and EA-18G aircraft beginning in late 2020 early 2030 timeframe.

The Joint Chiefs of Staff approved the Initial Capabilities Document that frames NGAD study requirements to support the full range of military operations from carrier-based platforms. The AoA will consider the widest possible range of materiel concepts while balancing capability, cost/affordability, schedule, and supportability. It will assess manned, unmanned, and optionally manned approaches to fulfill predicted 2030+ mission requirements. Analyses will consider baseline programs of record (current platforms), evolutionary or incremental upgrades to baseline programs (including derivative

platforms), and new development systems or aircraft to meet identified gaps in required capability.

STRIKE FIGHTER INVENTORY MANAGEMENT

Through 2009, the Department's Strike Fighter force was relatively healthy. Several events transpired since 2009, however, which drove our current Strike Fighter inventory shortfall. The Budget Control Act of 2011 started multiple years of reduced military funding and F-35B/C fielding plans were delayed. As a result, the DoN decided to extend the life of legacy F/A-18A-Ds using our aviation depots. Sequestration led to furlough and a hiring freeze of a skilled government civilian artisan workforce at aviation depots, significantly impacting depot throughput and fleet readiness along with other factors such as high utilization rates, lack of aircraft procurement and lack of spare parts. Throughout this period, the operational demand for Naval Aviation forces remained high and accelerated the consumption of existing fleet aircraft. In essence, consumption of aircraft exceeded the new and rework production capacity of aircraft and caused an increasing shortfall.

The Naval Aviation Enterprise (NAE) aggressively tackled Strike Fighter Inventory Management (SFIM) to ensure that deployed forces are properly manned, trained and equipped. Each budget year, the NAE attempts to harmonize available funding between flying hours and readiness enabler accounts in order to achieve the greatest return on investment towards improved readiness.

Under the current budget and with Secretary Mattis' focus on readiness, aviation spares and readiness enabler accounts are receiving improved funding levels. It is important to note, however, that years of underfunding cannot be corrected in one budget year and will require stable, predictable funding over multiple years to achieve positive results. This shortfall will take time and likely require several years to correct.

The DoN has accepted significant risk in SFIM. The Department remains challenged with planning for F/A-18A-D and AV-8B aircraft that reach the end of their

service life before replacement aircraft (F-35B/C or follow on F/A series) can be delivered into service. Fiscal Year 2018 investments begin to address the gap between the Strike Fighter inventory forecasts and Global Force Management Allocation Plan (GFMAP) demands by fully funding depot capacity. Near-to-mid-term risk remains due to uncertainty in readiness accounts and procurement levels that fail to match Strike Fighter service life consumption. Mid-to-long-term risk is driven by a shortfall in tactically relevant aircraft to replace F/A-18E/Fs that are soon to be inducted into commercial depots for SLM. Long-term risk is driven by Strike Fighter procurement that fails to match Strike Fighter service life consumption and attrition.

SFIM should be viewed in two separate and distinct phases. The near-term challenge is managing a DoN Tactical Aviation (TACAIR) force that has been reduced in capacity through a combination of historically high TACAIR utilization rates, constrained resourcing of sustainment and enabler accounts resulting in inadequate availability of spare parts, F/A-18 depot production falling short of the required output, and reduced Strike Fighter aircraft procurement. TACAIR aviation depots are expected to continue to improve productivity through 2019. In 2019, the focus will shift toward F-35 repair and begin to support F/A-18E/F SLM. In a similar effort to increase Harrier aircraft availability, the Marine Corps conducted a Harrier Independent Readiness Review which identified a need for changes in the Harrier sustainment plan to achieve required flight line and inventory readiness. This year, with sufficient resources, the Department is implementing these changes to return Harrier readiness to the required T 2.0 levels.

In the far-term, Strike Fighter inventory is predominantly affected by new procurement of F-35B/Cs and F/A-18E/Fs, as well as the F/A-18E/F SLM of our current fleet. CCDR driven operational demand, Fleet Response Training Plans and readiness requirements are expected to continue to drive increased Strike Fighter utilization rates that outpace procurements.

The DoN program of record is 680 F-35 aircraft. The Navy F-35C requirement is 340 aircraft, which includes 67 Marine Corps F-35C aircraft. Due to evolving

circumstances, the total Marine Corps F-35 requirement is 420 aircraft; 353 F-35Bs and the 67 F-35Cs. The Navy and Marine Corps will continue to modify transition plans to take advantage of any possible F-35 accelerated procurement. Due to delays in the F-35 program and a changing threat environment, sustainment and modernization funding will be required to maintain the relevant operational capability of the F/A-18A-F and the AV-8B.

Strike-Fighter Force Structure

The 1,174 aircraft Strike Fighter force provides the projected DoN inventory needed to support the anticipated operational demand of nine CVWs through the 2025 timeframe. The Navy inventory requirement of 779 aircraft supports 36 active duty DoN Strike Fighter squadrons (with a mix of 10-12 aircraft per squadron). This requirement includes four Marine Corps Strike Fighter squadrons and is composed of 396 aircraft and two reserve squadrons with 22 total aircraft assigned. In order to maintain the operational aircraft, support aircraft are required for aviator training, flight-test, attrition reserve and the depot pipeline. This inventory entitlement is estimated based on historical averages and supports the validated requirement of four Strike Fighter squadrons per CVW. Through detailed analysis, inspections and structural repairs, the DoN has been successful in extending F/A-18 A-D aircraft to 8,000 flight hours - 2,000 flight hours beyond the original designed service life. Future inventory projections are based on a service life extension for F/A-18E/F aircraft to 9,000 flight hours from the current design life of 6,000 flight hours.

The Department's F-35C Strike Fighter program requires 14 active Navy squadrons, four active Marine Corps squadrons, and two training squadrons. The F/A-18E/F capabilities complement the F-35C and enhance the overall carrier-based warfighting capabilities. This force structure supports the operational demand per the GFMAP and projected aircraft carrier deployments. The Marine Corps' F-35B Strike Fighter program requires 14 active, 2 reserve and 2 training squadrons. Integral to DoN's

current force structure reductions, tactical aviation squadrons were restructured to optimize the support they provide to the MAGTF and the Joint force.

PHYSIOLOGICAL EPISODES

The status of DoN efforts to address Physiological Episodes can be found at Addendum A.

AIRBORNE ELECTONIC ATTACK (AEA)

Next Generation Jammer (NGJ)

The Next Generation Jammer (NGJ) is the follow-on to the Vietnam-era AN/ALQ-99 initially fielded in 1971. The ALQ-99 has reached its capability limit both technologically and materially and is challenged against modern state-of-the-art computerized surface-to-air missiles systems. NGJ is designed to provide improved capability in support of Joint and coalition air, land and sea tactical strike missions and is critical to Navy's vision for the future of strike warfare. It will be DoDs only comprehensive tactical airborne electronic attack platform and is required to meet current and emerging threats. NGJ will use Active Electronically Scanned Array technology to provide full-spectrum dominance, the ability to jam multiple frequencies at the same time, higher radiated power, increased precision, and the application of digital techniques to counter increasingly advanced and sophisticated adversary radars and communications systems. NGJ will be implemented in three increments: Mid-Band (Increment 1), Low-Band (Increment 2), and High-Band (Increment 3).

Our Fiscal Year 2018 budget request of $632.9 million RDT&E,N is vital to maintain Increment 1 schedule, continue procurement and assembly of the Engineering and Development Models, and commence developmental flight testing. In addition, $66.7 million RDT&E,N is requested to complete Increment 2 technology feasibility studies and initiate technology demonstration efforts.

MAGTF Electronic Warfare/EA-6B Prowler

The Fiscal Year 2018 President's Budget request includes $29.6 million in RDT&E,N and $10.1 million in APN for MAGTF EW.

The MAGTF EW approach to Electromagnetic Spectrum Operations (EMSO) is a distributed, platform-agnostic strategy where every platform contributes and functions as a sensor, shooter and sharer to include EW. Marine Aviation is integrating EW systems and Intrepid Tiger II (IT II) payloads across all aviation platforms to provide commanders with an organic and persistent airborne EW capability - for every MAGTF - large and small. Included in this plan are the IT II EW payload, the F-35s organic EW capabilities, and the EW Services Architecture network to facilitate collaborative EW Battle Management.

IT II is a precision EW system providing EW Support and Electronic Attack capabilities. IT II has been integrated on the AV-8B, F/A-18A-D, and UH-1Y. Since 2012 IT II has completed over 20 deployments, and is currently deployed with the 11th, 24th, and 31st MEUs. Future aviation platforms for IT II integration are the MV-22B, KC-130J, AH-1Z, CH-53K, and RQ-21. Development of an IT II counter-radar capability began in Fiscal Year 2016 and will be fielded on the AV-8B, F/A-18A-D, and MV-22B from Fiscal Years 2020-2022. The F-35 brings a powerful combination of EW, weapons, sensors, and reduced signature to the MAGTF.

Currently, there are 18 EA-6Bs distributed to two Marine Corps operational squadrons, one deactivating Marine Corps squadron, and one Navy flight test squadron. Final retirement of the EA-6B from the DoN inventory will be in Fiscal Year 2019.

Future aviation EW capabilities will also be provided by the MAGTF Expeditionary Unmanned Aviation System (MUX). In addition to providing persistent reconnaissance, surveillance and communications, MUX will also provide a long range, persistent, penetrating and responsive airborne EMSO capability.

OTHER ELECTRONIC WARFARE INQUIRIES

Responses to Congressional requests for updates on electronic warfare can be found at Addendum B.

AIRBORNE EARLY WARNING AIRCRAFT

E-2D Advanced Hawkeye (AHE)

The E-2D AHE is the Navy's carrier-based Airborne Early Warning and Battle Management Command and Control system. The E-2D AHE provides Theater Air and Missile Defense and is capable of synthesizing information from multiple onboard and off-board sensors, making complex tactical decisions and then disseminating actionable information to Joint Forces in a distributed, open-architecture environment. E-2D is also a cornerstone of the Naval Integrated Fire Control – Counter Air system of systems capability.

