



H-53E IMDS/CBM Brief

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Ray Beasley, AIR 6.6.1.2

PMA-261 IMDS Logistics Lead



Agenda

In Service/H-53

- Mission/Requirements
- System Overview
- Components
- Data Path
- Condition Based Maintenance





IMDS Mission & Requirements

- Provides full-time usage & diagnostic monitoring for engine, drive train & rotor system mechanical components
- Enabling technology for CBM(+)/MFOQA
- IMDS System Key Performance Parameters (KPPs)

KPP	Threshold	Objective
Decreased Scheduled Maintenance	Decrease scheduled maintenance when compared to the existing maintenance plan	Reducing Man-hours to RTB aircraft from min of 3 turns to 1.5 turns.
Rotor Track & Balance	Complete balancing with no more than two sets of adjustments 95% of the time	Complete balancing with no more than one set of adjustments 70% of the time.
Information Exchange	Interface with NALCOMIS OOMA	Interfaces with optimized NALCOMIS
Program Affordability	Reduction of scheduled maintenance when compared to the existing maintenance plan of the host aircraft	Not Applicable until CBM credits are approved



H-53E IMDS System Overview

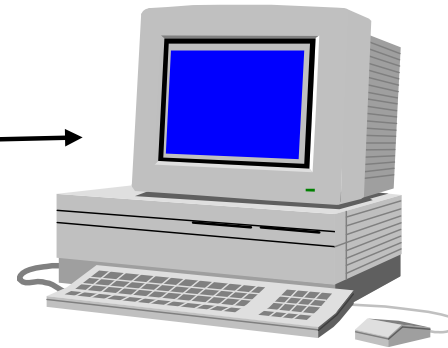
On-Board System (OBS)



Download of
aircraft data



Ground Station (GS)



IMD Hardware/Software

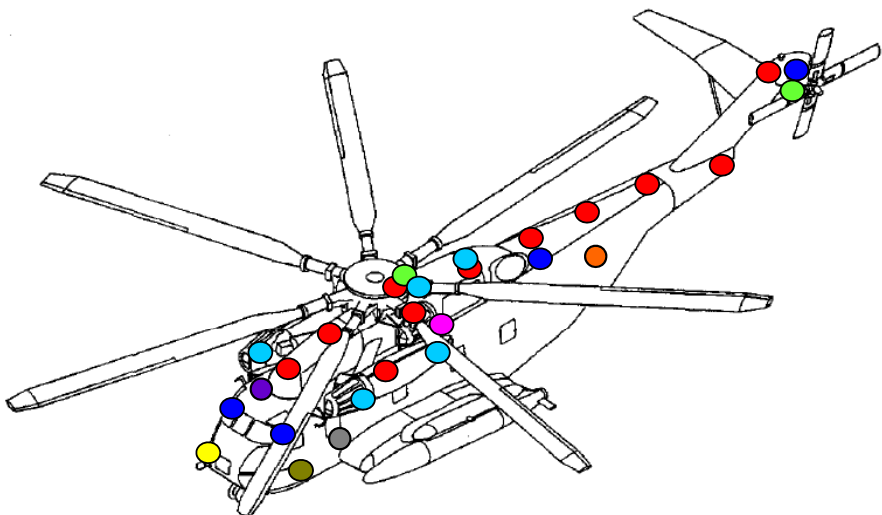
- Acquire & process data
- Provide advisories
- Automate FCF procedures
- Replace VATS/ATABS
- Provide maintenance info to shop, Quality Assurance & Function Check Pilot

- Pilot debrief
- Provide aircraft diagnostics
- Identify maintenance action
- Interactive Rotor Track & Balance
- Actual usage determination
- Customer Interface (MFOQA, NALCOMIS)

Open System Architecture

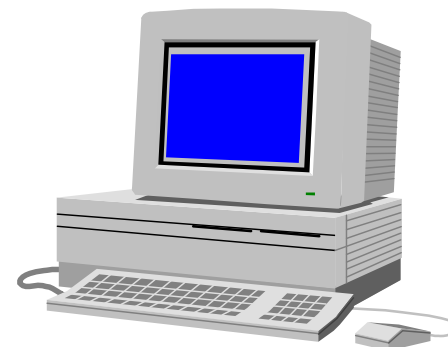


H-53E IMDS Components



- Optical Rotor Tracker
- Magnetic Pickups
- Drive Train Accels
- RTB Accels
- Engine Accels/RCC 4G

