

COMANCHE (RAH-66)



The RAH-66 Comanche is a twin-engine, two-pilot stealthy armed reconnaissance/attack helicopter which features low observable composite technologies with retractable landing gear and weapons pylon to achieve a low Radar Cross-Section (RCS) and a unique heat management system to suppress its infrared signature. A five-bladed main rotor and a shrouded tail rotor minimize the acoustic signature. A fly-by-wire flight control system and fully integrated digital avionics assist in piloting the aircraft. The Mission Equipment Package (MEP) integrates a radar, a forward-looking infrared sensor, and an image-intensified television sensor for night flying and target acquisition. The Comanche will be armed with the Hellfire missile, an air-to-air missile, 2.75-inch aerial rockets, and a turreted 20mm gun. The Comanche will replace the AH-1 and OH-58 helicopters in attack and cavalry units and some AH-64 Apaches in heavy attack units.

BACKGROUND INFORMATION

The development of the Comanche helicopter began in 1983 as the Light Helicopter Experimental (LHX). In the early 1980s, the LHX was envisioned to be a family of lightweight helicopters that could come in a scout, utility, or attack version. In 1988, the Army decided on a single combined armed reconnaissance and attack version.

The Milestone (MS) I Acquisition Decision Memorandum (1988) and TEMP envisioned an operational evaluation of an integrated system before MS II. However, program development was restructured and delayed several times, primarily as a result of several funding reductions until Comanche funding was partially restored in FY99. Even though developmental activities were delayed, the target date for MS III was not slipped, thereby compressing the schedule to force concurrent developmental testing, training, and operational testing in the two years prior to MS III.

First flight of the Comanche prototype occurred in January 1996. The current schedule has the first of 13 EMD aircraft to be delivered in April 2004. A fully integrated aircraft is not scheduled to be available until FY05. An updated TEMP was approved by OSD in February 2000. Both MS II and the program's entrance into EMD occurred in April 2000. MS III and Initial Operational Capability are scheduled for December 2006.

The Comanche program was designated a LFT&E system in November 1989. The LFT&E strategy was approved in fall 1995 and was recently revised as part of the updated TEMP in February 2000.

TEST & EVALUATION ACTIVITY

Testing to date has focused largely on sub-systems, flight testing of various configurations of the two prototype aircraft with no MEP, RCS testing of a full-scale model, component-level contractor testing, and two crew-level simulation events.

LFT&E activities since the MS II included the completion of the initial vulnerability assessment, and a series of risk reduction ballistic and structural tests on evolving design configurations for the main rotor blade, lightweight crew armor, and several FANTAIL (the newly developed enclosed anti-torque system) components against various caliber threats. The driver for the redesign of these components is to reduce weight and cost. The ballistic effort also involves a validation/verification type effort for the finite element analysis model for evaluating the dynamic structural response of the various FANTAIL structural components when impacted by high explosive incendiary projectiles.

Other LFT&E activities involved the 20mm ammunition and engine nacelle fire suppression system. The first effort involved the selection of a supplier for the XM1031 improved 20mm ammunition and the test planning to determine the penetration characteristics of the projectile. In a related effort, the first gun barrel is in gun contractor testing. The fire suppression effort involves finding an alternative agent to halon; testing of the down-selected candidate agents is scheduled to begin in FY02.

TEST & EVALUATION ASSESSMENT

As stated in last year's report, DOT&E's position remains that it is unlikely that the Service can deliver the expected system performance within the current budget and schedule.

Weight Growth. The program has reported that it will not achieve the MS II weight goal of 9,300 pounds and has set a new production weight goal of 9,400 pounds. To compensate for the weight growth, the PM has decided to increase the core temperature of the engines to produce an additional 70 shaft-horsepower for each engine. Testing to determine if the increased operating temperatures will reduce engine life is ongoing. The increased engine power and weight goal gives the PM about a 2 percent margin of weight growth during the remainder of EMD. Since most aircraft programs experience weight growth in excess of 2 percent during EMD, there is some risk that certain range or vertical rate of climb performance requirements may not be met by MS III.

Flight Testing. Flight testing of the two prototype aircraft has resulted in steady progress, but each design change has introduced new problems. Flight testing prior to MS II revealed a noticeable tail buffet as the aircraft's speed reached 80 to 100 knots. A reshaped pylon, first flight tested in 1999, reduced tail buffeting but compromised directional stability. To restore directional stability, endplates were added to a slightly shorter tail. Flight testing of the redesigned tail has confirmed that directional stability has been restored to acceptable levels with and without the radar dome installed. Full scale testing has also confirmed that the 5-foot² endplates do not significantly impact RCS. However, the endplates have created new challenges for antenna placement and possibly performance.