Utilizing the newly developed AN/APY-9 Mechanical/Electronic Scan Array radar and the Cooperative Engagement Capability system, the E-2D AHE works in concert with tactical aircraft and surface-combatants equipped with the Aegis combat system to detect, track and defeat air and cruise missile threats at extended ranges.

The Fiscal Year 2018 President's Budget requests $292.5 million in RDT&E,N for continuation of added capabilities, to include Aerial Refueling, Secret Internet Protocol Router chat, Advanced Mid-Term Interoperability Improvement Program, Multifunctional Information Distribution System /Joint Tactical Radio System Tactical Targeting Network Technology, Counter Electronic Attack, Sensor Netting, and Data Fusion, Navigation Warfare, Fighter to Fighter Backlink, ALQ217 Electronic Support Measures, and Crypto Modernization/Frequency Remapping. In the fifth year of a 26 aircraft Multi-Year Procurement (MYP) contract covering Fiscal Years 2014-2018, the

budget also requests $835.9 million in APN for five FRP Lot 6 aircraft and Advance Procurement for Fiscal Year 2019 FRP Lot 7 aircraft.

ASSAULT SUPPORT AIRCRAFT

MV-22/CMV-22

The Fiscal Year 2018 President's Budget requests $171.4 million in RDT&E,N for continued product improvements, including continued development of a Navy variant, the CMV-22B; and $706.7 million in APN for procurement of 6 Lot 22 CMV-22s.

The DoN begins procurement of the Navy CMV-22B variant in support of the Carrier On-Board Delivery mission in Fiscal Year 2018 which represents the first year of the next V-22 MYP contract (MYP III). The proposed follow-on MYP III contract will span seven years (Fiscal Years 2018-2024) and buy out the remaining domestic aircraft program of record. Fiscal Year 2018 President's Budget requests will fully fund Lot 22 and procure long-lead items for Fiscal Year 2019 Lot 23 CMV-22 aircraft. The request also includes $228.3 million to support Operations and Safety Improvement Programs (OSIPs), including Correction of Deficiencies, Readiness improvements, Common Configuration, and Aerial Refueling.

MV-22 Osprey vertical flight capabilities, coupled with the speed, range, and endurance of fixed-wing transports, continue to enable effective execution of current missions that were previously unachievable. The MV-22 fleet continues executing at a high operational tempo consisting of multiple MEU deployments and two Special Purpose MAGTF - Crisis Response (SPMAGTF-CR) deployments in support of AFRICOM and CENTCOM. During 2016, the 15th of 18 planned active component squadrons met Full Operational Capability (FOC), with the 16th scheduled for FOC in June 2017. This marks the beginning of MV-22 capacity catching up to operational demand requirements. To date, 293 of 360 MV-22s have been delivered and 52 of 53 AFSOC CV-22s have been delivered. The V-22 program focus establishes a third MYP for production aircraft, sustains Fleet aircraft, improves aircraft readiness, reduces

operating costs, and expands the domestic and international business base. Both the MV-22 and CV-22 continue to meet all cost, schedule and performance requirements.

MYP III continues affordable procurement, provides stability to industry and maintains a production line and contractual foundation to attract future V-22 international sales/customers. Continuing procurement under a MYP is particularly beneficial to the supplier base. It provides long-term stability and generates lower costs that may provide incentive for international V-22 customers. The program's first Foreign Military Sales program, 17 aircraft with the Government of Japan, was established under MYP II. The final four (of 17 aircraft) are planned to be included in the Fiscal Year 2018 procurement contract.

Due to extremely high CCDR MV-22 demand and operational tempo, the mission capability (MC) aircraft readiness rates have not improved as desired. The primary contributor to lower than planned MC rates is our ability to train and retain enlisted maintainers with the requisite qualifications needed to sustain the high demand. An equally important secondary contributor is related directly to multiple MV-22 configurations. In an attempt to increase overall readiness, the Marine Corps reduced each of the SPMAGTF-CR to a 0.5 VMM squadron footprint. The Marine Corps plans to allow the "remain behind" element necessary time to develop and train personnel for future deployments and improve the overall MV-22 readiness and MC rates.

Marine Aviation commissioned an Osprey Independent Readiness Review which identified a number of factors driving down MV-22 readiness. The major factor identified was the excessive number of aircraft configurations that resulted from years of concurrently incorporating engineering changes and reliability improvements during aircraft production. The Department's "Common Configuration, Readiness and Modernization" plan will streamline the total number of MV-22 configurations from 77 to three, simplify the supply system, reduce the number of technical manuals and improve troubleshooting and maintenance procedures. This will decrease maintenance man-hours, increase aircraft availability and reduce total operating costs by approximately $1.5 billion. The Fiscal Year 2018 OSIP provides a necessary and stable

source of crucial modification funding as the program continues to implement these readiness and cost reduction initiatives.

Along with the readiness and support initiatives, the Department is adding new capabilities to the MV-22 that will make it more valuable to the CCDRs such as the development of MV-22 Aerial Refueling System which will enable the MV-22 to deliver fuel to other airborne platforms. This is a critical enabler for both shore and sea-based operations and will extend the operational reach of deployed MAGTFs. Initial capability is planned to deliver by the summer of 2019.

Another transformative capability for the entire aviation force is the continued development and integration of Digital Interoperability (DI). A limited DI objective experiment was conducted utilizing a deployed MEU. The results showed promise and informed continued development of this capability. Initial DI fielded capability will consist of a suite of electronics to allow the embarked troop commander and aircrew to possess unprecedented situational awareness via real-time transmission of full motion video and other data generated by multiple air and ground platforms throughout the battlespace. This DI suite will also be able to collect, in real time, threat data gathered by existing aircraft survivability equipment and accompanying attack platforms, thereby shortening the kill-chain against ground and air based threats.

The MV-22 is the assault support platform of choice for all CCDRs. From MEUs to SPMAGTF-CR, the speed, range, and aerial refueling capability allow the Osprey to remain postured in strategic locations throughout the world, ready and poised to quickly support Marines Corps operations wherever they are required.

CH-53K Heavy Lift Replacement Program

The Fiscal Year 2018 President's Budget requests $341.0 million in RDT&E,N to continue the Engineering Manufacturing Development (EMD) phase of the CH-53K program and $756.4 million in APN for Low Rate Initial Production (LRIP) Aircraft (Lot 2), including Advance Procurement and initial spares.

The CH-53K achieved Milestone C, receiving an Acquisition Decision Memorandum April 3, 2017, authorizing LRIP. To date, four Engineering Development Model aircraft have accumulated over 450 test flight hours, completed the first 'Operational Test Assessment' ahead of schedule and set a U.S. Heavy Lift record with an 89.5K Maximum Gross Weight lift.

During Fiscal Year 2018, the program will continue to execute developmental test flights, complete the relocation of test assets to NAS Patuxent River, and take delivery of System Demonstration Test Article (SDTA) aircraft (production representative aircraft utilized for Operational Test). Three of the four SDTAs will deliver to NAS Patuxent River to supplement the remainder of developmental test. Marine Test and Evaluation Squadron One will take delivery of the balance of aircraft at Marine Corps Air Station (MCAS) New River to execute publication and maintenance demonstrations prior to Operational Test & Evaluation.

The CH-53K will provide land and sea based heavy-lift capabilities not resident in any of today's platforms and contribute directly to the increased agility, lethality, and presence of joint task forces and MAGTFs. The CH-53K can transport 27,000 pounds of external cargo out to a range of 110 nautical miles under the most extreme operational conditions, nearly tripling the CH-53E's lift capability under similar environmental conditions, while fitting into the same shipboard footprint. The CH-53K will provide an unparalleled lift capability under high-altitude and hot weather conditions and greatly expand the CCDRs operational reach and flexibility.

Compared to the CH-53E, maintenance and reliability enhancements of the CH-53K will improve aircraft availability and ensure cost effective operations. Additionally, survivability and force protection enhancements will dramatically increase protection for both aircrew and passengers. Expeditionary heavy-lift capabilities will continue to be critical to successful land and sea-based operations in future anti-access, area-denial environments, enabling sea-basing and the joint operating concepts of force application and focused logistics.

CH/MH-53E

As the CH-53E approaches 30 years of service, the community has accumulated over 95,000 combat flight hours in support of various combat operations. The unprecedented operational demand of this aircraft (peaking at three times the published utilization rate) has degraded the material condition of our heavy lift assault support aircraft sooner than expected. This makes them more challenging to maintain and underscores the importance of its replacement, the CH-53K King Stallion. We have instituted a fleet wide "reset" of the CH-53E inventory to ensure we extract maximum utility and readiness until the transition to the CH-53K occurs.

The MH-53E continues to perform its primary mission of airborne Mine Countermeasures (MCM) as well as transport of cargo and personnel. Over the past 12 years the MH-53E community has accumulated 84,131 flight hours. It too is approaching 30 years of service life and continues to be a challenging asset to maintain. MCM operations put added stress on these airframes. These aircraft are planned to remain in service until they are replaced by the Littoral Combat Ship (LCS) with its MCM mission package systems.

To keep the CH-53E and MH-53E viable through their remaining services lives, the 2018 President's Budget requests $37.0 million in APN and $5.1 million in RDT&E,N. The requested funding provides for critical capabilities, including Condition Based Maintenance software upgrades, finishing Kapton wiring replacement installations, improved engine nacelles, non-recurring engineering cockpit upgrades, Embedded Global Positioning System/Inertial Navigation System, T-64 engine reliability improvements, critical survivability upgrades, satellite communications kits and Phase I of CH-53E's Degraded Visual Environment capability. These critical safety and avionics upgrades will address obsolescence issues within the cockpit and increase overall situational awareness and mission effectiveness.