Ground Station (GS)



IMDS & Legacy Sensors



● Nose Junction Box



Remote Data Concentrator (RDC)



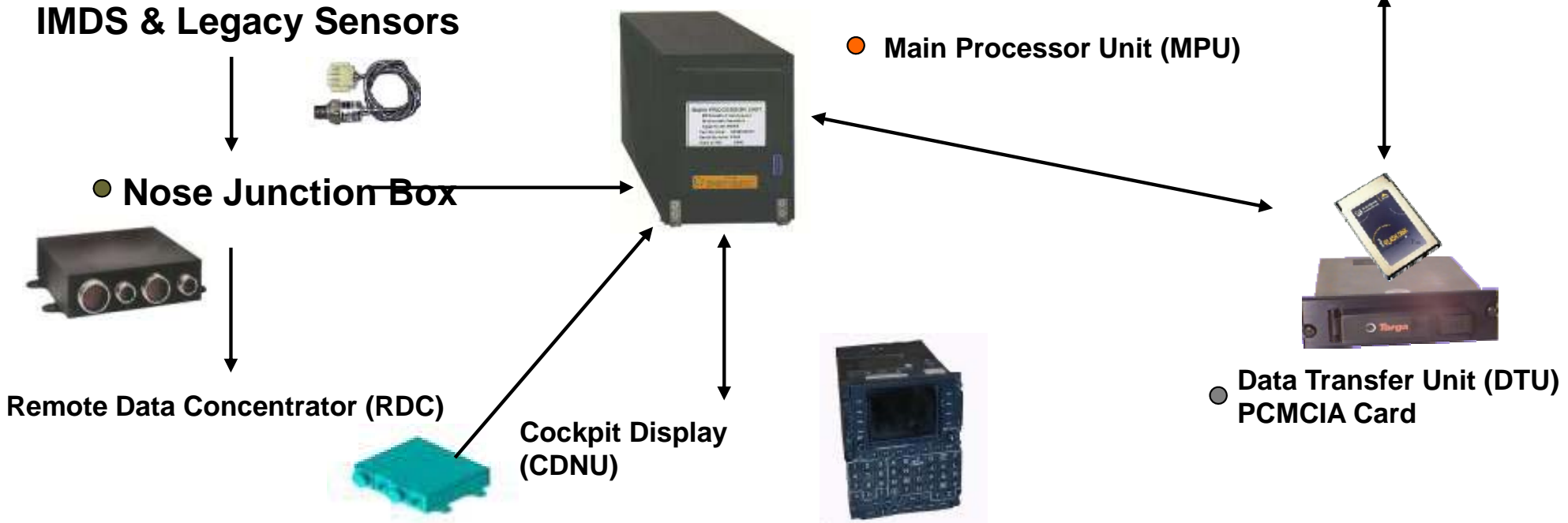
Cockpit Display (CDNU)



● Main Processor Unit (MPU)

