



CBM Advisory Board

8 September 2011

Orlando, FL



CBM Advisory (Board (AB) Update

- **Aug 2010 – Principals Approved the Creation of a CBM IPT**
- **Dec 2010 Principals VTC**
 - Principals Briefed on Charter
 - Concurred on Accepting the Charter
- **March Principals Conference**
 - Changed Name From IPT to Advisory Board to Align With Other JACG Standing Boards
 - Charter Signed



CBM Advisory (Board (AB) Update

- **Advisory Board Met Four Times, as Recently as 9 Aug 2011**
- **Shared Information to Include Where Each Service Is Regarding Reliability Centered Maintenance and a Value Stream Process**
- **Continue to Share Information With Representatives of Participating Advisory Board Members**
- **Current Participants Include:**
 - US Army, Chair
 - US Air Force
 - US Navy (Also Represents the US Marine Corps)
 - US Coast Guard
- **Status of Army Aviation CBM+ Efforts Follows**



Status Report

Christopher Smith

US Army AMCOM CBM Director

8 September 2011

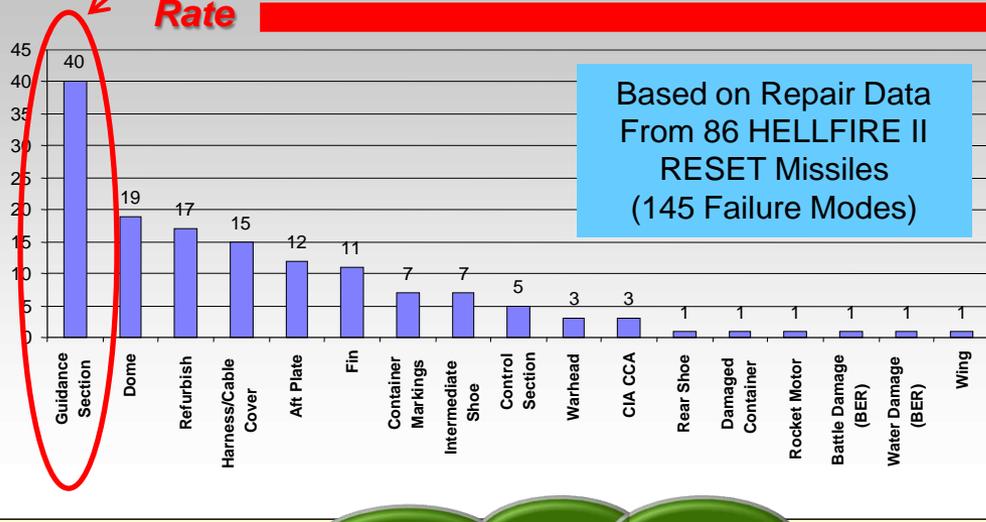


CBM: Hellfire Captive Carry Monitor



Pareto Plot of Defects - HFII

FY07 445 U.S. ARMY HELLFIRE RESET
245 AUR (HFII)
Repair Pareto

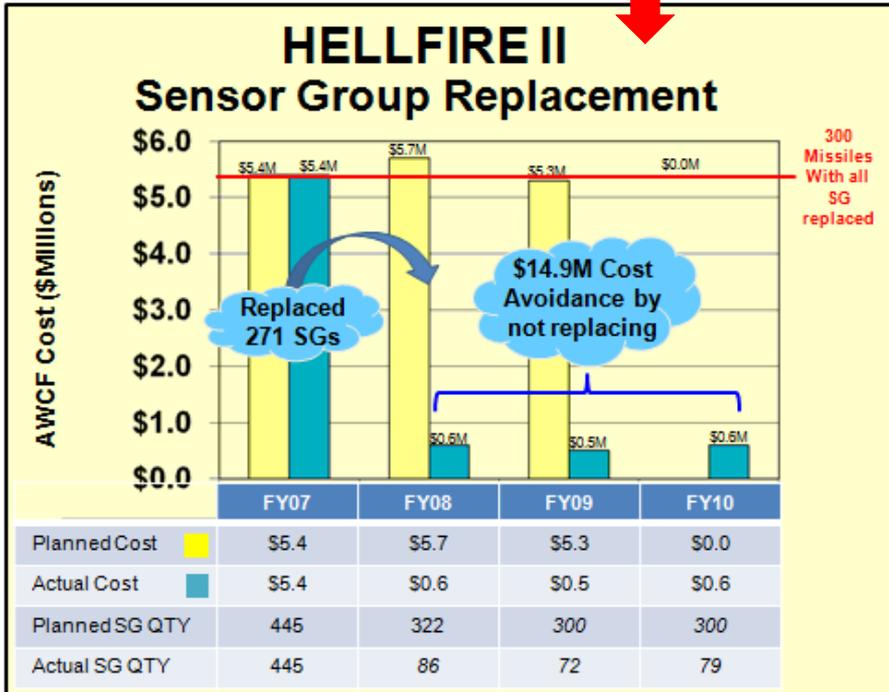


High Usage Rate

Based on Repair Data From 86 HELLFIRE II RESET Missiles (145 Failure Modes)

“Captive Carry hours impact HELLFIRE performance and drive repair and RESET activities by replacing Guidance Systems only when usage indicates.”