ATTACK AND UTILITY AIRCRAFT

UH-1Y / AH-1Z

Marine Corps Venom and Viper utility and attack aircraft have been critical to the success of the Marines in harm's way and have flown over 162,000 hours over the past decade. The Fiscal Year 2018 President's Budget requests $61.3 million in RDT&E,N for continued product improvements and $822.4 million in APN for 22 AH-1Z aircraft and system improvements. This budget reflects a deliberate decision to fund readiness through a five aircraft procurement reduction.

As of April 2017, 210 aircraft are operational within the Marine Force (146 UH-1Ys and 64 AH-1Zs). An additional 72 aircraft are on contract and in production, to include the first three of 12 Pakistan Foreign Military Sales aircraft. Lot 1-7 (Fiscal Years 2004-2010) aircraft deliveries are complete for both the UH-1Y and AH-1Z. Lot 8, 9, and 10 (Fiscal Years 2011-2013) deliveries are complete for the UH-1Y. Lot 11 UH-1Y deliveries are in progress and ahead of schedule. Additionally, the Czech Republic signed a Letter of Request for Letter of Acceptance in April 2017 for 12 UH-1Ys, which will be placed on contract in Fiscal Year 2018.

The H-1 Upgrades program is integrating both the UH-1Y and AH-1Z into the DI environment established throughout the MAGTF. With the integration of IT II EW pod, the Marine Corps' Light Attack Helicopter Squadron community will be able to provide MAGTF Commanders with all six functions of Marine Aviation, further increasing capability and flexibility. Additionally, these aircraft will incorporate Software Reprogrammable Payloads (SRP), which enables utilization of diverse networks and waveforms, thereby enabling maneuverability within the EW spectrum. SRP will employ systems such as Link-16, Tactical Targeting Network Technology, Adaptive Networking Wideband Waveform, and the Soldier Radio Waveform.

MH-60 (Overview)

MH-60 Seahawks have consistently met readiness and operational commitments. There will be 38 Navy Seahawk squadrons, with 275 MH-60S and 280 MH-60R aircraft, when transitions from the SH-60B, SH-60F, and HH-60H are complete. The last MH-60S delivered in January of 2016 and MH-60R deliveries are projected to continue into Fiscal Year 2018. The production program continues to deliver on cost and on schedule. Over the last twelve years of combat operations, deployed ashore and aboard our aircraft carriers, amphibious ships, and surface combatants at sea, Navy H-60 helicopters have provided vital over-watch and direct support to troops in combat across multiple theaters of operation and a variety of mission areas; including support for Surface Warfare (SUW), Anti-submarine Warfare (ASW), special operations forces, mine warfare, logistics support and humanitarian assistance/disaster relief.

The MH-60R Multi-Mission Helicopter provides Carrier Strike Group protection and adds significant capability in its primary mission areas of ASW, EW and SUW. The MH-60R is the sole organic air ASW asset in the Carrier Strike Group and serves as a key contributor to theater level ASW. The MH-60R also employs advanced sensors and communications to provide real-time battlespace management with a significant, active or passive, over-the-horizon targeting capability, as well as Fast Attack Craft/Fast In-shore Attack Craft threat response capabilities. Secondary mission areas include Search and Rescue, Vertical Replenishment, Naval Surface Fire Support, Logistics Support, Personnel Transport and Medical Evacuation.

The MH-60S supports Carrier and Expeditionary Strike Groups, Combat Logistics Ships, and LCS Surface Warfare and Mine Countermeasures variants in the mission areas of SUW, Strike Warfare, Combat Search and Rescue, Vertical Replenishment.

The Fiscal Year 2018 President's Budget requests $11.3 million in RDT&E,N across the FYDP for an MH-60S SLAP. SLAP will inform the Department on what will be required to extend the MH-60S airframe service life beyond 2030. The program will initially focus on the air vehicle and include a Fatigue Life Assessment, Dynamic Component, and Subsystem Analysis to inform SLEP requirements.

The Budget request includes $5.4 million in RDT&E,N to support the MH-60 test program and other improvements. The MH-60 test program consists of numerous system upgrades and Pre-Planned Product Improvements, and include the Multifunctional Information Distribution System - Low Volume Terminal Block Upgrade 2, the VHF Omnidirectional Ranging/Instrument Landing System, System Configuration 18 enhancements, MH-60S fixed forward-firing weapon/rocket corrections of deficiencies, and commencement of initial studies for a MH-60 Mid-Life Upgrade. These investments improve MH-60S lethality and provide forward-deployed capabilities to defeat area-denial strategies and allow joint forces to project and sustain power.

EXECUTIVE SUPPORT AIRCRAFT

VH-3D/VH-60N Executive Helicopter Series

The VH-3D and VH-60N are safely performing the Executive Lift mission worldwide. As these aircraft continue to provide seamless vertical lift for the President of the United States, the DoN works closely with HMX-1 and industry to sustain these aircraft until a Presidential Helicopter Replacement platform (VH-92A) is fielded.

The Fiscal Year 2018 President's Budget requests an investment of $38.8 million of APN to continue programs that will ensure the in-service Presidential fleet remains safe and reliable. Ongoing efforts include a Communications Suite Upgrade (Wide Band Line of Sight) that provides persistent access to the strategic communications network, the continuing Structural Enhancement Program necessary to extend the service life, and Obsolescence Management needed to sustain and improve system readiness for both VH-60N and VH-3D platforms. The Cabin Interior and Environmental Control System upgrade is a critical obsolescence management effort for the VH-3D, reducing aircraft operational weight and improving maintainability. Where appropriate, technology updates for legacy platforms will be directly leveraged for the benefit of the VH-92A program.

VH-92A Presidential Helicopter Replacement Aircraft

The Fiscal Year 2018 President's Budget requests $451.9 million in RDT&E,N to continue Engineering Development Model (EDM) activities, to include, contractor test for airworthiness certification and modifications of EDM and System Demonstration Test Article aircraft. The Sikorsky S-92A aircraft will be used to execute the acquisition strategy of integrating mature subsystems into an air vehicle that is currently in production. Significant progress has been made in the past year: completion of the System Critical Design Review in July 2016; continued progress of the test aircraft build with first flight and Contractor Test beginning July 2017; and the projected induction of the first of four S-92A aircraft into the modification process in May to become the SDTA aircraft that will support IOC. Government ground and flight testing is planned to commence in 2018. The first four of the planned operational inventory of 21 aircraft are planned to achieve IOC in 2020.

FIXED-WING AIRCRAFT

KC-130J

The DoN continues to procure two KC-130Js per year, and will continue product improvements. Targeted improvements include aircraft survivability through advanced electronic countermeasure modernization and obsolescence upgrades to the Harvest HAWK ISR/Weapon Mission Kit.

Fielded throughout our active force, the KC-130J brings increased capability, performance and survivability with lower operating and sustainment costs for the MAGTF. Forward deployed in support of ongoing operations since 2005, the KC-130J continues to deliver Marines, fuel and cargo whenever and wherever needed. Today, the KC-130J remains in high demand, providing tactical air-to-air refueling, assault support, CAS and Multi-sensor Imagery Reconnaissance (MIR) capabilities in support of SPMAGTFs and deployed MEUs.

First deployed in 2010, the roll-on/roll-off Harvest HAWK Mission Kit for the KC-130J continues to provide extended MIR and CAS capabilities. With almost 7,000

hours flown, 210 Hellfire missiles, and 91 Griffin missile combat engagements, this expeditionary mission kit has proven its worth and made the KC-130J even more indispensable for Marines on the ground. All six mission kits have been fielded, and the requested funding in the Fiscal Year 2018 budget request will be used to maintain operational relevance of this mission system through compatibility with additional Hellfire variants and an improved full motion video data-link.

The Marine Corps has funded 66 of the 79 KC-130J aircraft through the current FYDP. The 3 aircraft included in the Fiscal Year 2013 budget would have completed the Active Component (AC) requirement of 51 aircraft. However, in 2014 the Marine Corps began using the AC backup aircraft to accelerate the Reserve Component (RC) transition from the legacy KC-130T aircraft to the more capable and efficient KC-130J. The aircraft requested in the Fiscal Year 2018 President's Budget will continue to increase KC-130J inventory as we strive to achieve FOC in the RC. Delays in procurement would force the Marine Corps to sustain the KC-130T aircraft longer than planned at an increased cost and incur additional manpower issues.

It is also important to note that the USAF C-130J procurement is anticipated to end in 2023. If the Marine Corps procure KC-130Js at a rate of two per year, we will have approximately ten aircraft remaining to procure after Fiscal Year 2023 in order to reach the POR of 79 aircraft. The loss of USAF aircraft quantities and the uncertainty of additional Foreign Military Sales may result in a significant unit cost increase for these final aircraft.

MARITIME SUPPORT AIRCRAFT

P-8A Poseidon

The P-8A Poseidon recapitalizes the ASW, Anti-Surface Warfare (ASuW) and armed ISR capabilities from the aging P-3C Orion. The P-8A combines the proven reliability of the commercial 737 airframe with avionics that enable integration of modern sensors and robust military communications. The first P-8A operational deployment was completed in June 2014, with continuous deployments to both 7th Fleet and 6th Fleet

underway. As of April 2017, seven of twelve fleet squadrons have completed transition and an eighth is underway. All squadrons are scheduled to complete transition by Fiscal Year 2020. The P-8A program is meeting all cost, schedule and performance parameters in accordance with the approved Acquisition Program Baseline. It has achieved and surpassed reliability standards for operational availability and delivered forward commanders unprecedented capability.