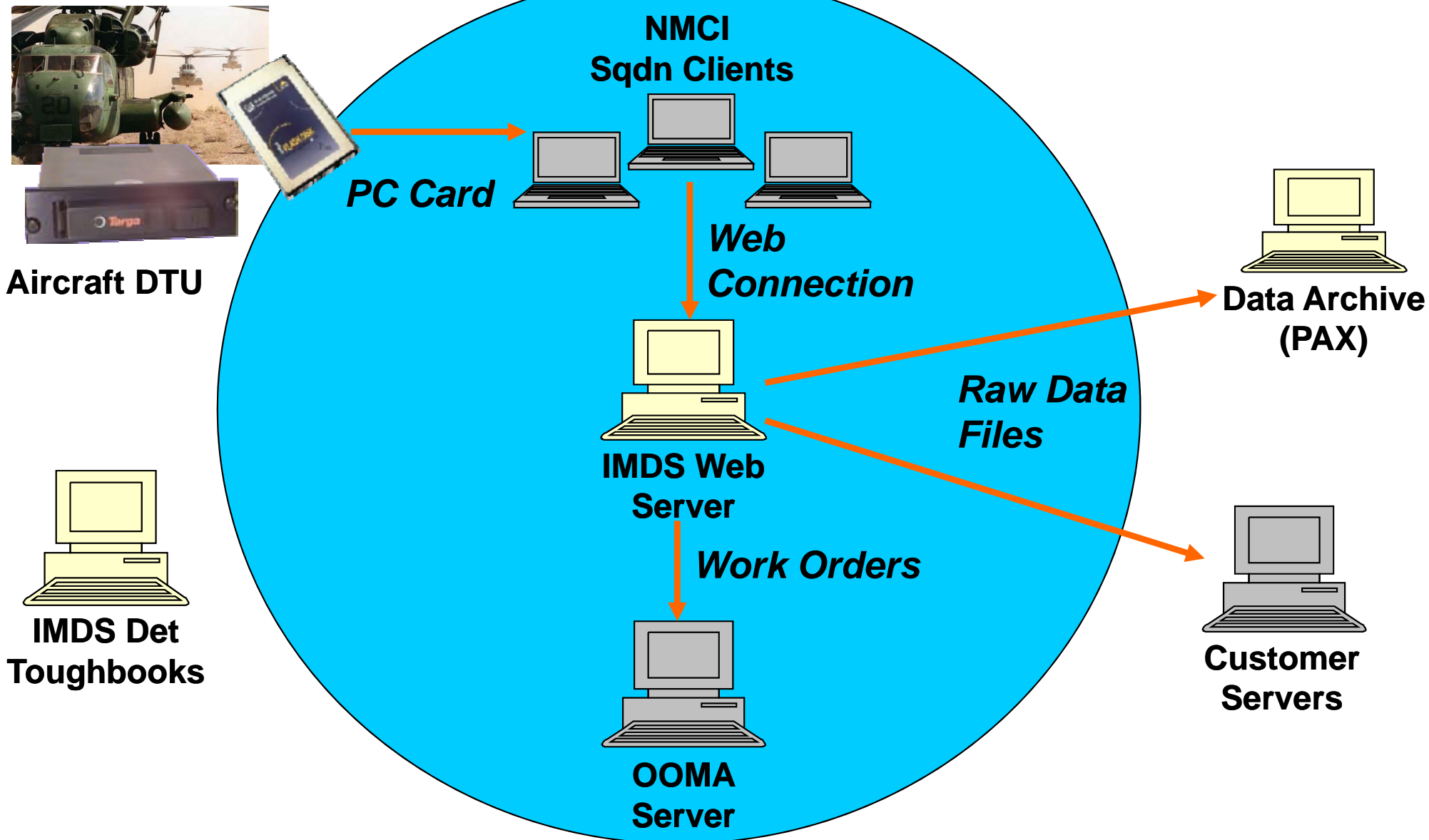


● Data Transfer Unit (DTU) PCMCIA Card





H-53E IMDS Data Path





H-53E CBM

- **Condition Based Maintenance (CBM)**

- Concept intended to direct maintenance by predicting failures based on real-time assessment of equipment condition obtained from IMDS embedded sensors
- Perform maintenance when a component needs it, not on a fixed flight hour interval
 - More efficient use of maintenance dollars/man-hours
 - Identify components exceeding a life limit before in-flight failure
- Initiatives in four areas: Rotor Track & Balance System, Mechanical Diagnostics, Structural Components & Engines





CBM Roadmap

- **H-53E CBM Roadmap**
- **Current CBM initiatives underway (on contract)**
 - Tail Rotor Drive Shaft bearings
 - Main Gearbox Oil Cooler Blower bearings
 - Upper & Lower Pitch Control Rod bearings
 - Inboard & Outboard Damper bearings
 - Nose Gearbox Oil Cooler TBO increase
 - Intermediate Gearbox TBO increase
 - Main Rotor Smoothing
 - Prognostics Diagnostics Based Maintenance (Engine Health & Parts Management)
- **Future CBM initiatives (future contract)**
 - AGB, MGB & TGB TBO increase
 - Tail Pylon Bulkhead
 - Tail Rotor Pitch Control Link bearings
 - Improved Rotor Tuning Procedures
 - Legacy System Advanced Troubleshooting Techniques

