Innovative Sustainment of ADF Helicopter Structural Integrity

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Fatigue Management - Helicopters

• Design and Fatigue Life Assumptions
  – Understanding the design assumptions
  – Testing assumptions through usage monitoring
  – Measuring fatigue drivers
  – What is the aircraft condition telling us?

• Component Retirement Times (CRTs)
  – Safe life
  – Assumptions made when calculating CRTs

• Design Usage Spectrum
  – Composite worst case usage spectrum
  – Load spectrum and manoeuvres
  – Measuring complicated fatigue drivers
Fixed Wing vs Rotary Wing

• High Cycle fatigue
  – Loads on dynamic components for each rotation of the rotor
  – Small changes in stress = large change in number of cycles

• Critical components replaced

• Complex DUS
  – Expressed as a percentage of flight time
  – Less severe for one component may be more severe for another component

• Asymmetrical Loads
  – Left hands turns more damaging than right hand turns for some components due to rotational forces

• Lack of access to lifing substantiation
Traditional Helicopter Usage Monitoring

• Many fatigue drivers are difficult to record / measure

• Manually record a limited number of fatigue drivers
  – Even simple fatigue drivers are difficult to record accurately

• Critical Structure consists of rotating components
  – Loads are often difficult to measure

• Compare to DUS which may be poorly described

• Improving UM through Flight Manoeuvre Recognition
Flight Manoeuvre Recognition

- Analysis of Usage data to determine actual flight manoeuvres
  - Data from Flight Data Recorder or HUMS
  - Algorithms match flight data to DUS manoeuvres
  - Tested against flight test data to validate

- FMR outcomes can input to effective fatigue management
  - Allows capture of a higher percentage of fatigue drivers than traditional UM
  - Test assumptions made in FM / CRTs
  - Requires flight manoeuvres to be linked to fatigue damage
Flight Manoeuvre Recognition
Extending CRTs and Risk Assessment

- Extending Black Hawk CRTs using AUUS2 Spectrum
  - Based on severe Australian Spectrum
  - Until recently only used AUUS2 to reduce lives
  - Enable greater flexibility for the SPO

- Black Hawk Risk Assessment
  - No access to the required data to determine if changes apply to our CRE
  - Establish level of risk based on available information
  - Determine appropriate approach to reduce the risk
  - Work closely with stakeholders to agree on appropriate action in light of PWD

![Defence Harmonised Risk Matrix](image-url)

Risk Management in the Defence Aviation Safety Program
AC 003/2018
Condition Data and Corrosion Sensors

- Insufficient for effective fatigue or environmental degradation management
- Non marinised helicopters being deployed on LHDs
- Environmental degradation management should be addressed before there is an issue
  - management and technology perspective
  - Improve condition monitoring and environmental degradation management
- Understanding and managing degradation prone areas on the aircraft
- Using corrosion sensors and modelling to predict rates of corrosion
Being a Smart Customer

• What is the service provider being contracted to provide?
• Understand your CRE
• Understand the fatigue management system being employed
• What outputs are you going to get and what do they mean?
• ASSUMPTIONS – Are they relevant?
Loads and Vibration Monitoring

- Measure critical structure loads on ADF aircraft
- Better understanding of the applicability of OEM Design Usage Spectra
- Input to Romeo SLAP / SLEP
- Understand loads and vibration on the airframe to:
  - reduce “nuisance” cracking
  - avoid just moving the cracking to a new area