

## **CH-47F IMPROVED CARGO HELICOPTER (ICH)**



The CH-47F Improved Cargo Helicopter (ICH) is a remanufactured version of the combat proven CH-47D Chinook with the new T55-GA-714A engines. This Service Life Extension Program is intended to sustain the aging CH-47D airframes and extend the aircraft's life expectancy another 20 years. The CH-47D is a twin-turbine tandem rotor helicopter designed for combat and combat support heavy-lift cargo missions. ICH improvements include: (1) fuselage stiffening (proven through testing to reduce vibrations by up to 60 percent in the cockpit area and is expected to lead to improved reliability and reduced operating and support costs); and (2) integrated cockpit and digital architecture for Force XXI compatibility. The ICH program will rebuild 300 systems.

### **BACKGROUND INFORMATION**

OSD approved entry into EMD in 3QFY98. The current TEMP was approved on November 6, 1998. Another TEMP update is currently being staffed and should be submitted for OSD approval in early FY02.

Preliminary and Critical Design Reviews are complete. Because of cost increases and schedule delays, the program manager has recently restructured the program by delaying the LRIP and production decisions one year. IOT&E has been delayed by three months and is now scheduled for 4QFY02. It will provide input to the LRIP decision as well as Milestone III, now scheduled for 1QFY03 and 1QFY05, respectively.

DOT&E approved an alternative LFT&E plan after concurring with the Army's request for a waiver from full-up, system-level testing in December 1997. The waiver certification to Congress was provided by USD (A&T) in March 1998. A LFT&E Strategy was approved by the U.S. Army in December 1998 and by DOT&E in January 1999. A damaged CH-47D production aircraft was repaired and is being used as the LFT full-up, system-level ground test vehicle (GTV). The LFT&E started in 2QFY99.

### **TEST & EVALUATION ACTIVITY**

Initial testing of ICH software (version 4 of 5 planned versions) began in May 2001 in the Boeing System Integration Laboratory (SIL) in Philadelphia. While no priority 1 or 2 Software Trouble

Reports (STRs) resulted, 166 lower priority STRs were recorded. Operational pilots, as well as other government representatives, participated in SIL testing. Version 4 software continues to be tested in the aircraft by a combined team of government and contractor personnel. A weekly Software Review Board (SRB) examines the software Problem Reports and makes a determination as to their disposition. The SRB is composed of operational pilots, representatives from the U.S. Army Aviation Technical Test Center, the Program Management Office, and contractors. Version 5 of the software began SIL testing in October 2001.

Developmental flight testing began with an on-time first flight of the first EMD aircraft in June 2001. As of the end of FY01, shakeout flight testing, light gross weight strain and vibration flights, and medium gross weight vibration flights are complete. Medium gross weight strain flights are in progress. After the initial shakeout flights by Boeing Flight Test Pilots, Army Test Pilots have flown tests as per the Army approved test plans. Integrated contractor and government tests this fall and winter will include software, vibration, performance, and electronic environmental effects (E3) testing. The second EMD aircraft's first flight occurred in November 2001. It completed flight tests and was positioned as the primary aircraft to conduct E3 testing in November 2001. It appears that the EMD schedule is sufficient to complete all required developmental flight testing prior to operational testing scheduled for July 2002.

The LFT&E program has prepared event design plans for testing and for modeling and simulation and detailed test plans that describe the testing for the Cockpit Skin Panels, Cockpit Components, Fuel Sub-system, Propulsion System, and Engine Nacelle Fire Suppression System. Planning for the Fuselage Tunnel Flight Controls System will start in FY02. The initial M&S for the baseline CH-47D and the CH-47F ICH is in progress and will be updated at the conclusion of LFT.

The program initiated ballistic testing of the Cockpit Skin Panels in 3QFY99 and completed 183 shots. Testing of the T55 engine and fuel sub-system began in 2QFY00. Cockpit components and fire suppression system began testing in 1QFY02.

Testing of the T55 engine and the fuel sub-system included both controlled damage dynamic simulations (with engines and rotors running) on the CH-47D GTV, and ballistic tests on actual production or surrogate components. During the tests, test events were conducted on various fuel-plumbing components and fuel tanks by simulating operational fuel flow conditions. For the propulsion system, controlled damage tests were completed on the GTV, and ballistic tests on various static (non-rotating) components of older but very similar T-55 engines. Ballistic testing of dynamic (rotating) engines will start in FY02.

In addition, as part of the DOT&E Joint Live Fire (JLF) program, 10 ballistic tests for the CH-47D rotor blades have been performed. Since these blades are the same as those to be used on the F-model, the data derived from the JLF program is directly applicable to the LFT&E of the CH-47F.

## **TEST & EVALUATION ASSESSMENT**

The CH-47 is a proven and dependable platform. With 130 flight hours of developmental testing, 90 flight hours of operational testing and a continuing R&M data collection effort, post Initial Operational Test, of 280 flight hour duration prior to milestone (MS) III, the proposed integrated test for this Service Life Extension Program should provide sufficient data to support a preliminary assessment of the operational effectiveness and suitability of the CH-47F. However, there are areas of concern.

The Army acknowledges that there is increased statistical risk stemming from the low number of flight hours planned for IOT&E. However, in view of the fact that this program is actually a remanufacturing of an already proven aircraft, and not a newly developed system, we anticipate that the risk of demonstrating R&M requirements before MS III is low. An additional 300 hours, planned to be flown during the training and fielding of the first unit equipped, brings the total test hours flown to 800 to complete the evaluation. This follow-on R&M data collection of 300 hours will not be completed in time to support the MS III decision, but is critical to demonstrating the anticipated reliability and maintainability improvements.

Software testing in the SIL may lack sufficient rigor to discover or properly score software errors. To date, test procedures in the SIL have focused on individual cockpit systems in a laboratory mock-up without the stresses of realistic operations. Communication nets were physically connected; there were no environmental extremes, no dust, no rain, no competing electromagnetic emissions, and no aircraft vibrations. In a benign environment, significant software anomalies that can affect operational performance may go unnoticed. For this reason, maturity of version 4 software will be confirmed during aircraft developmental and operational flight testing.

The CH-47F LFT&E program is a fairly robust program. Ample test data from the Army's LFT of the CH-47F and the DOT&E Joint Live Fire program of the basic CH-47D are expected to provide a good evaluation of the CH-47F. The only LFT&E concern at this time is that, at the completion of LFT, GTV may not be viable for the dynamic testing of the main rotor blades.

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