

P-8A Poseidon Multi-Mission Maritime Aircraft

Executive Summary

- The Navy conducted the P-8A Increment 1 IOT&E from September 2012 through March 2013. Based on IOT&E results, the P-8A Increment 1 system provides maritime patrol mission capabilities similar to the legacy P-3C system in selected mission areas, but it is not effective for executing the full range of mission tasks required by the P-8A Increment 1 concept of operations.
 - The P-8A Increment 1 system provides effective small-area, cued Anti-Submarine Warfare (ASW) search, localization, and attack mission capabilities similar to the legacy P-3C system. Fundamental limitations in current sensor technology restrict search capabilities against more stressing adversary targets, making the P-8A not effective in some mission scenarios. The P-8A does not have an equivalent broad-area ASW acoustic search capability similar to that provided by the P-3C Improved Extended Echo Ranging system. The Navy intends to install the next generation multi-static active system to provide broad-area ASW search capabilities as part of the P-8A Increment 2 program. As a result of these two sensor shortfalls, the P-8A cannot execute the full range of mission tasks required by the ASW concept of operations. In fact, current P-8A ASW search capabilities provide only a small fraction of what is needed for most Navy operational plans. P-8A non-acoustic search capabilities are also very limited for evasive targets attempting to limit exposure to detection by radar and other sensors. Existing Mk 54 torpedo limitations also reduce P-8A attack effectiveness against evasive targets.
 - The P-8A is effective in conducting unarmed Anti-Surface Warfare (ASuW) missions against maritime surface targets. The radar and supporting sensor systems provide an effective, all-weather surface target search, detection, and classification capability at short to medium ranges for all maritime surface targets and at longer ranges for larger target vessels.
 - The P-8A is not effective for the Intelligence, Surveillance, and Reconnaissance (ISR) mission. Radar performance deficiencies, sensor integration problems, and data transfer system interoperability shortfalls degrade imagery intelligence collection and dissemination capabilities. The Electronic Support Measures (ESM) sensor provides a limited electronic intelligence (ELINT) capability, when supported by well-defined signal signature libraries. The P-8A demonstrated the capability to collect exploitable acoustic signature intelligence data.
 - P-8A aircraft flight performance meets or exceeds operational requirements and fully supports execution of the ASW, ASuW, and ISR concept of operations. The



system provides increased range, payload, and speed compared to the legacy P-3C aircraft.

- The P-8A Increment 1 system is operationally suitable. The P-8A offers significant improvements in system hardware reliability, maintainability, and availability compared to the legacy P-3C aircraft. However, frequent mission software faults indicate that mission system stability and software maturity require further improvement. Over 75 percent of observed critical mission system failures resulted from software-related events.
- The P-8A is survivable in permissive threat environments. Survivability in other threat environments presented by peer, second-tier adversary, or non-state actors depends primarily on the threat detection capabilities of organic sensor systems and threat intelligence updates from off-board sources via datalinks and communication systems.
 - Current P-8A systems provide sufficient information for crews to effectively remain outside most threat engagement zones. However, some combinations of environmental factors, target density, and increased crew workload due to system integration problems can degrade threat situational awareness, which increases the likelihood of inadvertent entry into these threat engagement zones.
 - If engaged, the P-8A Early Warning Self-Protection (EWSP) system capabilities to prevent Man-Portable Air Defense System missile hits are similar to those for comparable aircraft with similar protection systems.
 - The P-8A has no radar warning receiver capability or countermeasures to provide warning or protection against radio frequency (RF)-guided threats.
 - The P-8A vulnerability reduction features including On-Board Inert Gas Generator (OBIGGS) and Dry Bay

Fire Protection System (DBFPS) improve the P-8A survivability when hit by likely gun threats.

- The Navy completed developmental and integration testing of the AGM-84 Harpoon Block 1C anti-ship missile on the P-8A aircraft in September 2013. FOT&E to verify system integration and effective employment of armed ASuW capabilities is scheduled for early FY14.
- In October 2013, DOT&E approved Test and Evaluation Master Plans (TEMPs) for the P-8A Increment 2 and Increment 3 programs that identified test strategies and required test resources necessary to execute operational testing for these programs through FY19. These programs are intended to significantly improve P-8A ASW and ASuW mission capabilities by integrating improved sensors, weapons, and mission system technologies. These TEMPs also incorporate test strategies for the next generation multi-static active system. This key P-8A sensor system upgrade is intended to provide P-8A with wide area ASW search capabilities necessary to execute both the current ASW concept of operations and future high-altitude ASW employment concepts.

