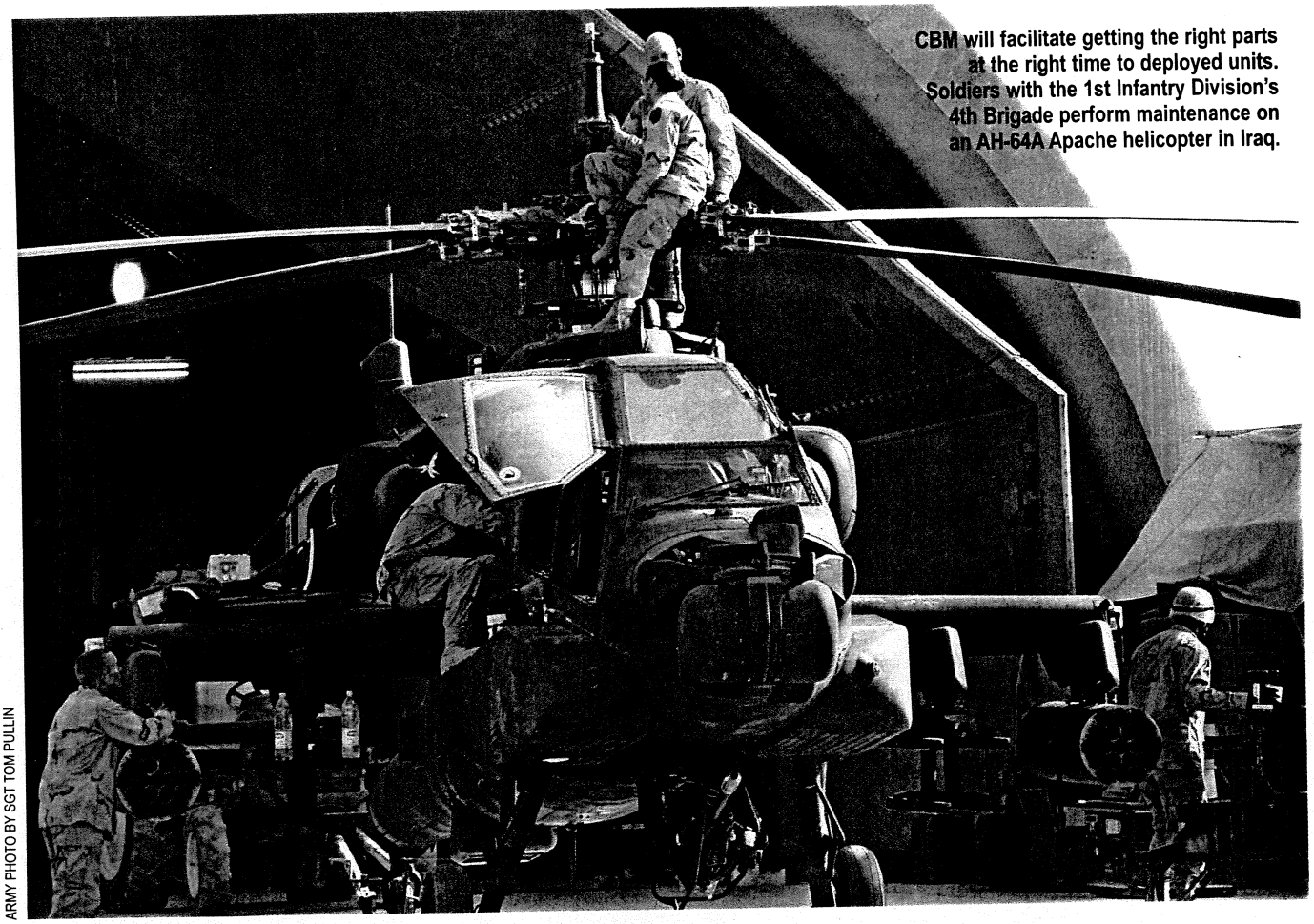


CBM will facilitate getting the right parts at the right time to deployed units. Soldiers with the 1st Infantry Division's 4th Brigade perform maintenance on an AH-64A Apache helicopter in Iraq.