\$14.9M Cost Savings Over 3 Years = Potential to Eliminate Many \$M in Unnecessary Guidance System Replacements





Recording Flight Time

Problem/Issue

- **No comprehensive Authorization to develop implementation plan to automate recording of flight time IAW AR 95-01**
- **Background:**
 - AMCOM G-3 Command Analysis Directorate (CAD) study (based on FY06 data) indicates 12-22% delta between Digital Source Collectors (DSC) and 2408-12
 - Study indicates projected efficiencies and impacts on accounting systems(s)
 - Introduced in multiple venues with no approval to progress toward implementation

Discussion

- **Validate damage fraction accrual, cycle time to accurately translate to flight hour (AED)**
- **Conduct – blind | | test to develop high accuracy delta in flight hours between DSC and -12 (AMCOM/ACLC)**
- **Validate test results (USAACE)**
- **Identify possible non-linear adjustments to Aviation reimbursable rates (FORSCOM)**
- **Identify and refine implementation impacts and requirements (policy, publications, organizations, and systems)**

Actions

- **Immediate execution of test on Aviation Center Logistics Command (ACLIC) UH-60M fleet**
- **Test time frame to run six months, with midpoint briefing during ASC #22 (spellout ASC)**
- **Lead agency is AMCOM G-3 CAD**

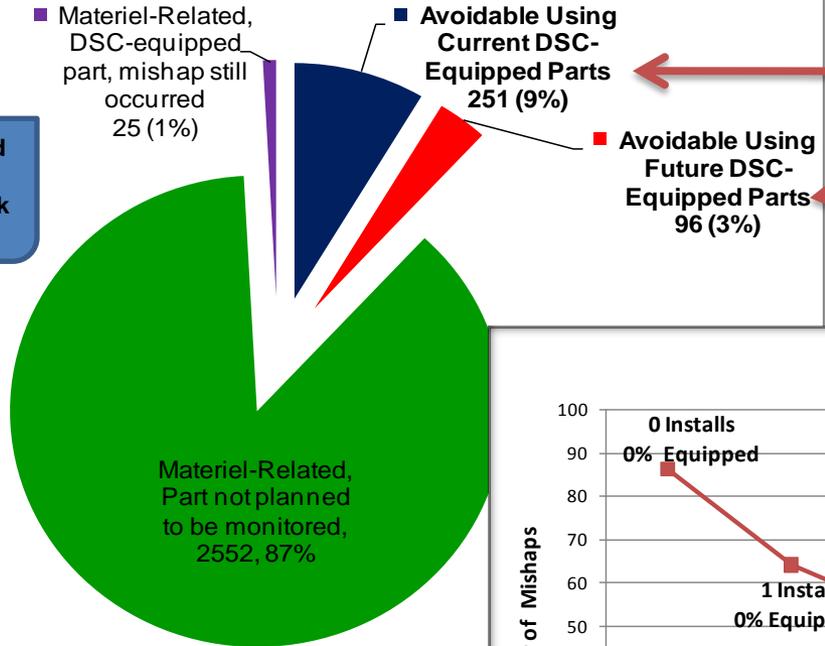
Agencies

- AMCOM G-3
- FORSCOM AVN
- DA G3/5/7
- TRADOC
- USAALS
- AMRDEC AED
- DA G4
- PEO AVIATION
- USAACE
- ASA(FM&C)