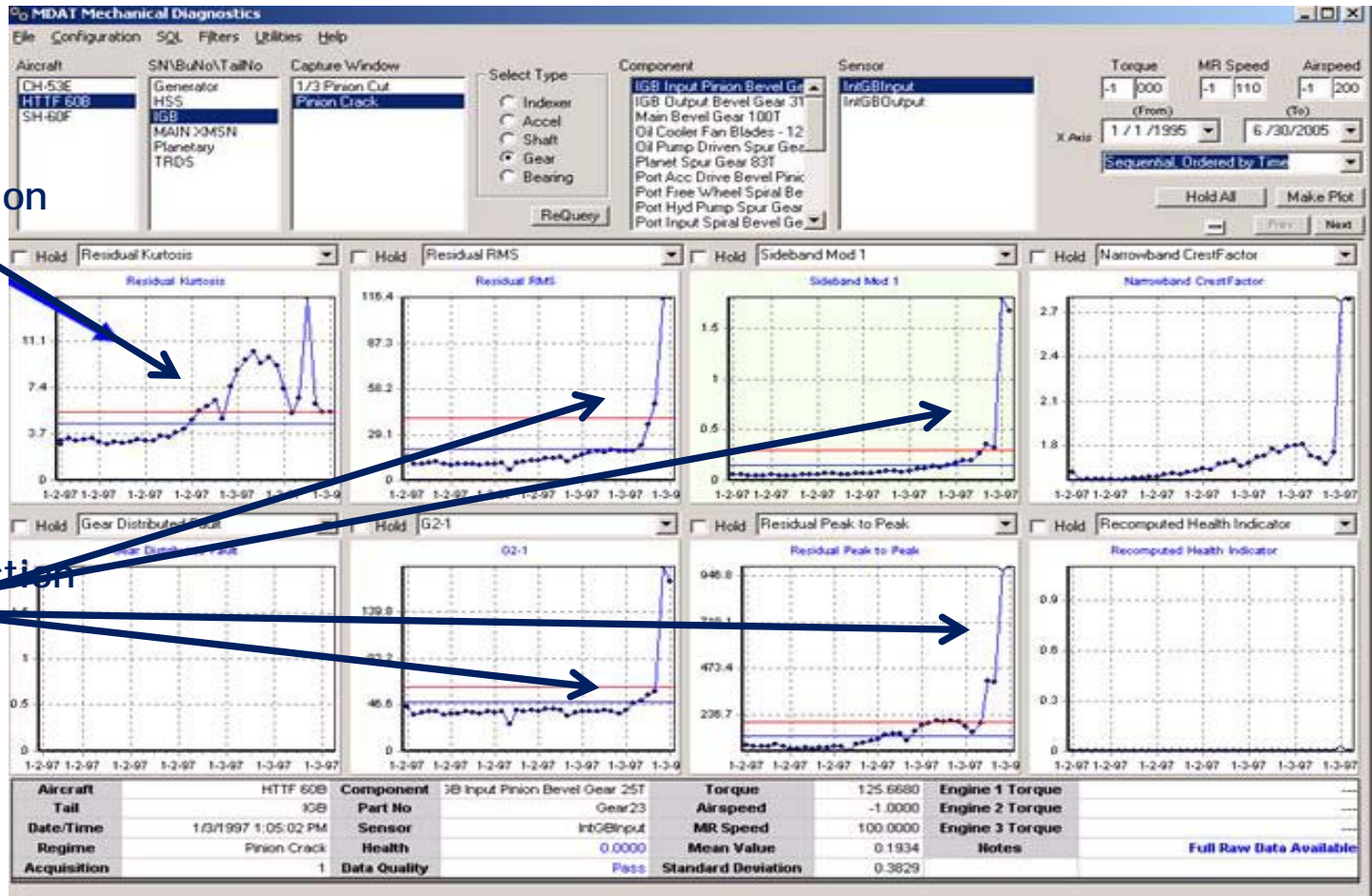


Mechanical Diagnostics (MD)