ARMY PHOTO BY SGT TOM PULLIN

CONDITION BASED MAINTENANCE

WHAT IT MEANS TO ARMY AVIATION

By LTC Kimberly A. Enderle

Editor's note: *This is the second in a series of articles on Aviation logistics transformation from the Office of the Deputy Chief of Staff for Logistics, G4, Aviation Logistics Division. In November the G4 released a white paper on Aviation Condition Based Maintenance. This month's Aviation Logistics article provides a brief summary of the G4 vision for Aviation CBM.*

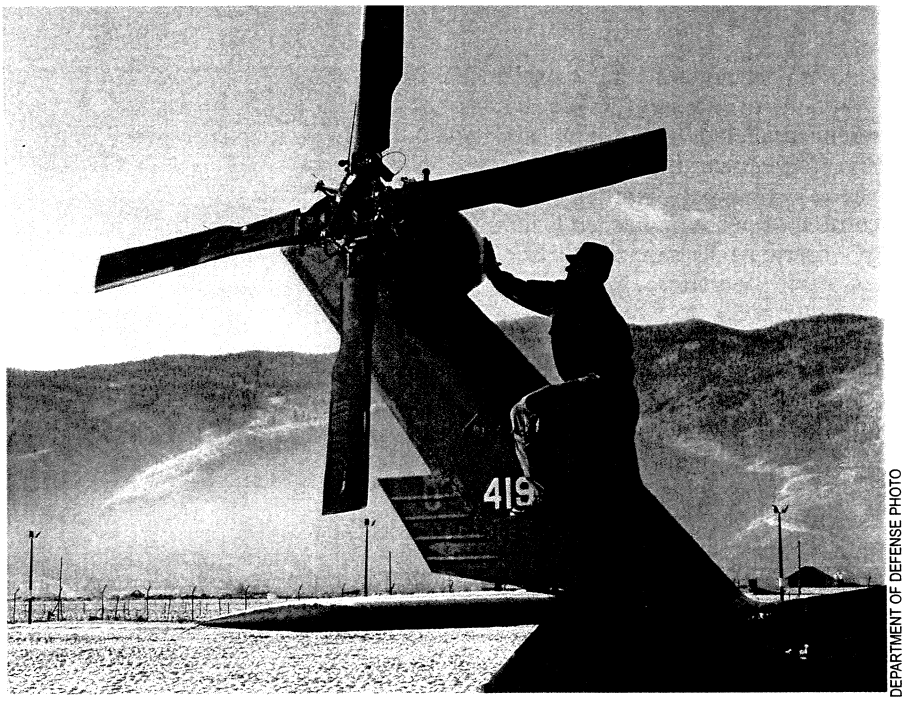
The Army G4's Aviation Logistics Division white paper provides broad guidance, measurable milestones and the vision for Aviation to transition to a Condition Based Maintenance (CBM) program by the end of fiscal year 2015. The transition to CBM is contingent on incorporating enhanced technology on existing aviation weapons systems, and embedding those capabilities into future and developmental aviation weapons systems. This technology insertion will lead to better components and improved system reliability analysis, thus increasing the operational availability of Army aircraft.

Defining CBM

"What it is condition based maintenance?" and "How is it different from the maintenance we do today?" At the tactical level, CBM is new tools, test equipment and embedded on-board diagnostics. These tools provide the

ability to translate aircraft condition data (temperature, vibration, cycle-time, etc.) in combination with environmental factors (i.e. desert, artic, high humidity usage profiles) into proactive maintenance actions, which will enable unit personnel to perform maintenance only when there is evidence of actual need. CBM enables Soldiers and leaders to plan and perform maintenance at the right place and time, resulting in greater aircraft operational availability.

At the operational or strategic level, CBM is a set of maintenance actions based on real-time or near real-time assessment of equipment status, obtained from embedded sensors and/or external measurements or tests performed by man-portable equipment. Data collected from health usage monitoring system (HUMS) equipment is then translated into predictive trends and metrics, which are capable of anticipating when component failures will occur based on actual operating environment. The predictive approach allows for the proactive acquisition and delivery of requisite spare parts to perform maintenance, prior to component failure. It also allows for adjustment of scheduled maintenance tasks based on actual equipment condition.