CBM Avoidable Mishaps (FY02-FY09 ASMIS Data)

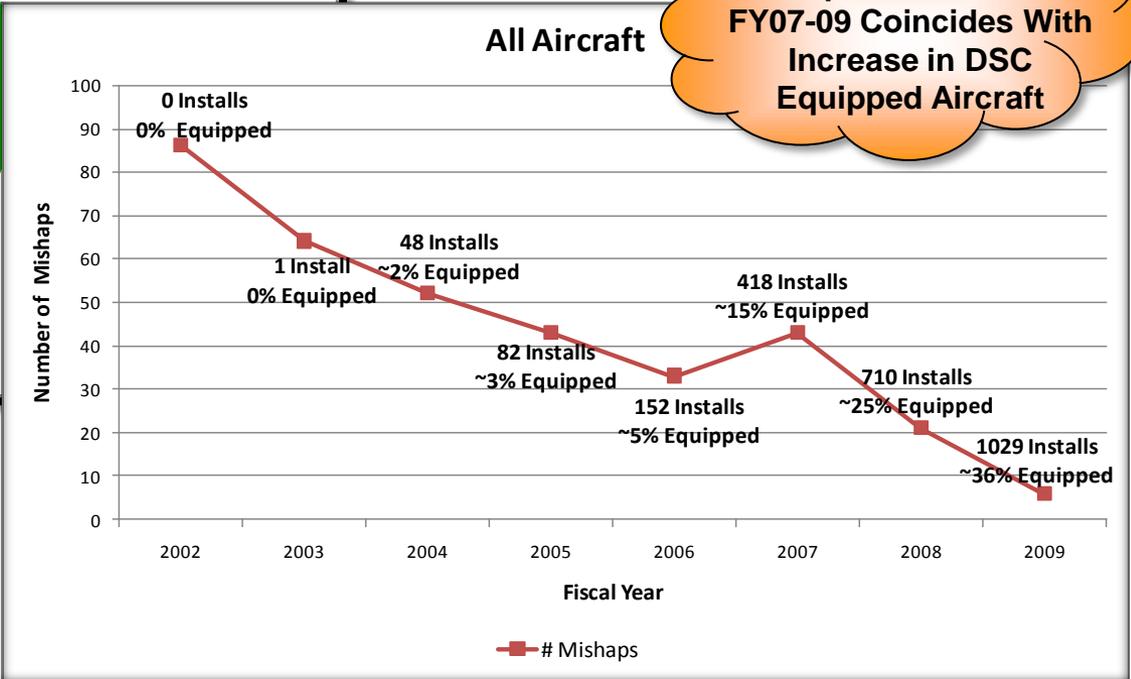
Analysis conducted using Apache, Blackhawk, Chinook Data (incl MH);