Each of the 54 fleet aircraft delivered early or on time. Lot 6 and Lot 7 are under contract, including eight aircraft for the Royal Australian Air Force, our cooperative partner. Lots 8-10 will include nine aircraft for the United Kingdom and five for the Royal Norwegian Air Force. In Fiscal Year 2018, our request is for $1.386 billion in APN for seven aircraft and $181.7 million in RDT&E,N for aircraft updates to include the addition of Networked Enabled Weapons capabilities.

The first planned upgrade for the P-8A, Increment 2, added a broad-area, multi-static acoustic (MAC) ASW capability to the aircraft. This capability significantly increased the P-8A ASW search rates in harsh, littoral environments. The capability is scheduled to receive regular incremental upgrades over the next five years in order to pace the threat and improve the aircraft's search capability. MAC completed Follow-On Operational Test & Evaluation in April 2015 and has been delivered to the Fleet. Separately, Increment 2 integrates a High Altitude ASW Weapons Capability under a contract awarded in December 2014, in support of a planned 2020 fleet introduction.

P-3C Orion

The aging P-3C fleet will continue to provide critical ASW, ASuW and ISR support for operations worldwide until the fleet completes transition to P-8A. The Fiscal Year 2018 budget request provides $0.7 million to manage P-3C aircraft mission systems obsolescence and $1.4 million to fund the P-3 Fatigue Life Management Program in order to maintain sufficient capacity to complete the transition to P-8A**.**

EP-3 Aries

The EP-3E Aries is the Navy's only Maritime ISR and Signals Intelligence (SIGINT) platform. The Joint Airborne SIGINT Common Configuration includes Multi-INT sensors, robust communication, and data links employed by the venerable P-3 air vehicle to ensure effective fleet support across the full spectrum of military operations. The Fiscal Year 2011 National Defense Authorization Act directed the Navy to sustain EP-3E airframe and associated mission systems to minimize SIGINT capability gaps until the systems are fully recapitalized with a system or family of systems that in aggregate provide equal or better capability and capacity. The Navy's family of systems approach to ISR shifts the focus from platforms to payloads to deliver increased capacity and persistence by the end of this decade. The EP-3 Fiscal Year 2018 budget request of $14.5M (Baseline and OCO) reduces risk compared to previous fiscal years while the Navy continues to collaborate with the Joint Staff and DoD to optimize the future of ISR.

UNMANNED AIRCRAFT SYSTEMS (UAS)

The DoN has placed a priority on the development of unmanned systems leading to a fully integrated manned and unmanned fleet. Unmanned technology will not replace our Sailors and Marines; instead it will unlock their full potential as we integrate this technology within our total force.

MQ-4C Triton UAS

The Fiscal Year 2018 President's Budget requests $84.1 million in RDT&E,N to continue Triton baseline development activities; $229.4 million in RDT&E,N for Triton modernization; and $676.3 million of APN for procurement of the third lot of LRIP aircraft and spares, retrofit of the LRIP Lot 1 aircraft to the Multi-INT configuration, and for procurement of long lead materials for the fourth lot of LRIP aircraft.

The MQ-4C Triton is a key component of the Navy Maritime Patrol Reconnaissance Force. Its persistent sensor dwell, combined with networked sensors,

will enable it to effectively meet ISR requirements in support of the Navy Maritime Strategy. Triton will start establishing five globally-distributed, persistent Maritime ISR orbits beginning in Fiscal Year 2018, as part of the Navy's Maritime ISR&T Transition Plan. MQ-4C Triton test vehicles have completed over 110 test flights as of April, 2017, and will complete sensor and performance flight testing this fall in support of establishing an early operational capability in the Pacific next year. Milestone C was successfully completed in September 2017, and the program has entered the production and deployment phase.

The Navy currently maintains an inventory of four RQ-4A Global Hawk Block 10 UAS, as part of the BAMS Demonstrator, or BAMS-D program. These aircraft have been deployed to CENTCOM's AOR for over eight years. BAMS-D recently achieved over 23,000 flight hours in support of CENTCOM ISR tasking.

MQ-25 Stingray

MQ-25 will deliver the Navy's first carrier-based unmanned aircraft to function primarily as a mission tanker to extend the range and reach of the CVW with secondary recovery tanking and ISR capabilities. MQ-25 will reduce current use of F/A-18E/Fs as CVW tankers and extend F/A-18E/F service life. As a secondary mission, MQ-25 will provide the Carrier Strike Group Commander an organic, persistent ISR capability for maritime domain awareness. The Fiscal Year 2018 President's Budget requests $222.2 million in RDT&E,N for MQ-25 developmental activities and the Air System Engineering and Manufacturing Development contract award.

MQ-8 Fire Scout

The MQ-8 Fire Scout is a rotary-wing system that includes two airframe types, the MQ-8B and MQ-8C. The MQ-8C is a larger, more capable and more cost-effective airframe that uses the same mission control system, avionics and payloads as the MQ-8B. The system is designed to operate from any suitably-equipped air-capable ship, carry modular mission payloads, and operate using the Tactical Control System and Line-Of-

Sight Tactical Common Data Link. The Fiscal Year 2018 President's Budget requests $62.7 million of RDT&E,N to continue hardware and software modifications, payload integration, cyber vulnerability closure and safety capability improvements such as a backup landing system and collision avoidance system. The request for $85.4 million in APN procures four MQ-8 mission control systems, MQ-8C AESA Radar kits, ancillary shipboard equipment, trainers and aircraft support equipment, technical support, modifications based on engineering changes, and logistics products to outfit suitably-equipped air-capable ships and train the associated Aviation Detachments.

The MQ-8B has completed 11 operational deployments and flown more than 16,000 operational hours, including deployments to Afghanistan, deployments on Navy Frigates, and deployments aboard LCS supporting Special Operations Forces and Navy operations. The MQ-8B is currently deployed on USS CORONADO (LCS-4) with HSC-23 in a composite aviation detachment with an MH-60S. This detachment represents the first deployment of an MQ-8B with a maritime search radar capability. HSC-21, located in San Diego, California, is currently working up for a Fiscal Year 2018 employment onboard USS INDEPENDENCE (LCS-2) marking the first deployment of the Coastal Battlefield Reconnaissance and Analysis MCM payload. HSC-22, located in Norfolk Virginia, has been identified as the MQ-8 introductory squadron for the east coast and will deploy onboard the USS DETROIT (LCS-7) in early 2018.

The MQ-8C Fire Scout has flown more than 800 flight hours conducting developmental and land-based operational testing including dynamic interface testing on LCS-8 in April 2017. The program begins Initial Operational Test & Evaluation in the first quarter of Fiscal Year 2018. The Navy is continuing efforts to integrate an AESA radar capability into the MQ-8C and is planning to integrate the APKWS II weapon system and future MCM payloads. The Fire Scout program will continue to support integration and testing for LCS-based Surface Warfare and MCM mission modules.

Tactical Control System (TCS)

The Fiscal Year 2018 President's Budget requests $7.8 million in RDT&E,N for the MQ-8 System's Tactical Control System (TCS). TCS provides a standards-compliant open architecture with scalable command and control capabilities for the MQ-8 Fire Scout system. In Fiscal Year 2018, TCS will continue transition of the Linux operating system to a technology refreshed mission control system, and enhance the MQ-8 System's Automatic Identification System and sensor track generation integration with ship systems. The Linux operating system conversion overcomes hardware obsolescence issues with the Solaris based control stations and provides lower cost software updates using DoD common application software. In addition, the TCS Linux upgrade will enhance collaboration with the Navy's future UAS Common Control System.

RQ-21A Blackjack

The Fiscal Year 2018 President's Budget requests $13.7 million in RDT&E ($4.8 million USN, $8.9 million USMC); $4.8 million in APN for support of Naval Special Warfare; and $86.2 million in PMC for four expeditionary RQ-21A systems (which includes 20 air vehicles) to address Marine Corps ISR capability requirements. This Group 3 UAS provides persistent ship and land based ISR support for expeditionary tactical-level maneuver decisions and unit level force defense and force protection missions. Blackjack entered LRIP in 2013, completed Initial Operational Test & Evaluation in the second quarter of Fiscal Year 2015, and reached IOC in January 2016. FRP was approved in the fourth quarter of Fiscal Year 2016.

The RQ-21 completed its first combat deployments in 2016 with support to the 24th and 22nd MEU and Marine Corps Special Operations Command operations in Operation INHERENT RESOLVE. The Blackjack has flown over 700 sorties and 3940 hours in support of the MAGTF.

The RQ-21's current configuration includes full motion video, communications relay package and automatic identification systems. The air vehicle's bay allows for rapid deployment of signals intelligence payloads. The Marine Corps is actively pursuing

technological developments for the RQ-21A system in an effort to provide the MAGTF and Marine Corps Special Operations Command with significantly improved capabilities. Initiatives include over-the-horizon communication and data relay ability to integrate the system into future networked digital environments; electronic warfare and cyber payloads to increase non-kinetic capabilities; and change detection radar and moving target indicators to assist warfighters in battlespace awareness and force application.

MAGTF Expeditionary UAS (MUX)

As the Marine Corps recapitalizes toward a more diverse, lethal, amphibious and middleweight expeditionary force, the Marine Corps will require a UAS that is network-enabled, digitally interoperable, and built to execute responsive, persistent, lethal, and adaptive full-spectrum operations. A MUX is planned to be the system that will provide the MEF/MEB-sized MAGTF with an advanced multi-mission platform.

The Fiscal Year 2018 budget requests $5.0 million in RDT&E for the MUX program to conduct an AoA and begin development of an acquisition strategy; $3.0 million in RDT&E for KMAX operations in support of MUX technology demonstrations and Concept of Operation development (included under the MUX line).

The MUX Initial Capabilities Document was approved by the Joint Requirements Oversight Council on October 4, 2016. The AoA study plan and guidance are being developed with OSD(CAPE). The AoA is projected to be completed by the fourth quarter of Fiscal Year 2018.

