

Rotorcraft Policy and Guidance for Health Usage Monitoring System (HUMS)



Federal Aviation
Administration



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Agenda

- HUMS FAA Guidance
- HUMS Certification Approach
- HUMS Research
 - HUMS Research Roadmap
 - HUMS Research Conclusion
 - Current HUMS Research Reports
- AC MG-15 Update

HUMS FAA Guidance

- Health Usage Monitoring System (HUMS) is not a required system
- FAA has no plans for mandating HUMS
- FAA has certification guidance for installations via STC, TC
 - AC 27-1B & 29-2C. Change 3, Section MG 15
 - AC was developed by Rotorcraft Health Usage Monitoring System Advisory Group (1999)
 - Committee Members
 - FAA Aircraft Certification
 - European Joint Aviation Authorities (JAA)
 - US and European Industry Groups (AIA & AECMA)



HUMS Certification Approach (1)

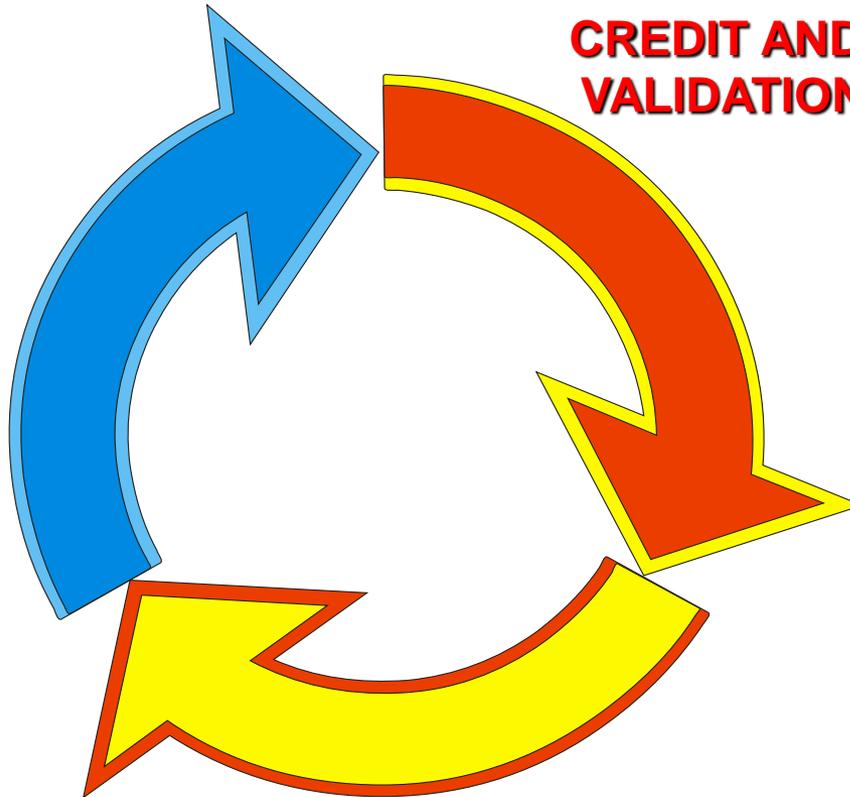


Onboard Systems

INSTALLATION



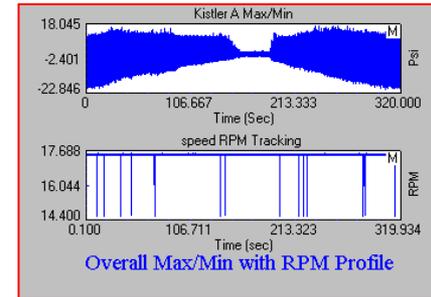
Sensors



CREDIT AND VALIDATION

Algorithms

INSTRUCTIONS FOR CONTINUED AIRWORTHINESS

An illustration of a desktop computer system including a monitor, tower unit, keyboard, and mouse.