Comanche Radar. A redesign of the Comanche radar (CR) antenna in the past year has increased schedule risk, but may have reduced the risk to performance. At MS II, the CR design hinged on an electronically steered array (ESA) antenna that was thought to be crucial to meeting performance requirements. The prototype ESA antenna, however, exhibited excessive losses during MS II testing and has since been abandoned in favor of an Azimuth and Elevation Mono-Pulse mechanically scanned antenna, building upon the success of the Longbow Fire Control Radar development. Additionally, designers believe that the Azimuth and Elevation Mono-Pulse mechanically scanned antenna will eliminate the need for roll-stabilizing the antenna azimuth mount, reduce weight, increase reliability, reduce O&S costs, and support synchronous scanning and fusion with the electro-optical sensor suite.

Unfortunately, the schedule for the development of a flight-ready engineering model for the CR has been shortened by the antenna redesign. It is critical that a working model of this antenna be available as soon as possible to permit the airborne collection of clutter data and development of the CR detection algorithms. Confirmation of the efficacy of the proposed antenna concept is scheduled for October 2002 and hinges on the collection of radar performance data against moving and stationary targets. The schedule for integration of the CR onto the aircraft is equally compressed. The earliest date for installation of the CR on Comanche aircraft #2 is October 2003. A short 22-month window, to address product shortfalls if necessary, follows the installation of the first prototype antenna before IOT&E.

Radar Cross-Section. From a preliminary review of RCS measurements of a full-scale model, the Comanche appears to be in a position to meet RCS goals in most areas. It is particularly encouraging that there was margin between measured RCS averages and ORD requirements at many of the frequencies. RCS will only grow from these measurements, as sensors are added and as additional, inevitable aircraft modifications are made to solve problems unrelated to signature.

Maintainability of Low Observable (LO) Materials. Sustained operational success for the Comanche will depend heavily on the reliability and maintainability of LO aircraft components. The program office discovered that curing times for LO materials exceed the required maintenance thresholds. Procedures for maintenance of LO materials are being developed to reduce curing times in order to achieve sustainability requirements.

Antennas. Antenna placement, design, and performance are one of the highest program risk areas. Fewer than half the planned avionics antennas have been installed on the full-scale model and many remain to be designed and integrated. The focus to date seems to have been on maximizing antenna gain while minimizing radar signature. While gain is certainly a critical parameter that must be addressed, pattern coverage may prove to be the more intractable problem. Attempts to meet the RCS budget may compromise antenna performance to the point that it adversely affects operational effectiveness. Consequently, testing of antenna patterns and gain measurements should be made as soon as practical so that problems can be identified and addressed early.

MEP Integration. Overall, the Comanche has a high-risk test and evaluation strategy for integrating the MEP components on the aircraft. Integration and testing of the complete MEP on the aircraft will not occur until the end of the EMD phase. The resulting schedule compression allows little reserve in the timetable, thereby increasing the impact of unforeseen events/delays and leaving no time to resolve problems discovered in testing.

Comanche Reliability. Although the program office/contractor has a comprehensive system to identify and correct failures, corrective actions generally will not be implemented except at several discrete points in time. Because of the compressed developmental schedule, it will be difficult to demonstrate improvements in aircraft reliability by means of testing. Moreover, the program office has recently proposed later deliveries of EMD aircraft and reductions in the number of EMD flight hours. Consequently, it is even less likely that Comanche will demonstrate the required levels of reliability before MS III.

Crew Station Simulations. In the past year, two simulation events have refined Comanche tactics, techniques, and procedures and confirmed that design of the Comanche cockpit will facilitate mission accomplishment. There has been steady progress in the maturity of software supporting the cockpit simulators. Scenario, threat, and task realism have improved significantly. While the simulators still lack fidelity in several key areas (engagements are not resolved realistically and the tactical internet is not portrayed) the program is postured to successfully conduct the operational test event, Force Development, Test and Experimentation I in FY02.

The LFT&E program, scheduled to be completed before MS III, includes component qualification and sub-system level ballistic testing for 27 critical components, as well as full-up, system level dynamic testing on a production-representative configuration aircraft. However, because of the compressed nature of the EMD phase (aircraft # 11 designated for LFT&E is scheduled to be delivered in May 2005), it will be extremely difficult to correct any weaknesses discovered during LFT&E. There is a schedule risk to accomplish the stated goals of the ORD.

Because of cost growth and schedule delays since EMD, the Army has recognized that a new Comanche development strategy is needed. The Army intends to develop a revised strategy by 2QFY02. It is envisioned that the revised development strategy will be an evolutionary approach to deliver the ultimate capability to the user via block developments, with increasing increments of capability.

Comanche is a revolutionary helicopter design. It is imperative that the revised development strategy, now being considered by the Army, eliminates the concurrency between the development of the aircraft and testing. This is critical to providing the much needed time to identify problem areas, which are bound to arise in testing and to develop and apply fixes to the system prior to initial operating capability.