MUX supports the Marine Corps Operating Concept by significantly mitigating or eliminating the following MAGTF gaps: EW, ISR, Command, Control and Communications (C3) DI, Aerial Escort, all weather, persistent CAS and Deep Air Support, Airborne Early Warning, and Tactical Cargo Distribution. MUX will be a long range (690+ NM), persistent (24+ hours) UAS capable of complimenting MV-22 operations and operating from both sea and expeditionary bases.

Common Control System (CCS)

The Fiscal Year 2018 President's Budget requests $39.7 million in RDT&E,N for the Common Control System (CCS). The primary mission of CCS is to provide common control across the Navy's unmanned systems (UxS) portfolio to add scalable and adaptable warfighting capability, implement robust cybersecurity attributes, leverage existing government owned products, eliminate redundant software development efforts, consolidate product support, encourage innovation, improve cost control, and enable rapid integration of UxS capabilities across all domains: Air, Surface, Sub-Surface, and Ground. CCS leverages existing Government owned software to provide UxS Vehicle Management (VM), Mission Management (MM) and Mission Planning (MP) capabilities. CCS uses an open and modular business model and is being developed initially as Government Furnished Information/Equipment for the MQ-25 and for follow-on use with Triton and Fire Scout. In Fiscal Year 2018, CCS Increment I will continue to perform software design, development, integration and test for VM. Concurrently, CCS Increment II will conduct MM/MP requirements development and software design.

SAFETY

Responses to Congressional requests for updates on Naval Aviation safety can be found at Addendum C.

STRIKE WEAPONS PROGRAMS

Cruise Missile Strategy

The DoN has aligned its Cruise Missile Strategy along warfighter domains to pursue maximized lethality while minimizing overall costs to the taxpayer and Department.

The first tenet of our plan is to sustain the Tomahawk cruise missile inventory through its anticipated service-life via a mid-life recertification program (first quarter of

Fiscal Year 2019 start). This recertification program will increase missile service-life by an additional 15-years (total of 30-years) and enable the Department to support Tomahawk in our active inventory through the mid-late 2040s. In concert with our recertification program we will integrate modernization and technological upgrades and address existing obsolescence issues. In addition, we are developing a Maritime Strike Tomahawk capability to deliver a long-range anti-surface warfare capability.

Second, we will field the Long Range Anti-Ship Missile (LRASM) as the air-launched Offensive Anti-Surface Warfare (OASuW)/Increment 1 material solution to meet near to mid-term anti-surface warfare threats. LRASM is pioneering accelerated acquisition processes in accordance with DoD-5000.02 (Model 4). Currently, we anticipate LRASM to meet all Joint Chiefs of Staff approved warfighting requirements, deliver on-time, and cost within approximately one-percent of its original program cost estimate.

We also plan to develop follow-on next generation strike capabilities. We intend to develop an air-launched OASuW/Increment 2 weapon to address long-term ASuW threats and a surface and submarine launched Next Generation Land Attack Weapon (NGLAW). NGLAW will have both a long-range land strike and maritime ASuW capability that initially complements, and then replaces, the highly successful Tomahawk Weapon System.

To the maximum extent possible, the DoN plans to utilize common components and component technologies (e.g. navigation, communications, seeker, guidance and control) to reduce cost, shorten development timelines, and promote interoperability. Based on performance requirements and launch parameters, next generation strike capability missile airframes and propulsion systems will differ between the air-launched and sea-launched weapons.

Tactical Tomahawk (TACTOM) BLK IV Cruise Missile

The Fiscal Year 2018 President's Budget requests $234.5 million in WPN for procurement of an additional 100 TACTOM weapons and associated support to include

replacement of weapons launched in combat (Syria), $31.7 million in OPN for the Tomahawk support equipment, and $114.8 million in RDT&E,N for capability updates of the weapon system. WPN resources will be for the continued procurement of this versatile, combat-proven, deep-strike weapon system in order to meet ship load-outs and combat requirements. OPN resources will address the resolution of Tactical Tomahawk Weapons Control System obsolescence, Tomahawk Theater Mission Planning Center (TMPC) complexity and usability issues, interoperability, and information assurance mandates. RDT&E,N resources will be used to develop navigation system improvements and communications upgrades to improve TACTOMs performance in Anti-Access/Area Denial environments, as well as development of a seeker to enable TACTOM to engage maritime targets, and the development and integration of a multiple effects warhead.

Tomahawk provides an attack capability against fixed and mobile targets, and can be launched from both Ships and Submarines. The current variant, TACTOM, preserves Tomahawk's long-range precision-strike capability while significantly increasing responsiveness and flexibility. TACTOM's improvements include in-flight retargeting, the ability to loiter over the battlefield, in-flight missile health and status monitoring, and. Other Tomahawk improvements include rapid mission planning and execution via Global Positioning System (GPS) onboard the launch platform and improved anti-jam GPS.

Tomahawk Theater Mission Planning Center (TMPC)

The Fiscal Year 2018 President's Budget for TMPC requests $18.8 million in RDT&E,N and $41.5 million in OPN. TMPC is the mission planning and strike execution segment of the Tomahawk Weapon System. TMPC develops and distributes strike missions for the Tomahawk Missile; provides for precision targeting, weaponeering, mission and strike planning, execution, coordination, control and reporting. TMPC provides CCDRs and Maritime Component Commanders the capability to plan and/or modify conventional Tomahawk Land-Attack Missile missions. TMPC is a Mission Assurance Category 1 system, vital to operational readiness and mission effectiveness of deployed and contingency forces. RDT&E,N efforts will

address National imagery format changes, update Tomahawk navigation and accuracy algorithms - to include operations in the maritime and/or Anti-Access Area Denial environments, upgrade obsolete Tomahawk Cruise Missile Communications and initiate a Tomahawk seeker integration into the TMPC mission planning environment. OPN resources will enable the Navy to continue software engineering efforts associated with Tomahawk Missile Modernization, upgrade unsupportable and obsolete TMPC software to ensure compliance with DoD cybersecurity mandates, and implement the TMPC Enterprise Network to allow for rapid delivery of security policies, cybersecurity software patches and anti-virus definitions. All of these upgrades are critical for the support of over 180 TMPC operational sites worldwide, afloat and ashore, to include: Cruise Missile Support Activities (inclusive of STRATCOM), Tomahawk Strike and Mission Planning Cells (5th, 6th, 7th Fleet), Carrier Strike Groups, Surface and Subsurface Firing Units and Labs/Training Classrooms.

Offensive Anti-Surface Warfare (OASuW) Increment 1 (Long Range Anti-Ship Missile (LRASM))

OASuW/Increment 1 (LRASM) will provide CCDRs the ability to conduct ASuW operations against high-value surface combatants protected by Integrated Air Defense Systems with long-range Surface-to-Air-Missiles and deny adversaries the sanctuary of maneuver against 2018-2020 threats. The program is scheduled to achieve Early Operational Capability on the Air Force B-1 by the end of Fiscal Year 2018 and Navy F/A-18E/F by the end of Fiscal Year 2019.

The Fiscal Year 2018 President's Budget request contains $160.7 million in RDT&E,N for LRASM development and testing and $74.7 million in WPN to purchase 25 LRASM All-Up-Round weapons. OASuW Increment 1 (LRASM) leverages the Defense Advanced Research Projects Agency weapon demonstration effort.

Offensive Anti-Surface Warfare (OASuW) Increment 2

OASuW/Increment 2 is required to deliver the long-term air-launched ASuW capability to counter 2024 (and beyond) threats. The Department continues to plan for OASuW/Increment 2 to be determined via full and open competition. Full OASuW/Inc. 2 capability is delayed until at least Fiscal Year 2026 (est.).

Next Generation Land Attack Weapon (NGLAW)

The Next Generation Land Attack Weapon (NGLAW) will provide the next generation of long-range, kinetic strike to destroy high-priority fixed, stationary and moving targets – as well as those targets hardened, defended or positioned at ranges such that engagement by aviation assets would incur unacceptable risk. NGLAW will be capable of kinetic land and maritime attack from surface and sub-surface platforms and initially complement, and then eventually replace, the Tomahawk Weapon System. IOC is planned for the 2028-2030 timeframe (est.).

On November 28, 2016, the Under Secretary of Defense approved Navy's entry into the MS-A phase and authorized initiation of an AoA. Fiscal Year 2018 resources totaling $9.9 million begins the transition from the analysis phase to planning for a formal program of record.

Sidewinder Air-Intercept Missile (AIM-9X)

The Fiscal Year 2018 President's Budget requests $ 42.9 million in RDT&E,N and $79.7 million in WPN for this joint DoN and USAF program. RDT&E,N will be applied toward the Engineering Manufacturing Development phase of critical hardware obsolescence redesign and Developmental Testing of Version 9.4 missile software, both part of the AIM-9X/Block II System Improvement Program (SIP) III. Navy also continues the design and development of Insensitive Munitions improvements in accordance with direction from the Joint Chiefs of Staff. WPN funding is requested to procure a combined 185 All-Up-Rounds and Captive Air Training Missiles and associated missile-related

hardware. The AIM-9X Block II/ II+ Sidewinder is the newest in the Sidewinder family and is the only short-range infrared air-to-air missile integrated on Navy, Marine Corps, and USAF strike-fighter aircraft. This fifth-generation weapon incorporates high off-boresight acquisition capability and increased seeker sensitivity through an imaging infrared focal plane array seeker with advanced guidance processing for improved target acquisition; data link capability; and advanced thrust vectoring technology to achieve superior maneuverability and increase the probability of intercept of adversary aircraft.