- **What is Mechanical Diagnostics ?**
 - A health examination of individual bearings, gears, and shafts on specific components
 - Utilizes vibratory signatures and aircraft state parameters to determine current condition and projected health
 - Automatically acquires data collected during ground and flight operations
 - Provides maintenance with early detection of faults and alerts aircrew to potential in-flight component failures

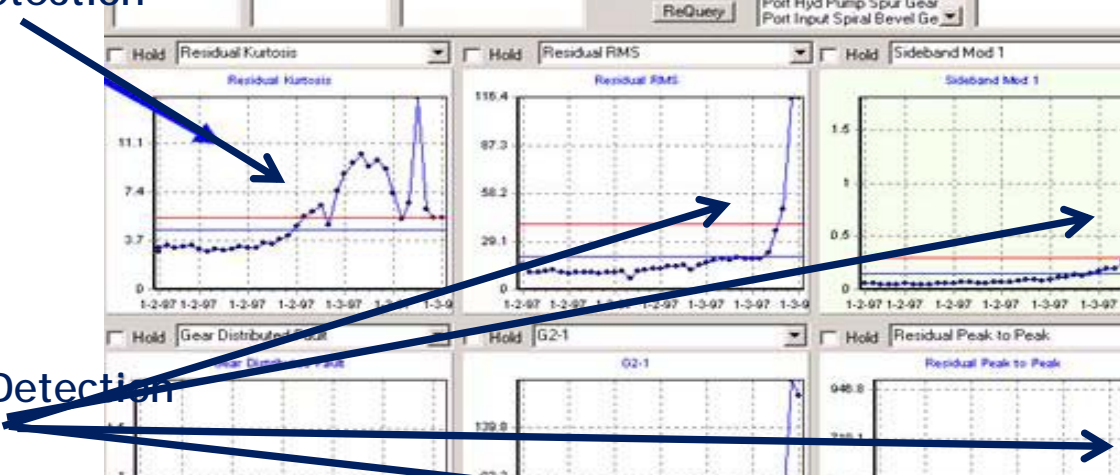


Data Collection/Results



EARLY Stage Fault Detection

LATE Stage Fault Detection





Health/Condition Indicators

- Mixture of classic energy indicators and pattern recognition indicators (CI) are monitored
 - Condition indicators are “rolled-up” to achieve a health score (HI) that is modeled for known fault types
 - The CI and HI will eliminate the need to remove, service, or disassemble a component to determine its material condition
 - Also provides opportunity to schedule many “unscheduled” maintenance tasks
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Mechanical Diagnostics (MD)

- **MD Timeline**

- Implementation of MD credits is dependent on the development of condition and health indicators and subsequent CBM software releases
- Initially targeted components for the H-53 are:
 - Tail Rotor Drive Shaft Hangar Bearing Assembly
 - Main Rotor Head Pitch Control Rod and Damper Bearing
 - Main Gearbox Oil Cooler Blower Bearing Assembly
 - Intermediate Gearbox
 - Nose Gearboxes (2X)
- Future components:
 - Tail Gear Box
 - Accessory Gearbox
 - Main Gearbox
- Additional components to be targeted as algorithms are developed and improved



H-53 Accomplishments

- 103 installs complete, 1 in-work
- Currently evaluating the first CBM credits – Inboard/outboard damper bearings & Pitch Control Rod (PCR) bearings
- CBM & MH-53E Non Recurring Engineering (NRE) contracts awarded
- CBM Quarterly Meetings held with the PMA , In-Service Logistics and Engineering teams.



H-53 IMDS Success Stories

Enables squadron to do required jobs faster

Squadrons have noted that main rotor track & balance check flights can be done within one flight.

Significantly reduces troubleshooting time

During initial check flight ground turn, IMDS indicated high vibration from drive-shaft bearing. Inspection revealed bearing had disintegrated. Current system would not have pinpointed problem for at least three more ground turns.

Finds aircraft problems that may go undetected

Noted high vibe signature from #3 hanger bearing; subsequent data collection showed vibes within limits. Removal & inspection of bearing & shaft showed both worn beyond limits.

Finds aircraft problems before scheduled maintenance

Identified impending failure of #3 engine by strip chart. Engine was approaching high time. Subsequent inspection indicated excessive wear to power turbine rotor section.





Questions