System

- The P-8A Poseidon Multi-mission Maritime Aircraft design is based on the Boeing 737-800 aircraft with significant modifications to support Navy maritime patrol mission requirements. It will replace the P-3C Orion.
- The P-8A incorporates an integrated sensor suite that includes radar, electro-optical (EO), and electronic signal detection sensors to detect, identify, locate, and track surface targets. An integrated acoustic sonobuoy launch and monitoring system detects, identifies, locates, and tracks submarine targets. The P-8A carries Mk 54 torpedoes and is currently integrating

the AGM-84 Harpoon missile system to engage identified submarine and surface targets. Sensor systems also provide tactical situational awareness information for dissemination to the fleet and ISR information for exploitation by the joint intelligence community.

- The P-8A aircraft incorporates aircraft survivability enhancement and vulnerability reduction systems. An integrated infrared (IR) missile detection system, flare dispenser, and directed IR countermeasure system is designed to improve survivability against IR missile threats. On and off-board sensors and datalink systems are used to improve tactical situational awareness of expected threat systems. Fuel tank inerting and fire protection systems reduce aircraft vulnerability.

Mission

- Theater Commanders primarily use units equipped with the P-8A Multi-mission Maritime Aircraft to conduct ASW. P-8A units detect, identify, track, and destroy submarine targets.
- Additional P-8A maritime patrol missions include:
 - ASuW operations to detect, identify, track, and destroy enemy surface combatants or other shipping targets
 - Maritime and littoral ISR operations to collect and disseminate imagery and signals information for exploitation by the joint intelligence community
 - Collection and dissemination of tactical situation information to improve the fleet common operational picture
 - Identification and precise geo-location of targets ashore to support fleet strike warfare missions

Major Contractor

Boeing Defense, Space, and Security – St. Louis, Missouri

Activity

- The Navy conducted the P-8A Increment 1 IOT&E from September 2012 through March 2013. IOT&E events included testing conducted in conjunction with fleet exercises in Guam, the United Kingdom, and Japan, and during dedicated operational test events in the United States. IOT&E included 93 flight missions totaling 561 flight hours to evaluate operational effectiveness and survivability. DOT&E evaluated 1,620 maintenance actions performed in the course of integrated and operational test missions, totaling 727 flight hours. Testing was completed in accordance with the DOT&E-approved TEMP and IOT&E plan.
- The Navy completed live fire test events on an actual P-8A airframe – the S-1 structural test article – to assess P-8A vulnerability to ballistically-induced structural failure and sustained dry bay fire. The Navy also completed the performance verification testing of the P-8A vulnerability reduction features including OBIGGS and DBFPS. Incorporating the results from these tests, the Navy used

standard DoD-sponsored vulnerability analysis tools to determine the overall P-8A vulnerable area and probability of kill given a hit as well as the likelihood of crew casualties. In assessing P-8A susceptibility, the Navy completed hardware-in-the-loop simulation and flight testing of the EWSP system. Testing was completed in accordance with the DOT&E-approved TEMP and the Live Fire Alternative test plan.

- In September 2013, the Navy completed development of P-8A Increment 1 Operational Flight Program software upgrades and integration testing to support carriage and employment of the AGM-84 Harpoon Block 1C anti-ship missile. This upgrade will provide P-8A with an armed ASuW mission capability. The Navy also implemented Operational Flight Program software changes to correct a limited number of system performance deficiencies identified during IOT&E. The Navy is planning to conduct FOT&E

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to verify AGM-84 Harpoon integration and deficiency corrections in early FY14 prior to initial operational fielding.

- The Navy completed P-8A Increment 2 TEMP development and initiated early software development testing for this program in FY13. During the Increment 2 program, the Navy intends to install and upgrade the Multi-static Active Coherent (MAC) system (currently in IOT&E on P-3C aircraft) to provide a limited broad-area search capability on P-8A, complete delayed IOT&E testing, add high-altitude ASW capability, and correct some IOT&E deficiencies.
- The Navy completed P-8A Increment 3 TEMP development for the P-8A Increment 3 program. This program is intended to provide additional ASW sensor capabilities and upgrades to mission system architectures in the FY19 timeframe.