Advanced Medium-Range Air-to-Air Missile (AMRAAM/AIM-120D)

The Fiscal Year 2018 President's Budget requests $25.4 million in RDT&E,N for continued software capability enhancements and $197.1 million in WPN for 120 All-Up-Rounds and associated missile-related hardware. AMRAAM is a joint USAF and DoN weapon that counters existing aircraft and cruise-missile threats. It uses advanced counter-electronic attack capabilities at both high and low altitudes, and can engage targets from both beyond visual range and within visual range. AMRAAM provides an air-to-air first look, first shot, first kill capability, while working within a networked environment in support of the Navy's Theater Air and Missile Defense Mission Area. RDT&E,N will be applied toward critical hardware obsolescence through the Form, Fit, Function, Refresh (F3R) redesign effort as well as software upgrades to counter emerging Electronic Attack threats for AIM-120C/D missiles. Production challenges linked to the F3R program forced the Navy to reduce its planned procurement of AMRAAM in Fiscal Year 2018.

Small Diameter Bomb II (SDB II)

The Fiscal Year 2018 President’s Budget requests $112.8 million in RDT&E,N for continued development of the USAF-led Joint Service SDB II weapon and Joint Miniature Munitions Bomb Rack Unit (JMM BRU) programs and $21.0 million in WPN to procure 90 All-Up-Round weapons. Using multi-mode seeker and two-way data-link capabilities, SDB II provides an adverse weather, day or night standoff capability against

mobile, moving, and fixed targets, and enables target prosecution while minimizing collateral damage. SDB II will be integrated into the internal carriage of both DoN variants of the Joint Strike Fighter (F-35B/F-35C) and externally on the Navy's F/A-18E/F via the JMM BRU (BRU-77A). JMM BRU completed Milestone B and entered Engineering Manufacturing Development in August 2015. Both SDB II and JMMU BRU will use an Universal Armament Interface architecture to enable more efficient and less costly future weapon/platform integration.

Advanced Anti-Radiation Guided Missile (AARGM) & AARGM Extended Range

The Fiscal Year 2018 President's Budget requests $6.4 million of RDT&E,N for High-Speed Anti-Radiation Missile (HARM) and AARGM Foreign Material Assessment; $15.2M for AARGM to implement M Code, transition receiver upgrade from ONR efforts and Block 1 follow-on development; $66.3 million of RDT&E,N for AARGM Extended Range (AARGM-ER) development; and $183.4 million of WPN for production of AARGM modification kits for 251 All-Up-Rounds and Captive Training Missiles. The AARGM cooperative program with the Italian Air Force transforms the HARM into an affordable, lethal, and flexible time-sensitive strike weapon system for conducting Destruction of Enemy Air Defense missions. AARGM adds multi-spectral targeting capability and targeting geospecificity to its supersonic fly-out to destroy sophisticated enemy air defenses and expands upon the HARM target set. The program achieved IOC on the F/A-18C/D aircraft in July 2012, with forward deployment to PACOM; integration is complete for AARGM with release of H-8 System Configuration Set for F/A-18E/F and EA-18G aircraft. The AARGM Block 1 software only update will achieve IOC the third quarter of FY 2017. The AARGM-ER modification program, involving hardware and software improvements, began in Fiscal Year 2016. This effort will increase the weapon system's survivability against complex and emerging threat systems and affords greater stand-off range for the launch platform. AARGM-ER will be designed to fit internally in both the F-35A and F-35C, thereby increasing the capability and lethality of the Lightening II weapon system.

Joint Air-to-Ground Missile (JAGM)

The Fiscal Year 2018 President's Budget requests $15.5 million in RDT&E,N to continue a five year integration effort of JAGM Increment 1 onto the Marine Corps AH-1Z and $3.8 million in WPN to support the Fiscal Year 2017 procurement of 96 All-Up-Rounds in order to meet the IOC in Fiscal Year 2020. The Fiscal Year 2017 and Fiscal Year 2018 funding will be used to procure the JAGM LRIP All Up Rounds, Other Production Support, training missiles, production related engineering and logistics to support the procurement in order to meet the IOC.

JAGM is an Army-led, Joint ACAT-1D Major Defense Acquisition Program. JAGM is a direct attack/CAS missile program that will utilize advanced seeker technology to provide fire-and-forget, simultaneous target engagement against land and maritime targets. JAGM will replace the HELLFIRE and TOW II missile systems for the DoN. In November 2012, the Joint Chiefs of Staff authorized the JAGM incremental requirements and revalidated the DoN's AH-1Z Cobra aircraft as a threshold platform. JAGM Increment 1 achieved Milestone B approval in Fiscal Year 2015, a Milestone C (LRIP) is planned for the Fiscal Year 2018 and AH-1Z Cobra/JAGM IOC is planned for Fiscal Year 2020.

Advanced Precision Kill Weapon System II (APKWS II)

The Fiscal Year 2018 President's Budget requests $39.5 million in PANMC for procurement of 1,210 APKWS II Precision Guidance Kits. APKWS II provides an unprecedented precision guidance capability to DoN unguided rocket inventories, improving accuracy and minimizing collateral damage. Program production continues on schedule, meeting the needs of our warfighters in today's theaters of operations. Marine Corps AH-1W and UH-1Y achieved IOC in March 2012 and the Marine Corps AH-1Z platform was certified to fire APKWS II in June 2015. To date, these platforms have expended more than 190 APKWS II weapons during combat missions. The Navy successfully integrated APKWS II on the MH-60S for an Early Operational Capability in March 2014 and fielded a similar effort on the MH-60R in March 2015. A variant of

APKWS II has been integrated onto the AV-8B, A-10 and F-16 aircraft, and is currently being employed in support of Operation INHERENT RESOLVE.

Direct Attack Weapons and General Purpose Bombs

The Fiscal Year 2018 President's Budget requests $108.9 million in PANMC for Direct Attack Weapons and General Purpose bombs and an additional $164.3M specifically to procure 7,209 Joint Direct Attack Munition (JDAM) kits to enhance readiness. In thirty months of Operation INHERENT RESOLVE, DoN aircraft have expended more than three times the number of 500lb JDAM kits than we have procured during the same period. This significant warfighter demand has forced the Navy to reduce the number of 500-pound JDAM available for training in order to preserve warfighting inventory. The OCO request for Fiscal Year 2018 replaces the ordnance expended in the first six months of 2016. While OCO replenishment is helpful, it does not overcome the remainder of the year's expenditures which will continue to exacerbate the current inventory shortfall. Fully funding the General Purpose Bomb line item is critical to sustaining the DoN's inventory for ongoing combat operations and replenishing it for future contingencies.

CONCLUSION

The Department of the Navy continues to instill affordability, strive for stability, and maintain capacity to advance capabilities and meet mission requirements. We remain an agile strike and amphibious power projection force in readiness, and such agility requires that the aviation arm of our naval strike and expeditionary forces remain strong. Mr. Chairman, and distinguished committee members, we request your continued support for the Department's Fiscal Year 2018 budget request for our Naval Aviation programs.

Addendum A

PHYSIOLOGICAL EPISODES

Physiological Episodes (PEs) occur when aircrew experience a decrement in performance, related to disturbances in tissue oxygenation, depressurization or other factors present in the flight environment. PEs are categorized into two general groups, those related to Onboard Oxygen Generation Systems (OBOGS) or pilot breathing gas, and those caused by problems in the Environmental Control System s (ECS), i.e. – unscheduled pressure changes in the flight station. These phenomena jeopardize safe flight.

As a result of physiological episodes, the F/A-18 Program Office (PMA-265) established a Physiological Episode Team (PET) in 2010. In March of 2017, the PET was reorganized to form the PMA-265 Physiological Episode (PE) Integrated Product Team (IPT) to perform a formal Root Cause and Corrective Action analysis of F/A-18A-F and EA-18G events. The F/A-18 PE IPT is a formal partnership between PMA-265 and Boeing, and includes participation from Northrop Grumman, the NAVAIR Engineering Fleet Support Team (FST), NAVAIR 4.3's Environmental Control System (ECS) Team, NAVAIR 4.6's Human Systems Team, and the NAE's Aeromedical Crisis Action Team. The F/A-18 PE IPT works closely with other program offices, cross-service affiliates and industry partners in evaluating each episode for root cause and appropriate corrective action.

The PMA-265 PE IPT is currently addressing hypoxia and decompression events as the two most likely causes of recent physiological episodes in aviators. As symptoms related to depressurization, tissue hypoxia and contaminant intoxication overlap, discerning a root cause is a complex process. Episodes of decompression sickness typically accompany a noticeable loss or rapid fluctuation of cabin pressure, while the cause of hypoxic related events is often not readily apparent during flight or post flight. Reconstruction of the flight event is difficult with potential causal factors not always readily apparent during post-flight debrief and examination of aircraft and aircrew.

Historical data of F/A-18 physiological events prior to May 2010 is based on safety reports. The rate per 100,000 flight hours during FY 2006-FY 2010:

Date Range	F/A-18A-D	F/A-18E-F	EA-18G
FY06	3.66	2.18	0.00
FY07	1.63	3.73	0.00
FY08	3.72	4.28	0.00
FY09	6.19	8.33	0.00
FY10	4.95	11.96	0.00

In May 2010, the Commander, Naval Air Forces directed specific reporting procedures to collect more data on the occurrence of PEs. Following implementation of the new reporting protocol, the rate per 100,000 flight hours beginning in May 2010:

Date Range	F/A-18A-D	F/A-18E-F	EA-18G
05/1/2010 - 10/31/2010	12.20	8.98	0.00
11/1/2010 - 10/31/2011	10.90	8.65	5.52
11/1/2011 - 10/31/2012	16.39	23.35	5.42
11/1/2012 - 10/31/2013	21.01	26.23	9.80
11/1/2013 - 10/31/2014	29.54	26.39	15.05
11/1/2014 - 10/31/2015	30.20	28.02	42.89
11/1/2015 - 10/31/2016	57.24	31.05	90.83

The process for investigating a physiological episode begins with the submission of data describing the event. Engineers from the ECS FST and the Aircrew Oxygen Systems In-Service Support Center work with the squadron maintenance department to identify which components of the aircraft should be removed and submitted for

engineering investigation. The squadron flight surgeon also submits data on the medical condition of the pilot and in-flight symptoms that were experienced.