CBM Could Have Avoided 9%-12% of Materiel Related Mishaps

Mishap Rate Reduction FY07-09 Coincides With Increase in DSC Equipped Aircraft

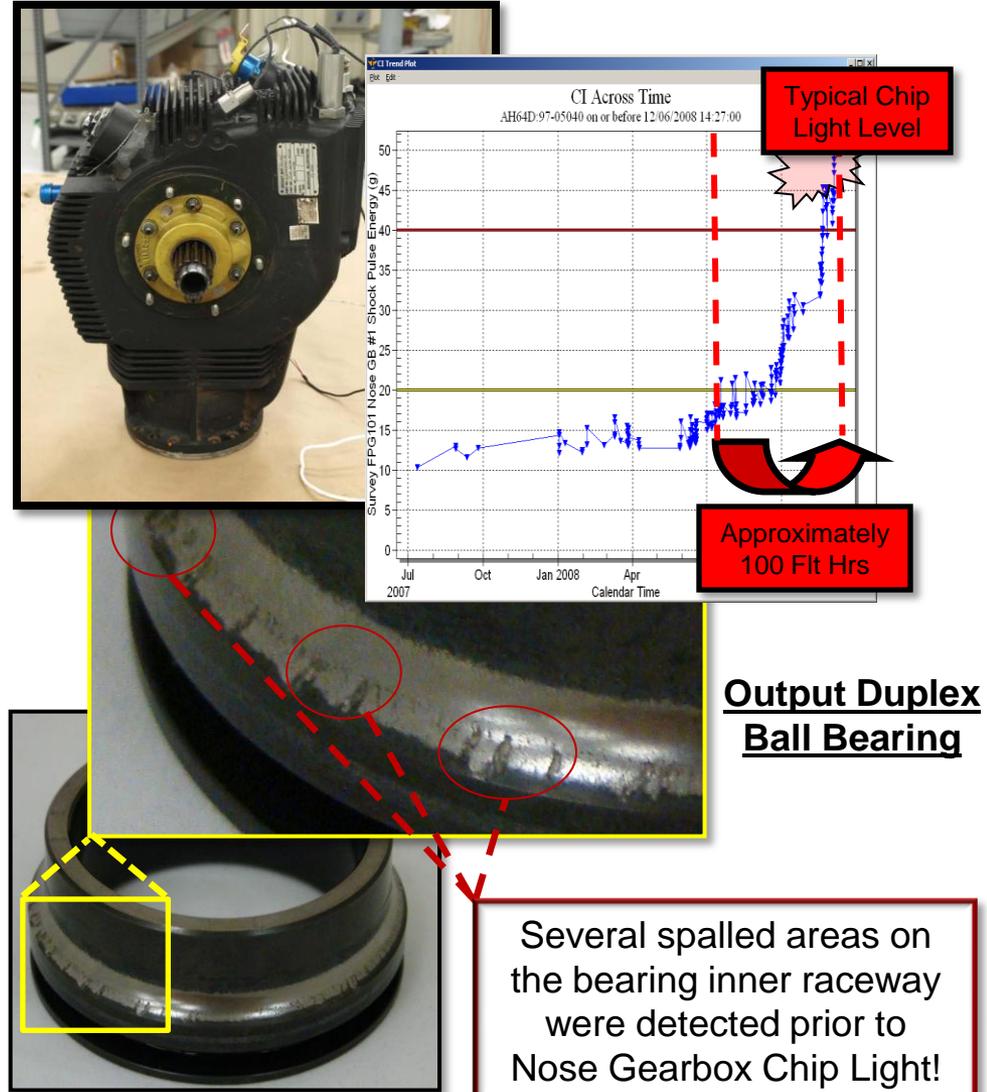
Most Class D and E Mishaps Cause Mission Aborts
[Possibly Impacts MTBMEF]





Apache Nose Gearbox

- Nose gearbox duplex ball bearing accounts for 20% of removals
- Without CBM, NGB light requires a mission abort and subsequent grounding of the aircraft until replaced
- With CBM, the pilot is given 50-100 hours advanced notice allowing scheduled maintenance
 - Reduced Mission Aborts





AH-64 Tail Rotor

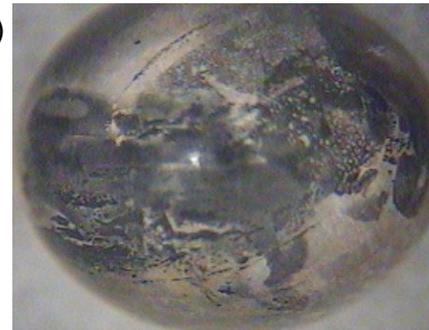
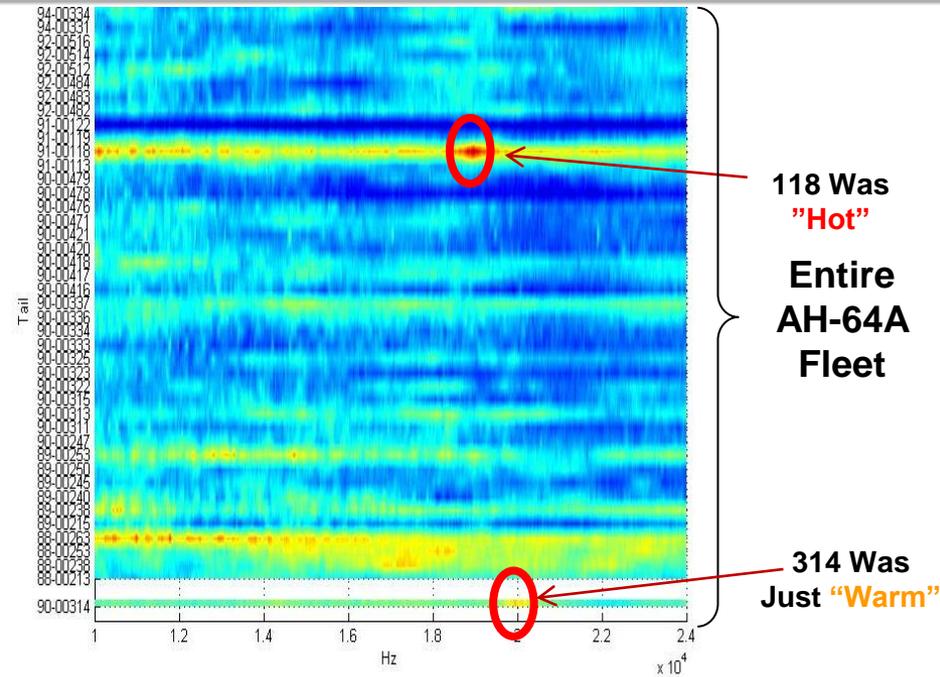
Background