Assessment

- Based on IOT&E results, the P-8A Increment 1 system provides effective small-area, cued ASW search, localization, and attack mission capabilities, similar to the legacy P-3C system.
 - Fundamental limitations in current sensor technology restrict search capabilities against more stressing adversary targets, making the P-8A not effective in some mission scenarios.
 - The P-8A does not have an equivalent broad-area ASW acoustic search capability similar to that provided by the P-3C Improved Extended Echo Ranging system. The Navy intends to install the next generation multi-static active system to provide broad-area ASW search capabilities as part of the P-8A Increment 2 program.
 - As a result of these two sensor shortfalls, the P-8A cannot execute the full range of mission tasks required by the ASW concept of operations. In fact, current P-8A ASW search capabilities provide only a small fraction of what is needed for most Navy operational plans. P-8A non-acoustic search capabilities are also very limited for evasive targets attempting to limit exposure to detection by radar and other sensors. Existing Mk 54 torpedo limitations also reduce attack effectiveness against evasive targets.
- The P-8A Increment 1 system is effective in conducting unarmed ASuW missions against maritime surface targets.
 - The P-8A radar provides an effective, all-weather surface target search and detection capability at short to medium ranges for all maritime surface targets and at longer ranges for larger target vessels.
 - P-8A sensors effectively support surface surveillance operations and cue other Navy surveillance and strike platforms. However, the P-8A radar track-while-scan mode does not provide reliable track information for targets outside the radar field-of-view. Operational workarounds require P-8A crews to track each target of interest manually, which significantly increases sensor operator workload in target-dense operational environments.
- P-8A unarmed ASuW maritime surface target search, classification, track, and cue-to-attack capabilities are equivalent to P-3C capabilities. The Navy deferred armed ASuW mission capability until successful integration of the AGM-84 Harpoon anti-ship missile in FY14.
- The P-8A Increment 1 system is not effective for the ISR mission. Imagery intelligence collection and dissemination capabilities are limited by radar performance deficiencies, sensor integration problems, and data transfer system interoperability shortfalls.
 - The P-8A sensor suite can effectively collect EO and IR imagery in clear weather, day/night conditions. However, the P-8A does not have an effective high-resolution synthetic aperture radar imagery collection capability.
 - The P-8A ESM sensor provides a limited ELINT capability with high-signal detection and identification rates when supported by well-defined, signal signature libraries specifically tailored to the expected electronic order of battle in a specific theater of operations. However, ELINT signal identification capabilities are limited by ESM signature library-size constraints.
 - The P-8A demonstrated the capability to collect exploitable acoustic signature intelligence data during test events utilizing surface vessel targets.
- The P-8A Increment 1 system provides a limited command, control, and communications mission capability to monitor and disseminate maritime target information to enhance the tactical awareness of maritime forces and on-scene commanders.
 - During fleet training exercises, P-8A crews developed, maintained, and disseminated key elements of the fleet common operating picture to participating units while simultaneously conducting ASW, ASuW, and ISR operations. However, radar track-while-scan performance deficiencies and data display limitations often require manual target position tracking by the operator, which reduced tactical awareness and the capability to disseminate timely information to fleet forces.
 - Communication system interoperability shortfalls related to the International Maritime Satellite, Common Data Link, and voice satellite communication systems limit crew access to off-board intelligence updates, preclude participation in some real-time tactical communication forums, and reduce capabilities to transmit tactical and intelligence data updates to on-scene commanders.
 - Recent developmental test results indicate that the Navy has improved performance in the majority of these areas. Mission capability improvements will be evaluated during FOT&E planned for early FY14.
- P-8A aircraft flight performance meets or exceeds operational requirements and fully supports execution of the ASW, ASuW, and ISR concept of operations.
 - The aircraft can effectively self-deploy from main operating base locations to primary theater deployment sites and sustain long-term operations at more remote forward operating locations. Unrefueled range exceeds