After completion of the component investigations, the incident is examined holistically by members of the engineering teams and Aeromedical specialists to identify the most likely cause of the incident. Of 382 cases adjudicated by the PET so far, 130 have involved some form of possible contamination, 114 involved an ECS component failure, 91 involved human factors, 50 involved an OBOGS component failure, 13 involved a breathing gas delivery component failure, and 76 were inconclusive or involved another aircraft system failure. Of note, some of the events resulted in assignment to more than one category.

T-45 Physiological Episodes

Data recorded since introduction of the T-45 Physiological Event Reporting Protocol form in November 2011 is presented below by calendar year. Prior years' data for T-45 aircraft is incomplete and is not included.

Calendar Year	Calendar year rate per 100K flight hours	Cumulative rate per 100K flight hours
2012	11.86	11.86
2013	16.22	13.94
2014	18.43	15.36
2015	44.99	22.70
2016	46.97	28.01

The process for investigating a physiological episode mimics that being used by the F/A-18 and is also managed by PET. After completion of the component investigations, the incident is examined holistically by members of the PET's engineering teams and aviation medical specialists to identify the most likely cause of the incident. More than one causal factor can be attributed to a single physiological episode event. Of

the 79 physiological episode reports adjudicated to date, 24 were assessed to be possible contamination, 12 involved human factors (these may also include incidents of airsickness and vertigo), 12 involved OBOGS component failure, 11 involved a breathing gas delivery failure, three involved cabin integrity, and the remaining 23 were inconclusive or involved another system failure.

Efforts to Mitigate Physiological Episodes on F/A-18 and EA-18G

A variety of actions have been undertaken to address the occurrence of physiological episodes in the F/A-18 / E/A-18G:

1. New maintenance rules for handling the occurrence of specific ECS built-in test faults have been implemented throughout the fleet requiring that the cause of the fault be identified and corrected prior to next flight.
2. Transportable Recompression Systems have been put on forward deployed aircraft carriers to immediately treat aircrew in the event they experience decompression sickness symptoms.
3. Mandatory cabin pressurization testing is now performed on all F/A-18A-F and EA-18G aircraft every 400 flight hours and ECS pressure port testing is performed on all F/A-18A-D aircraft every 400 flight hours. Overhaul procedures for ECS components and aircraft servicing procedures have been improved.
4. Emergency procedures have been revised, all pilots now receive annual hypoxia awareness training, and biennial dynamic training using a Reduced Oxygen Breathing Device to experience and recognize hypoxia symptoms while operating an aircraft simulation.
5. Aircrews are provided portable hypobaric recording watches to alert them when cabin altitude reaches a preset threshold.
6. Internal components of the F/A-18 OBOGS have been redesigned to incorporate a catalyst to prevent carbon monoxide from reaching the pilot and provide an improved capability sieve material (filter). These new OBOGS components have been installed in 84 percent of the in service F/A-18 fleet so far.

7. Improvements to existing maintenance troubleshooting procedures and acceptance and test procedures for reworked components have been incorporated and additional improvements are under evaluation.
8. Hardware and software changes are in work for Super Hornets and Growlers to mitigate cabin pressurization issues due to moisture freezing in the ECS lines.
9. Component redesign, improved performance testing, and newly established life limits will improve component reliability across all F/A-18 configurations.
10. An increased capacity for the emergency oxygen bottles is under contract.
11. Trial sampling efforts for contamination have been conducted at EA-18G squadrons located at NAS Whidbey Island to improve real-time data collection for OBOGS related systems. "Sorbent tubes" which help collect and identify unknown contaminants have been attached to aircrew regulators to collect samples of breathing gas for post-flight analysis of potentially harmful compounds.
12. An ECS laboratory is under construction to improve root cause and correct actions of ECS engineering investigations of fleet events. The projected operational date of the ECS lab is September of 2017.
13. Aircraft are flown with "slam sticks" to track and collect cabin pressure changes over time for rigorous data analysis and to compare data to what the aircrew experienced.
14. Future projects include systematic evaluations of technologies to monitor and detect physiological symptoms.

Efforts to Mitigate Physiological Episodes on T-45

A variety of actions have been undertaken to address the occurrence of physiological episodes in the T-45:

1. Instituted recurring immersion training at all Chief of Naval Air Training sites using Reduced-Oxygen Breathing Devices.
2. Flight manual procedures were updated to optimize crew posture for PE recognition, response, and avoidance.
3. Revised maintenance publications at both the operational and intermediate maintenance levels to increase the minimum oxygen generating performance of the concentrator.

4. Conducted engine wash water intrusion tests to determine if water was entering the OBOGS bleed air. Tests indicated that no water was ingested in the OBOGS bleed air lines.
5. Installed sorbent tubes and hydrocarbon detectors on aircrew to monitor breathing gasses coming off OBOGS. The sorbent tube and HCD are attached to the aircrew vest and ported off the oxygen mask hose.
6. Installed new sieve beds in the Gas Generating Unit (GGU)-7 Oxygen Concentrator. The new sieve beds addressed the possibility of built up contaminants in the sieve bed material by installing all new material, and incorporated a carbon monoxide catalyst to protect against carbon monoxide.
7. Began fielding of new design CRU-123 oxygen monitoring units. A fielded demo unit has over 100 flight hours; up to 15 additional new monitors are expected by the end of May. Thirty additional units will be installed every month thereafter. The new oxygen monitor provides new aircrew alerting if delivery pressure falls, and it records system performance and faults.
8. Initiated requirements analysis for a new OBOGS oxygen concentrator unit.
9. Formed a combined team with Government, Boeing (T-45 OEM), and Cobham (Oxygen Concentrator OEM) members to cooperate on multiple lines of effort to address Physiological Episodes.
10. Conducted multiple rounds of high intensity stress testing of the GGU-7 Oxygen Concentrator at both NAVAIR and Cobham Laboratories to determine concentrator performance outside of the normal operating limits (high temperature and high humidity).
11. NAVAIR released an end to end cleaning procedure for the OBOGS bleed system. Updated regular maintenance procedures to sustain system hygiene. Additional thorough cleaning procedures are being developed.
12. Evaluated the thermal performance of the OBOGS bleed air system by conducting tests on in-service heat exchangers and temperature switches that provide alerts when over-temperature conditions occur.
13. Conducted laboratory testing and on-aircraft fit checks of a new water separator that would be installed in the OBOGS bleed line prior to the OBOGS concentrator to help

guard against water intrusion in the concentrator. This program is currently in the early stages of detailed engineering design.

14. Enhanced data management and collection through initiation of a new data management plan; contracted data analysis support to
15. Developed new test procedures and conducted OBOGS and ECS bleed air contaminant testing on fleet aircraft to establish measurement thresholds and foment a predictive system performance methodology; developed new test sets to assess oxygen system degraded performance.
16. Updated flight and maintenance publications to help prevent inadvertent system damage, ensure leak free system integrity, add periodic inspections, and ensure system cleanliness.

The Department of the Navy remains focused on solving this issue. Fleet awareness is high, protocols are in place and we are focused on mitigating risk, correcting known deficiencies and attacking this issue. Moving forward we will continue to fly while applying every resource to solve this challenging problem.

End of Addendum A

Addendum B

ELECTRONIC WARFARE SUPPLEMENTAL

AN/ALQ-214 - Navy completed testing the upgraded version of the ALQ-214 v4 Integrated Defensive Electronic Countermeasure (IDECM) last year and continues developing software improvements under the Software Improvement Program (SWIP). IOC of SWIP is expected in the second quarter of Fiscal Year 2018. IDECM hardware is currently being installed into deploying F/A-18 E/F aircraft on the planned procurement ramp.

Next Generation Jammer (NGJ) - The first increment of NGJ, which covers a mid-band frequency range, completed its critical design review in May and is on timeline for a Fiscal Year 2021 IOC. OSD established this program as a Skunk Works charter in Fiscal Year 2015 which has allowed a small team of experts to streamline the acquisition process. The Next Generation Jammer Low Band (increment 2) is the next material solution to replace the 40 year old ALQ-99 low band transmitter systems. The acquisition strategy for Low Band (Inc. 2) will be a full and open competition supporting program entry at Milestone (MS) B. Prior to the EMD competition, there will be up to three Demonstration of Existing Technology (DET) contracts awarded as an extension of the Low Band (Inc. 2) program's market research effort. In the execution of the DET contracts, contractors will demonstrate their existing, mature technologies in a relevant environment (i.e. not a technology maturation effort, but rather substantiation of the assertion the technologies of appropriate level of maturity currently exist to support program entry at MS B). Not being awarded a DET contract will not preclude any contractor from submitting a proposal and competing for award of the Low Band (Inc. 2) EMD contract, as, again, it will be a full and open competition. IOC for NGJ Low band is being planned for Fiscal Year 2025.

ALQ-99 - While sustainment and reliability of the 40 year old ALQ-99 systems continues to challenge the DoN (USMC and Navy), we have prioritized NGJ implementation to replace the most stressing frequency coverage first. Navy is developing an interim upgrade solution for the low frequency range transmitter in the Low Band Consolidation (LBC) transmitter set. The LBC is on track to field in the first quarter of Fiscal Year 2020. The LBC does not meet the full requirements of the NGJ Low Band system, however will increase the reliability of the low frequency system.