- AH-64A 90-00314 Class-A Incident (undetected) on 5 Apr 07
 - Aircraft instrumented with VMEP, tail rotor swashplate bearing suspected
 - First Apache tail rotor swashplate incident on a VMEP or MSPU-equipped aircraft
 - At this time only 1 condition indicator (CI) for tail rotor swashplate; other CIs not developed due to lack of data on damaged bearings
 - Current CI had “All Green” status
- Web-based data mining tools quick view of “Normal” 314 has “Hot” (Red) at 20 KHz; norm all aircraft “Cool” in this area
- Legacy SPU algorithms did not detect damage on 314
 - TR balance well within normal range up to and including last flight
- Current swashplate bearing CI did not detect 314, anomaly present 1 calendar year prior to incident on 314
- Post-processing of archived vibration data quickly identified original anomaly on 314 - but also on AH-64A 91-00118 (MO ARNG)

Conclusion

- Once CI was developed, it was noticed that 118 had even higher vibration levels than 314.
- **Unit removed and replaced the Tail Rotor Swashplate resulting first CBM attributed Class-A avoidance.**

**Fleet View of All AH-64As With VMEP
Here 314 Was Just “Warm” Compared to 91-00118!**





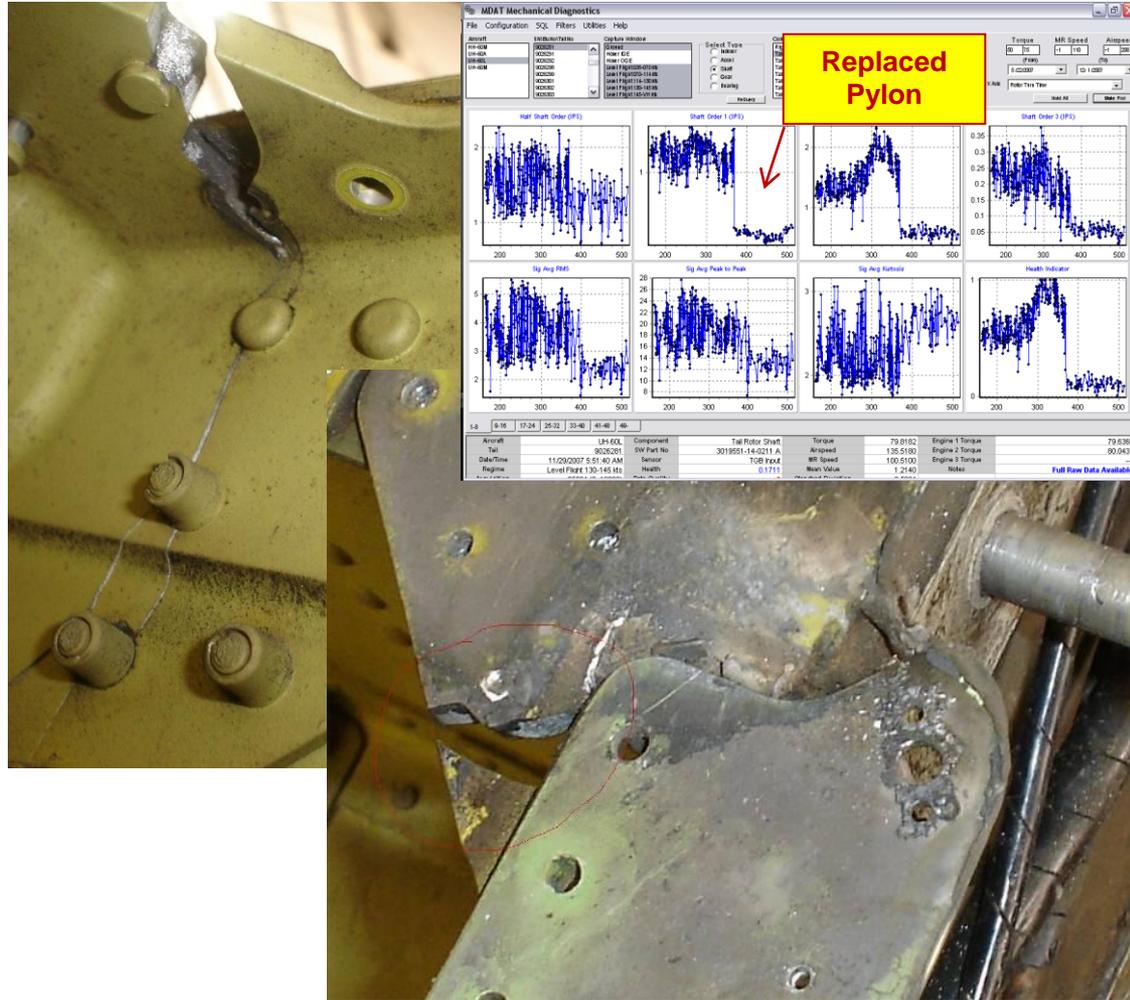
Blackhawk Vertical Fin

Background

- Aircraft 90-26281 (Equipped With IVHMS), 5-101 AVN JUL 08
- Maintainer Detected a High Vibration Indication in the Tail Gearbox Input Accel.