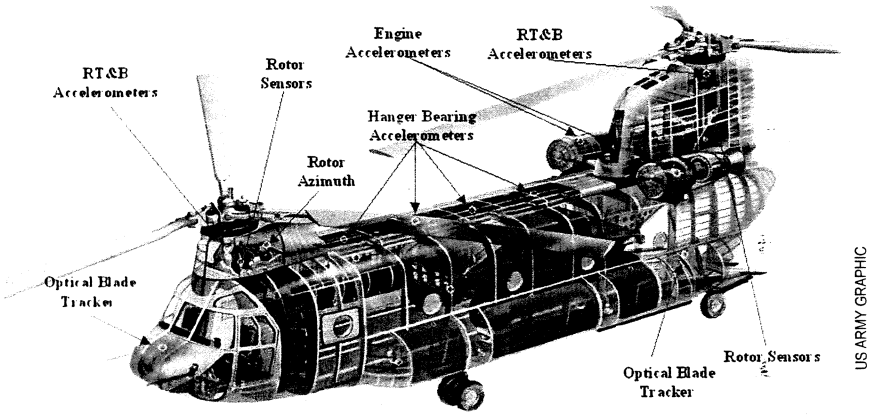
DEPARTMENT OF DEFENSE PHOTO

Condition based maintenance takes environmental factors into consideration when conducting aviation maintenance. CW3 Kelly Nokes with 1256th Med. Co. (AA), Minnesota National Guard, cleans snow off of his UH-60 helicopter in Bosnia.

ponent or weapon system failure, to a proactive or predictive CBM approach that performs maintenance upon evidence of need. This will permit maintainers to plan, sequence and perform needed supply and maintenance actions with minimal impact on operations. CBM is supported by automated maintenance information systems that rely on automated onboard or man-portable data collection sensors and seamlessly integrate (requirements and performance data) with other logistics systems. CBM has the potential to lead to more efficient maintenance practices and procedures, improved operational availability, and provide cost savings associated with smaller logistics footprints. Integration of CBM predicted component and airframe data into an end-to-end logistics system can improve performance of supply and transport, as well as maintenance operations. Accurate and timely transmission of requirements through integrated data systems can be combined with known process cycle time (captured by automated identification system and UID [unique identification] movement data) to optimize and synchronize acquisition, maintenance, supply and transportation processes with funding.

Furthermore, CBM results in component and airframe data collection that will promote the development and integration of an end-to-end aviation life-cycle maintenance and logistics management system that employs timely and accurate integration of data systems, and supports the Army's logistics and distribution system. CBM enables responsive and predictive maintenance that will eventually reduce the Aviation logistics tail and expense.

HUMS INSTALLATION



US ARMY GRAPHIC

Data collected from an onboard health usage monitoring system (HUMS) will help to predict trends and metrics used to anticipate when component failures will occur, thus allowing maintainers to better schedule phase maintenance and obtain needed parts.

Transformation Link

Transitioning Army Aviation to a CBM program requires a conscious shift from reactive, fault-based maintenance, which is identified by com-

Why Change?

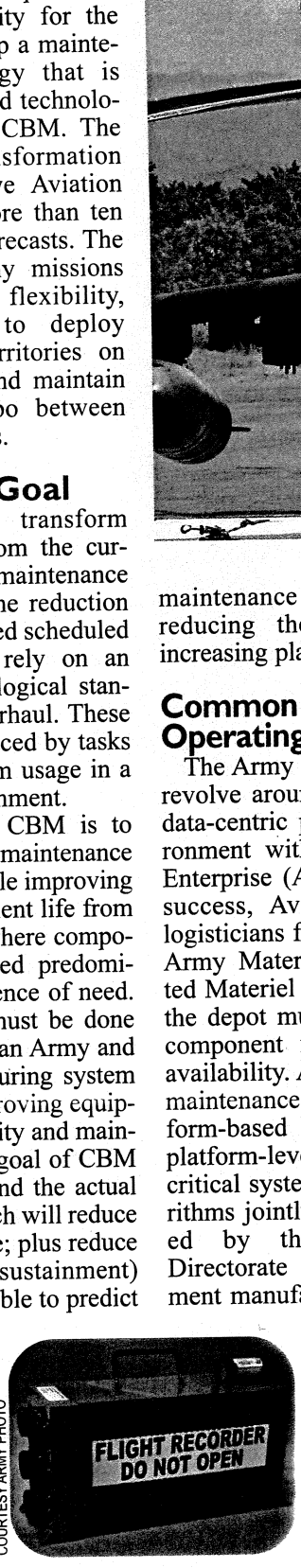
This is an unprecedented time in the history of Army Aviation. The deci-