End of Addendum B

Addendum C

SUMMARY OF CLASS A, B AND C AVIATION-RELATED SAFETY ISSUES

A summary of all Naval Aviation Class A, B and C aviation-related safety issues, including recent mishaps, trends, and analysis from October 2015 through May 24, 2017 follows. The rates presented in the table are based on total mishaps per 100,000 flight hours and include Flight, Flight-Related and Ground mishaps.

Year	Flight Hours	Class A	Class A Rate	Class B	Class B Rate	Class C	Class C Rate
FY16	1,098,519	18	1.64	27	2.46	224	20.39
FY17	689,850	15	2.17	19	2.75	163	23.63

The most recent Fiscal Year 2017 DoN flight Class A mishaps include:

- 26 Apr 2017: (Off the Coast of Guam) MH-60R collided with water on initial takeoff from ship. No injuries.
- 21 Apr 2017: (Philippine Sea) F-18E lost on approach to landing on carrier. Pilot ejected without injury prior to water impact.
- 05 Apr 2017: (Yuma, AZ) CH-53E landed hard and rolled on day training flight. Crew of 5 uninjured.
- 17 Jan 2017: (NAS Meridian, MS) T-45 crashed following a BASH incident on takeoff. Both crewmembers ejected. No fatalities.
- 13 Dec 2016: (Off the Coast of Okinawa, Japan) MV-22B attempted a precautionary emergency landing (PEL) to dry land but crash landed in shallow water. Crew of 5 evacuated with injuries.
- 07 Dec 2016: (Off the Coast of Iwakuni MCAS, Japan) F/A-18C crashed into the water while conducting a night mission. 1 fatality.
- 21 Nov 2016: (Upper Mojave Desert Region) F/A-18F struck a tree while instructor pilot was conducting a currency flight event. Returned to base safely. No injuries.
- 09 Nov 2016: (Off the Coast of San Diego) Two F/A-18As were conducting basic flight maneuvers and had a mid-air collision. 1 aircraft crashed in the water. Pilot ejected successfully. 1 aircraft landed with significant damage
- 27 Oct 2016: (MCAS Beaufort, SC) F/A-35B had an inflight weapons bay fire followed by an uneventful landing. No injuries.
- 25 Oct 2016: (Twentynine Palms, CA) F/A-18C crashed on final approach. Pilot ejected successfully. No injuries.

- 20 Oct 2016: (Yuma, AZ) CH-53E main rotor contacted building causing damage to the aircraft.
- 13 Oct 2016: (Tinker AFB, OK) E-6B #2 engine sustained compressor blade damage due to bird ingestion. Aircraft landed safely. No injuries.

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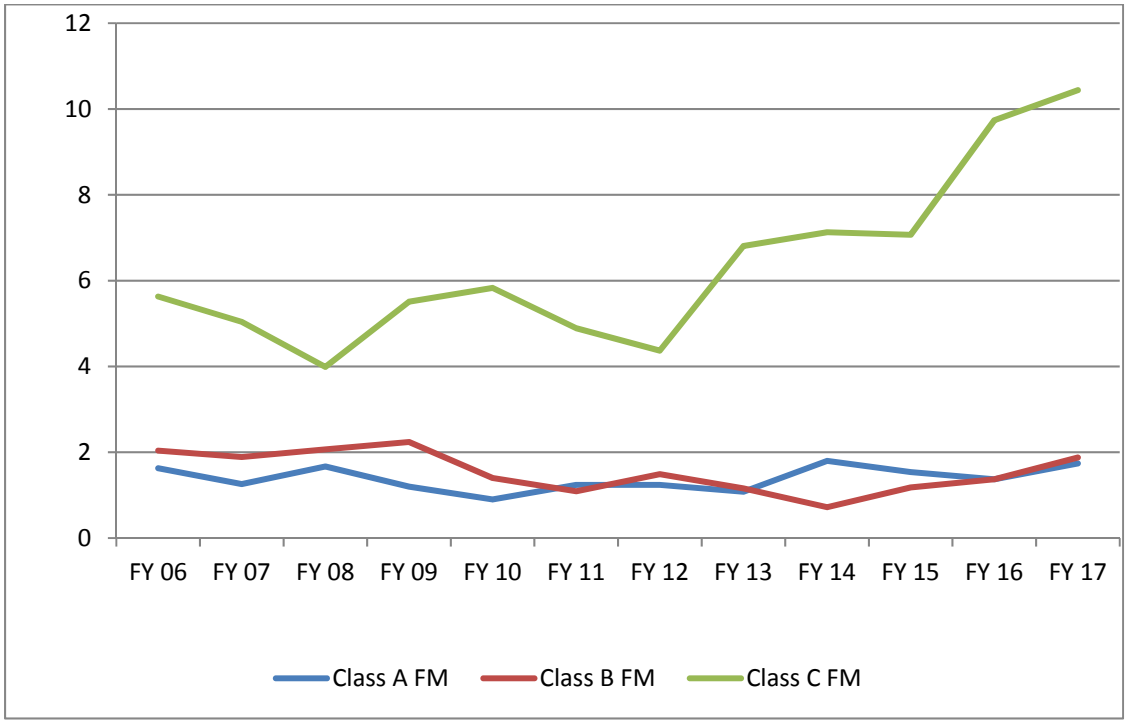
There are three recent FY 2017 DoN Class A aviation ground operations mishaps (AGM):

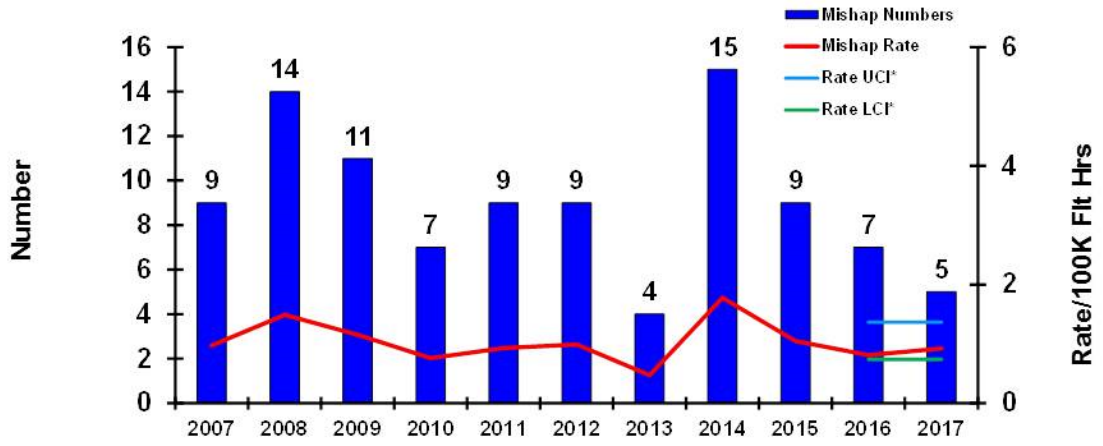
- 19 January 2017: (NAS Norfolk, VA) Three E-2C aircraft damaged in an engine oil related event. (AGM)
- 18 December 0216: (Kadena Air Force Base, Japan) Tow bar separation resulted in aircraft/tow collision with damage to nose gear and lower fuselage of P-8A. (AGM)
- 16 December 2016: (NAS Whidbey Island, WA) Canopy on EA-18G exploded/jettisoned resulting in severe injuries to two personnel. (AGM)



DoN Historical Mishap Rate Trend per 100K Flight Hours per Mishap Class (As of 24 May, 2017)

CLASS A FLIGHT MISHAPS

Manned Aircraft Only



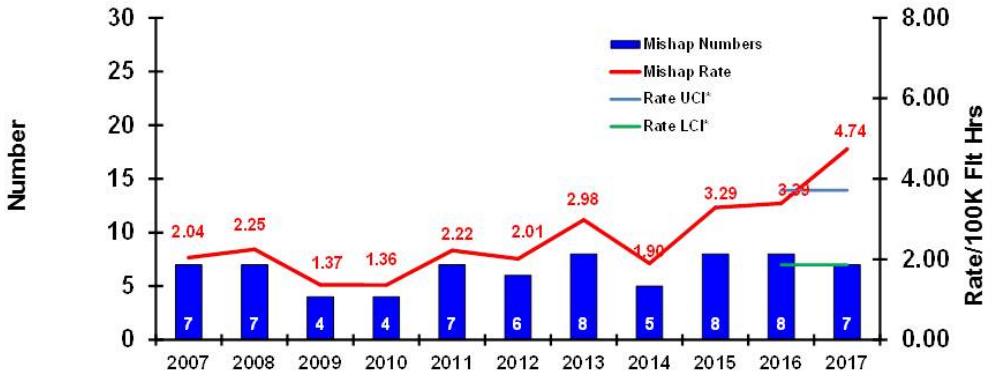
	24-May-17	24-May-16
CLASS A MISHAPS/MISHAP RATE FY COMPARISON:	5/0.92	1/0.18
FY16 MISHAPS/MISHAP RATE:	7/0.81	
10-YEAR AVERAGE (FY07-16) MISHAPS/MISHAP RATE:	9.40/1.04	

*see last slide for definition of UCI/LCI

Class A Manned Flight MISHAP Historical Data for U.S. Navy

CLASS A FLIGHT MISHAPS

Manned Aircraft Only



	24-May-17	24-May-16
CLASS A FM/FM RATE FY COMPARISON:	7/4.74	5/3.26
FY16 MISHAPS/MISHAP RATE:	8/3.39	
10-YEAR AVERAGE (FY07-16) MISHAPS/MISHAP RATE:	6.40/2.28	

Class A Manned Flight MISHAP Historical Data for U.S. Marine Corps

UCI = Upper Confidence Interval LCI = Lower Confidence Interval
Rate values above the UCI or below the LCI infer a statistically significant change is probable. This is only an indicator. Significance cannot be determined until end-of-year. Values between the UCI and LCI infer that nothing significant has occurred to increase or decrease mishap rate.

End of Addendum C