- 4,000 nautical miles and increased transit speeds reduce transit times as compared to the legacy P-3C system. The P-8A is compatible with planned operating locations and meets worldwide navigation and airspace operating requirements.
- Weapons and expendable store carriage and employment capabilities support planned ASW and ASuW mission operations.
 - The P-8A provides an adequate all-weather operating capability in most operational environments, although main tank fuel overheating problems currently preclude ground and flight operations during peak temperature periods in extreme hot weather environments.
 - Cyber-security measures implemented for the P-8A are effective.
- The P-8A Increment 1 system is operationally suitable for ASW, ASuW, and ISR mission operations. The P-8A offers significant improvements in system reliability, maintainability, and availability compared to the legacy P-3C aircraft.
 - During fleet exercise missions conducted from main operating bases and worldwide forward operating locations, the P-8A demonstrated high-mission reliability with an on-time take-off rate of 93.6 percent and airborne mission abort rate of only 1.6 percent.
 - Operational availability exceeded the established Navy requirement of 60 percent for initial fielding. P-8A hardware reliability, system maintenance frequency, and maintenance corrective action times surpass operational requirement thresholds, directly contributing to high-operational availability rates. However, frequent mission software faults indicate that mission system stability and software maturity require further improvement. Over 75 percent of observed critical mission system failures resulted from software-related events.
 - The P-8A is survivable in permissive threat environments. Survivability in conflicts against peer adversaries with advanced military technologies, second-tier adversary nations with less sophisticated threat systems, or non-state actors, depends on the P-8A capability to use off-board intelligence sources and onboard sensor performance to maintain safe standoff distances from all expected threats. The P-8A systems provide sufficient information for the crew to remain outside most threat engagement zones. However, some combination of environmental conditions, target density, and increased crew workload due to system integration problems can degrade threat situational awareness, which increases the likelihood of inadvertent entry into these threat engagement zones.
 - If engaged, the EWSP testing demonstrated the effectiveness of the system against a range of simulated Man-Portable Air Defense System missiles. The EWSP system has no radar warning receiver capability or countermeasures to provide warning or protection against RF-guided threats.
 - The P-8A vulnerability reduction features (e.g., OBIGGS, DBFPS, etc.) improve its survivability when hit by likely gun threats:
 - OBIGGS is capable of reducing fuel tank oxygen levels to a non-combustible 9 percent throughout most flight conditions except for an emergency dive when concentrations went as high as 9.5 percent. The aircraft fuel tanks can withstand the pressure rise expected from combustion at this oxygen concentration.
 - The effectiveness of the P-8A DBFPS was lower than demonstrated in developmental tests using surrogate test articles. The DBFPS system reduces the P-8A vulnerability against ballistic threats from that of the unprotected aircraft. The P-8A vulnerability to dry bay fire could be further reduced by changing the DBFPS suppressor design and footprint.
 - Following developmental and integration testing of the AGM-84 Harpoon Block 1C anti-ship missile on the P-8A, the Navy certified the system for missile carriage, safe separation, and employment. FOT&E to verify system integration and effective employment is on schedule for early FY14.
 - The Navy also conducted additional developmental testing to correct a limited number of system deficiencies identified during IOT&E. System improvements in the following areas are expected to be delivered for re-evaluation during FOT&E in FY14:
 - Radar track-while-scan mode target tracking
 - Radar pointing and high-resolution imagery collection
 - EO/IR sensor cueing and target tracking
 - International Maritime Satellite and Common Data Link interoperability
 - Radar periscope detection and search capability
 - Initial MAC broad-area ASW search capability
 - The Navy completed P-8A Increment 2 TEMP development and initiated early software development testing for this program in FY13. During Increment 2, the Navy intends to install and upgrade the MAC system (currently in IOT&E on P-3C aircraft) to provide a limited broad-area search capability on P-8A, complete delayed IOT&E, add high-altitude ASW capability, and correct some IOT&E deficiencies.
 - The Navy completed P-8A Increment 3 TEMP development for the P-8A Increment 3 program. This program is intended to provide additional ASW sensor capabilities and upgrades to mission system architectures in the FY19 timeframe.
- Recommendations**
- Status of Previous Recommendations. The Navy made progress on three of the four FY12 recommendations. The Navy completed recommended LFT&E events prior to completion of IOT&E. The Navy accelerated efforts to correct a number of key system deficiencies identified in FY12 testing and is planning to conduct FOT&E to verify fix effectiveness prior to operational deployment in FY14. Remaining deficiency corrections were deferred to future test periods.

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- FY13 Recommendations. The Navy should:
 1. Implement corrective actions for deficiencies identified in the DOT&E IOT&E report and conduct FOT&E to verify improved mission capabilities.
 2. Complete adequate operational testing of delayed capabilities and of new system improvements intended to provide P-8A a broad-area and high-altitude ASW search and attack capability.
 3. Consider integrating RF threat warning and countermeasure self-protection systems on the P-8A aircraft to improve threat situational awareness and to provide protection against RF-guided threat systems.
 4. Modify the DBFPS design, i.e., increase the number and volume of suppressors or change their type and location to improve DBFPS effectiveness.

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