sion to terminate the Comanche Program in February 2004 provided an unparalleled opportunity for the Aviation branch to develop a maintenance investment strategy that is capable of pursuing needed technology insertions to support CBM. The Aviation logistics transformation strategy seeks to achieve Aviation CBM implementation more than ten years ahead of original forecasts. The changing nature of Army missions require unprecedented flexibility, including the ability to deploy Aviation into hostile territories on extremely short notice and maintain higher operational tempo between major maintenance events.

Transformation Goal

Army Aviation must transform Aviation maintenance from the current reactive, fault-based maintenance program. This requires the reduction in the frequency of selected scheduled maintenance tasks that rely on an assumed fatigue life or logical standardized time before overhaul. These legacy tasks will be replaced by tasks tailored to actual platform usage in a specific operating environment.

The key objective of CBM is to reduce the unnecessary maintenance burden on field units, while improving and/or extending component life from a finite quantity to one where component replacement is based predominantly on objective evidence of need. Achieving this change must be done within the constraints of an Army and nation at war, while ensuring system safety, in addition to improving equipment reliability, availability and maintainability. The ultimate goal of CBM is to know and understand the actual status of equipment, which will reduce unnecessary maintenance; plus reduce total (operations and sustainment) ownership costs. Being able to predict when and where aircraft components are most likely to fail will enable replacement components to be positioned when and where they are needed on the battlefield, thus reduce the logistics tail and operational expense. Sensor based assessment of equipment condition also reduces scheduled maintenance requirements, further reducing the logistics tail while increasing platform availability.



COURTESY ARMY PHOTO

The HUMS will be integrated with the cockpit voice and flight data recorder similar to this UH-60 FDR.

Common Logistics Operating Environment

The Army envisions that CBM will revolve around the construction of a data-centric platform-operating environment within the Army Logistics Enterprise (ALE). For CBM to be a success, Aviation maintainers and logisticians from the flight line to the Army Materiel Command's Integrated Materiel Management Centers, to the depot must all have visibility on component failures and component availability. ALE will monitor critical maintenance data elements using platform-based processors to determine platform-level component health and critical systems health by using algorithms jointly developed and validated by the Army Engineering Directorate and the original equipment manufacturer. These algorithms will support metrics that will use physics of failure for each component and will focus engineering efforts to merge traditional areas (such as system, reliability, design and controls) to rethink the way we design, build and support future systems with new dynamic maintenance programs.

DEPARTMENT OF DEFENSE PHOTO

At the tactical level, CBM is new tools, test equipment and embedded on-board diagnostics to assist Soldiers like SPC Justin Stanton with the 1st Bn., 228th Avn. Regt. in Honduras obtain higher operational readiness.

Summary

In conclusion, CBM technology has the potential to monitor the health of aviation weapon systems and sub-systems thru the use of on-board diagnostics (near-term goal) and on/off-board prognostics (long-term goal), which lead to component reliability improvements, reduced maintenance man-hours, and to reduced aviation accidents and incidents. The common logistics operating environment directly supports efforts to achieve the Army's integrated logistics enterprise and to enable joint force interoperability and interdependency, sense-and-respond logistics, network-centric warfare for logistics, and a fully modernized and transformed sustainment environment for the future that supports multifunctional, expeditionary and combined-arms units on a distributed, non-linear battlefield. The eventual transition to CBM will enable Aviation to achieve the CSA directed mission of reducing the Aviation logistics tail and will result in a more ready force.

Delivering Materiel Readiness!

❖❖

LTC Kimberly A. Enderle is the military assistance to the G4 in the Office of the Deputy Chief of Staff for Logistics, Washington, D.C.