UH-60V Black Hawk

Executive Summary

- The UH-60V Black Hawk is a digital upgrade to the analog UH-60L Black Hawk that will replace a large portion of the Army's UH-60Ls. The UH-60V design consists of a refurbished UH-60L aircraft, an upgrade to the 2,000 shaft-horsepower T700-GE-701D engine (as part of the UH-60L refurbishment program), multi-function multi-band radios, Blue Force Tracker 2 (BFT2), digital architecture in place of the analog architecture of the UH-60L, and a pilot-vehicle interface (PVI) that is similar to that of the UH-60M.
- The UH-60V performs as well as the UH-60L in executing its external lift mission and meets the external lift Key Performance Parameter. The UH-60V digital cockpit provides pilots with a suite of capabilities for situational awareness and navigation. These capabilities are either similar or superior to those provided on the UH-60M.
- UH-60V completed IOT&E I in September 2019 at Joint Base Lewis McChord, Washington. IOT&E I was not adequate due to the software, hardware, and production process not being production representative.
- The UH-60V was less reliable than fielded UH-60L and UH-60M helicopters during IOT&E I. The UH-60V did not meet its reliability requirements during the 334.5-flight-hour operational test.
- The UH-60V is as survivable as the UH-60L against ballistic, infrared, and laser threats. The UH-60V experienced frequent false radar warnings throughout IOT&E I.
- The UH-60V is vulnerable to insider and nearsider cybersecurity attacks. The system has not been assessed from an outsider cybersecurity threat and for the security of the supply chain.

System

- The Army recapitalized UH-60L to serve as the backbone of the UH-60V. Older UH-60L will be baselined to the Lot 30 configuration, which is the final production version of the UH-60L. The Army will then apply modification kits to finalize the UH-60V production.
- The UH-60V program is a low cost modernization of the UH-60L that the Army intends to produce similar qualities to the UH-60M, such as modernizing the existing UH-60L analog cockpit to a digital cockpit enabling a PVI similar to the UH-60M.
- The program reduces avionics obsolescence and upgrades navigation systems to meet future Global Air Traffic Management instrument flight rule requirements.

- The UH-60V employs an open systems architecture with Army-owned technical data.
- The basic mission configuration includes a crew of four (pilot, copilot, crew chief, and gunner), integral (internal) mission fuel tank, avionics, aircraft survivability equipment, armor protection, two M240 machine guns and ammunition, and other mission-related equipment.

Mission

Commanders will use the UH-60V Black Hawk to conduct air assault, air movement, aerial command and control (C2), and aerial medical evacuation missions. Garrison units equipped with the UH-60V will execute garrison support missions, training and training support, and test support. The UH-60V can be employed individually, in multi-ship formations, or as a company depending on requirements.

Major Contractors

- Development and Engineering: Defense Systems and Solutions – Huntsville, Alabama
- Avionics Enhancements: Northrup Grumman – Woodland Hills, California

Activity

- The Army conducted all testing in accordance with a DOT&E-approved Test and Evaluation Master Plan and test plan. The Army conducted 2019 IOT&E I at Joint Base Lewis McChord, Washington, in September 2019.
- DOT&E approved the Milestone C Test and Evaluation Master Plan and IOT&E I operational test plan using Engineering Development Model (EDM) aircraft with the understanding that UH-60V software build 2.1 was mature and would require minor changes prior to fielding. The UH-60V suffered numerous software reliability issues during IOT&E I. A few software issues, such as those involving the digital moving map, were a frequent occurrence, which in aggregate account for a large number of failures.
- The UH-60V program has been impacted by the coronavirus (COVID-19) pandemic resulting in a delay in IOT&E II from 3QFY20 to 3QFY21. The Program Office is experiencing delays in their instrument flight rules certification process. This certification is required to test a production-representative test article.
- The UH-60V program has been developing software build 3.0 to address software build 2.1 deficiencies identified during developmental testing and IOT&E I. The UH-60V System Integration Laboratory (SIL) has been used throughout developmental testing to confirm software functionality prior to flight testing.
- The program demonstrated developmental software build 3.0 improvements for the Test and Evaluation Working-Level Integrated Product Team (T&E WIPT) using the UH-60V SIL in January 2020.
  - Integration testing for UH-60V software build 3.0 began 2QFY20. Integration testing will ensure that software changes do not adversely affect other UH-60V systems.
  - The Program Office uploaded software build 3.0 onto the UH-60V EDM aircraft in November 2020. The program is using flight testing to ensure improvements developed with the UH-60V SIL are working correctly in an operational aircraft.
- DOT&E published a report evaluating IOT&E I in September 2020.