- Inspection Revealed Numerous Cracks in the Tail Pylon. Detection Prevented Subsequent Damage and Potential AC Mishap. This On-condition Detection Identified Signatures That Can Be Used to Analyze Other Aircraft.

Conclusion

- Engineering Judgment That Within a Few Flight Hours, the Vertical Fin (and Thus Entire Tail Rotor) Would Have Separated From Aircraft, Leading to Catastrophic Mishap



***Saved 1 UH-60L Potential Class A Accident
= \$6M Aircraft And At Least 3 Crew Members***



AH-64D Tail Rotor Gearbox

Background

- April 2010 MSPU detected excessive vibration and illuminated the VIB GRBX in the crewstation, directing the crew to Land as soon as Possible
- Two MSPU CIs were coded RED
- RIMFIRE (tear down analysis) documented several findings including a cracked cage, gear spalling, rolled metal and severe spalling on an inner race
- Additional AED CI not yet deployed to field coded RED upon post- flight data analysis



Cracked cage from 076 ball bearing



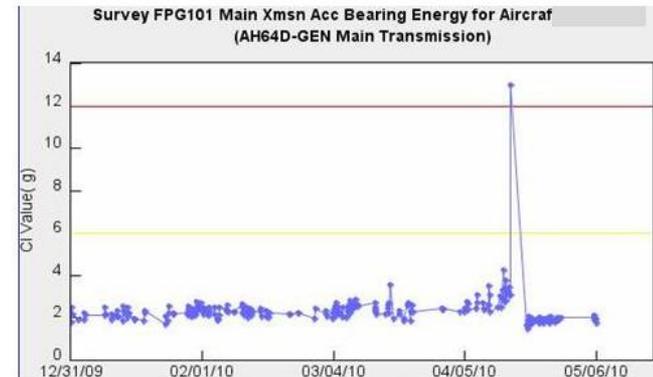
Spalling damage on 229 gear teeth



Rolled metal on inner race of 076 bearing

Conclusion

- MSPU properly informed crew to land. If the A/C continued to fly, *“is likely that the APU drive shaft may have severed”*.
 - RIMFIRE documented the disassembly
 - Data was received back to CBM WG to analyze and confirm new CIs
 - AED’s new CI will be deployed next Apache MSPU release.





