

CH-53K – Heavy Lift Replacement Program

Executive Summary

- In FY16, the CH-53K program will provide four Engineering Manufacturing and Development (EMD) aircraft to support integrated developmental and operational flight testing. A Ground Test Vehicle (GTV) is being used to qualify key dynamic components and assess aircraft stresses, vibrations, and rotor performance. GTV also supports long term verification and reliability testing. The program achieved first flight of the CH-53K EMD-1 aircraft on October 27, 2015.
- Gear box failures discovered in ground testing in January 2015, most notably a quill shaft failure in the Main Gear Box, have contributed to program delays. The quill shaft and the Rear Module Assembly of the gear box have been redesigned and testing has resumed on the GTV.
- Initial environmental qualifications of the pilot armored seats experienced temperature-induced cracking in the seat bucket and wing armor, which has driven a redesign.
- The Navy reduced the cabin floor and sidewall armor requirements to allow for a lighter armor design. The accepted design was qualified and assessed as part of the CV-22 LFT&E program in FY14.
- In FY15, the Navy completed live fire vulnerability testing of the fuel system and flight-critical main and tail rotor system components. With one exception, preliminary assessment of the data revealed no unexpected vulnerabilities. The effect of the observed main and tail-rotor combat-induced damage on aircraft survivability will be assessed after the cyclic structural testing, scheduled for FY16.

System

- The CH-53K is a new-build, fly-by-wire, dual-piloted, three-engine heavy lift helicopter slated to replace the aging CH-53E. The CH-53K is designed to carry 27,000 pounds useful payload (three times the CH-53E payload) to a distance of up to 110 nautical miles and climbing from sea level at 103 degrees Fahrenheit to 3,000 feet above mean sea level at 91.5 degrees Fahrenheit.
- The greater lift capability is facilitated by increased engine power (7,500 shaft horsepower versus 4,380 horsepower per engine in the CH-53E) and a composite airframe. This composite airframe is lighter than the CH-53E metal airframe.
- The CH-53K design incorporates the following survivability enhancement features:



- Aircraft Survivability Equipment to include Large Aircraft Infrared Countermeasures with the advanced threat warning sensors (combines infrared, laser, and hostile fire functions into a single system), AN/APR-39D(V)2 radar warning receiver, and AN/ALE-47 countermeasure dispensing system.
- Pilot armored seats, cabin armor for the floor and sidewalls, fuel tank inerting, self-sealing fuel bladders, and 30-minute run dry capability gear boxes.
- The CH-53K maintains a logistics shipboard footprint equivalent to that of the CH-53E.

Mission

- Commanders will employ the Marine Air-Ground Task Force equipped with the CH-53K for:
 - Heavy lift missions, including assault transport of weapons, equipment, supplies, and troops
 - Supporting forward arming and refueling points and rapid ground refueling
 - Assault support in evacuation and maritime special operations
 - Casualty evacuation
 - Recovery of downed aircraft, equipment, and personnel
 - Airborne control for assault support

Major Contractor

Sikorsky Aircraft Corporation – Stratford, Connecticut

Activity

- In FY16, the program will provide four EMD aircraft to support integrated developmental and operational flight testing.
- The Navy intends ongoing GTV testing to qualify key dynamic components and assess aircraft stresses, vibrations, and rotor performance. GTV also supports long term

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verification and reliability testing. The program achieved first flight of the CH-53K EMD-1 aircraft on October 27, 2015.

- In previous testing, the Navy completed qualification and live fire testing of the full-up and installed sponson fuel cell against operationally realistic, small arms threats.
- The pilots' armored seats experienced thermal cracking during initial environmental qualifications and had to be redesigned in FY13. The new design was qualified by analysis and has been part of the qualification program to date. Final environmental and live fire testing of the redesigned pilot seat armor against the specification small arms threat is scheduled for FY16.
- In FY15, the Navy changed the requirement and design of the cabin floor and sidewall armor to an achievable armor performance given the aircraft weight constraints. The new, albeit reduced, requirements allow for a lighter armor design that has already been qualified as effective against specific CV-22 ballistic threats.
- In January through August 2015, the Navy completed live fire testing of three flight-critical main and tail rotor system components. Testing was conducted against a range of operationally relevant, small arms threats and under static loads representative of flight conditions. Sikorsky will subject the damaged components to post-ballistic cyclic structural testing to assess the residual flight capability, representative of get-home flight and landing conditions. This testing is scheduled for FY16.
- The Navy is modifying the Aircraft Survivability Equipment to address cybersecurity requirements (data at rest protection), obsolescence (removable media and computer processors), and reduce life cycle cost (elimination of components). The Navy is upgrading the infrared countermeasure subsystem and adding hostile fire indication.
- The Program Office is revising the Test and Evaluation Master Plan (TEMP) to reflect programmatic changes and updates to the cybersecurity test strategy for Milestone C to include a Cooperative Vulnerability and Penetration Assessment and an Adversarial Assessment.
- The Navy conducted testing in accordance with a DOT&E-approved TEMP and a DOT&E-approved 2010 Alternative LFT&E plan.

Assessment

- Component level bench testing and GTV testing uncovered gear box failures, most notably a quill shaft failure in the Main

Gear Box. The quill shaft and the Rear Module Assembly of the gear box required redesign before testing could resume on the GTV. New Rear Module Assemblies were installed on the GTV and the EMD aircraft and the subsequent qualification testing was completed to enable first flight on October 27, 2015.

- Preliminary assessment of the sponson fuel cell qualification test data indicates acceptable performance against small arms threats. Additional live fire ballistic tests will be performed on the GTV in FY19.
- During initial environmental qualification testing, the armored pilot seat did not fully meet environmental specifications, experiencing some thermal cracking. The Program Office initiated redesign of the seats, and final environmental testing, as well as live fire testing of the redesigned pilot seat armor against the specification small arms threat, is scheduled for FY16.
- Three of the four flight-critical main and tail rotor system components tested to date demonstrated the required ballistic damage tolerance to the specified projectile. The Navy will assess the consequent effect of the observed damage on aircraft survivability, in operationally representative conditions, after the completion of the respective structural cyclic endurance tests.
- Modification of the Aircraft Survivability Equipment accelerates inclusion of additional capabilities while reducing life cycle costs.

Recommendations

- Status of Previous Recommendations. This is the first annual report for this program.
- FY15 Recommendations. The program should:
 1. Update the TEMP in FY16.
 2. Review data resulting from a DOT&E funded joint live fire program to assess CV-22 armor performance against threats that the Navy did not address in the CV-22 Advanced Ballistic Stopping System LFT&E program. This will enable the Navy to better understand the effectiveness of the armor against additional, operationally realistic threats and adjust the tactics, techniques, and procedures, as needed.