Assessment

- IOT&E I was not adequate due to the software, hardware, and production process not being production representative.
- UH-60V aircrews were successful in 38 of 42 mission flights during IOT&E I. The UH-60V performs as well as the UH-60L in executing its external lift mission and meets the external lift Key Performance Parameter.
- The UH-60V provides pilots with flight planning and navigation capabilities that are similar to or exceed those provided by the UH-60M.
  - Pilots strongly preferred the UH-60V digital cockpit to the UH-60L analog cockpit.
  - The UH-60V digital cockpit features an integrated digital moving map (DMM) that is displayed on a multi-function display, similar to the UH-60M. The DMM is a major improvement over the paper maps and digital kneeboards available in the UH-60L.
- IOT&E I used UH-60V EDM aircraft that were determined to be not production representative. The EDM aircraft included all UH-60V modifications, but were not produced at the Corpus Christi Army Depot, Texas, production facility using the final production process. Two of the aircraft did not have production-representative wiring harnesses that may have contributed to some reliability failures.
- The Army identified 8 deficiencies and 44 shortcomings with software version 2.1 during developmental testing; additional details are available in the UH-60V IOT&E I Operational Assessment. These software problems were not addressed prior to IOT&E I and contributed to poor suitability findings. Software version 2.1 was used during IOT&E I, despite known deficiencies and shortcomings, due to the lengthy airworthiness certification process. Initial developmental testing has demonstrated that software build 3.0 appears to fix many of the failures observed during IOT&E I in a simulated environment.
  - The UH-60V cockpit software did not function correctly throughout IOT&E I. Software problems distracted pilots during mission execution and forced aircrews to focus inside the aircraft.
  - DMM performance was poor due to software and processor problems. The DMM often loaded slowly and did not keep pace with mission demands.
  - Aircrew knowledge of the test area allowed aircrews to successfully complete missions despite software limitations. The mission success rate would most likely be reduced if reliance on the digital cockpit and navigational systems was necessary to develop situational awareness.
- The UH-60V did not inform aircrews of radar threats during IOT&E I due to frequent false notifications. Several factors contributed to the high false return rate, some may be attributed to the aircraft and some to the test environment's ambient electromagnetic activity (such as cell towers). The EDM aircraft all produced false notifications at differing rates. The sole EDM aircraft production-representative wiring harness had the highest false notification rate. An EDM aircraft with a non-production representative wiring harness was used for signal testing on the radar warning receiver. The use of a non-production representative wiring harness for developmental testing may have contributed to higher false radar warning notifications on the production-representative wiring harness aircraft.
- The UH-60V did not meet its reliability requirements during the 334.5-flight-hour IOT&E I. UH-60V-specific systems failed at a higher rate than corresponding UH 60L-specific systems. Sixty-five percent of reliability failures during the IOT&E I were related to UH-60V-specific systems and components.
- The program has made some cybersecurity improvements. The UH-60V remains vulnerable to insider and nearsider cybersecurity attacks. Cybersecurity vulnerabilities will

have a limited effect on flight safety due to the UH-60V retaining the mechanical flight controls of the UH-60L. More information can be found in the DOT&E IOT&E I Report classified annex.

Recommendations

The Army should:

1. Plan and conduct IOT&E II using production-representative aircraft containing hardware, software, and built using the production-representative processes.
2. Plan future testing in locations unfamiliar to aircrews to emphasize use the digital cockpit and navigational systems to develop situational awareness.
3. Improve and verify software reliability prior to conducting IOT&E II.
4. Verify radar warning receiver by conducting additional developmental testing with production-representative wiring harness design.
5. Plan and conduct an adversarial assessment in conjunction with IOT&E II to assess cybersecurity against an outsider threat and the security of the supply chain.