Apache Main Transmission

Intermediate Stage Helical Gear Upper Roller Bearing

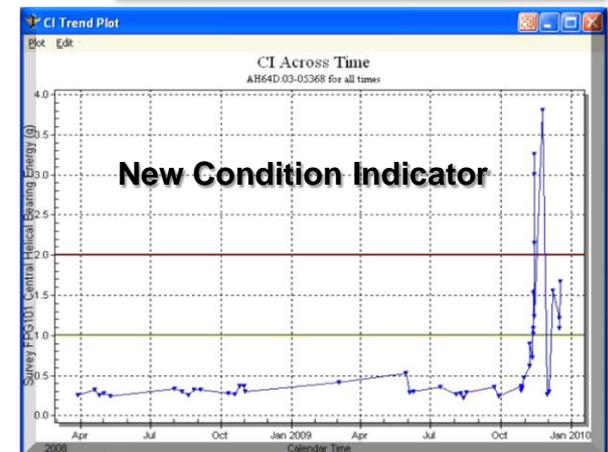
Background

- Apache Main Transmissions chipping out
 - Six transmissions found to have severe spalling on the main transmission inner race (bull gear bearing journal), rolling elements and bearing raceway
 - Questionable lot of fifty bearing assemblies manufactured
 - Twenty-five installed in transmissions.
 - Failure analysis determined that a new second source bearing supplier performed overly aggressive black oxide treatment.
- CI developed based on data from three MSPU equipped aircraft
 - Identified one other transmission operating beyond red threshold.



Course of Action

- Put out a Safety of Flight Message, H-64-10-SOF-01
 - **Ground non-MSPU equipped aircraft and replace transmission**
 - **Continued flight is authorized on MSPU equipped aircraft until replacement transmission is available or deemed unserviceable**
 - CBM allows us to address specific hazards
 - Increases readiness and combat power



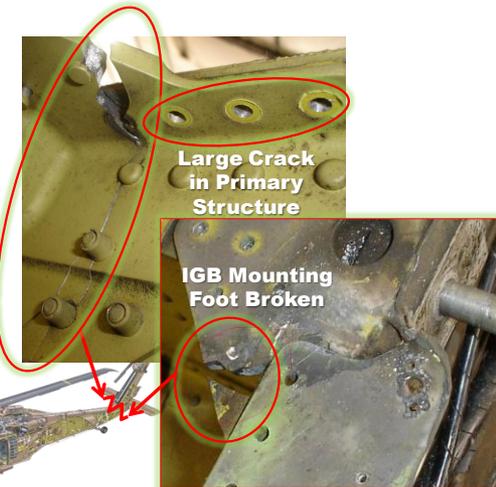


CBM Aviation Benefits/Status

- **Enhanced Safety – Avoided 4 Class A (Major) Mishaps**
 - Fully equipped CBM fleet could have reduced mishaps (Class A-E) by 9-12% from FY02-08
 - Predicted to avoid 11-12 additional Class A mishaps over next 10 years
- **Gains in Readiness/Combat Power:**
 - Experienced 3.8%-12.4% NMCM reduction
 - 1 less mission abort per 100 flight hours
 - 5-8% increase in Readiness
 - Equipping 20 aircraft with CBM gives one additional aircraft worth of flying hours to the Warfighter
- **Decrease in Maintenance Cost and Soldier Burden**
 - Maintenance Test Flight reduction 1-4%
 - Over 125 maintenance procedures improved or eliminated
- **CBM-equipped Fleets Have Lower Class IX Parts Costs/Flight Hour:**
 - FY07-09 analysis of 41 units (~700 aircraft) indicates CBM-equipped units consume 12 to 23% less parts than non CBM-equipped units
 - Based on FY10 flight hours, this equates to saving over \$200M in parts per year
- **Current CBA Indicates Strong Benefit-to-Investment Ration (4.2) Without Considering Non-Monetary Benefits (ie., Combat Power)**



**CBM Detected
Faults Prior to
Catastrophic
Failure**



Equipped Over Half The Army's Manned Aircraft Fleet (2165/3434)