Hardware/Software

- Maintenance
- Support Systems
- Interface

HUMS Certification Approach (2)

- MG -15 is comprised of three parts:
 - Installation
 - Qualification of Airborne System
 - Qualification of the Ground Equipment
 - Allows approval for installation before Credit Validation
 - Must retain traditional maintenance program (i.e. no “Credit” provided yet)
 - Credit Validation
 - Validates that HUMS Functions as Intended
 - HUMS “Credit” granted after validation
 - Instructions For Continued Airworthiness (ICA)
 - HUMS operating instructions, training and controlled introduction to service

HUMS Research (1)

- Roadmap developed in 2005
- Validate/Enhance HUMS Advisory Circular (AC)
- Assist in maturing HUMS technology



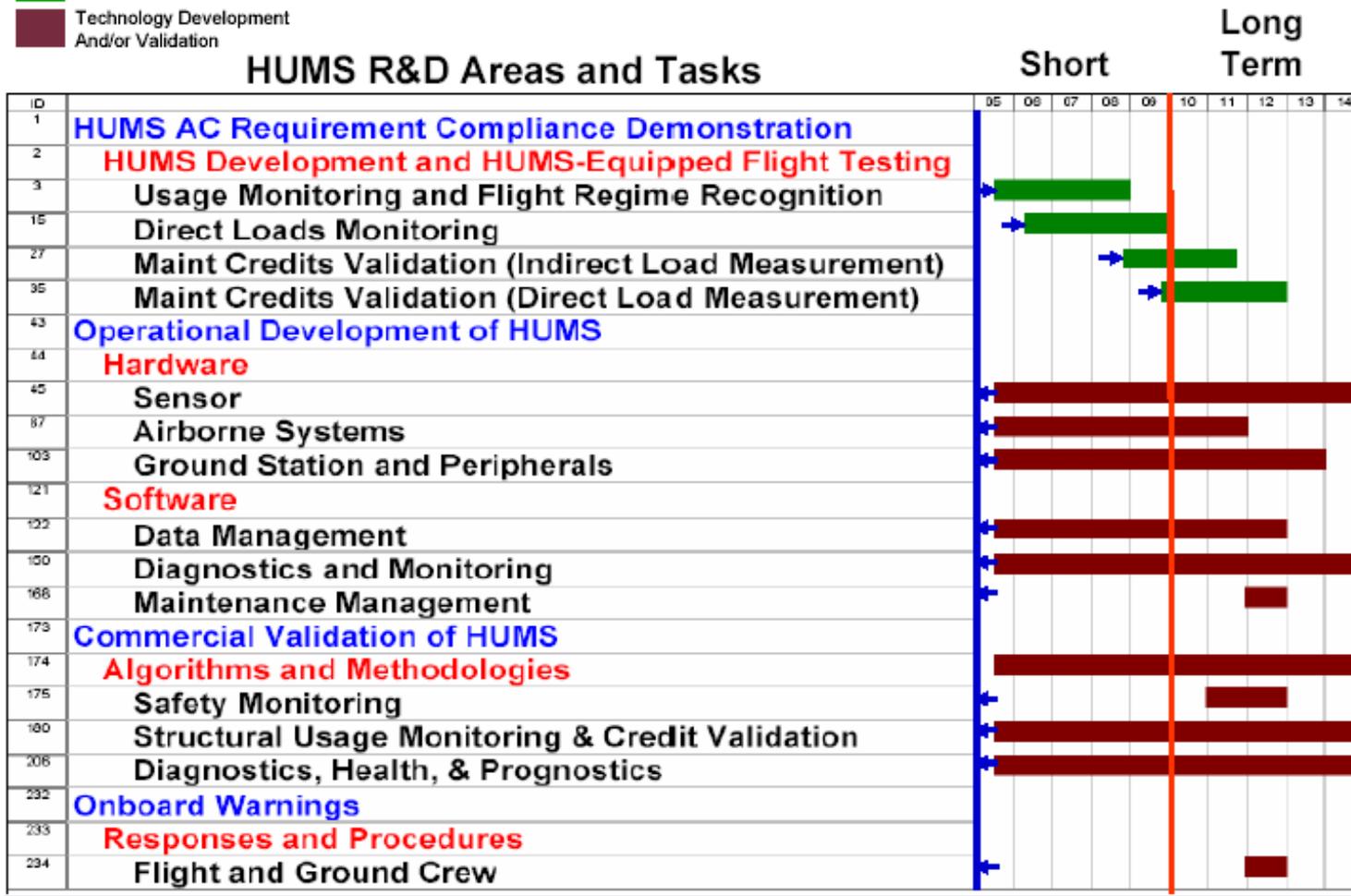
HUMS Research (2)

- AC Compliance Demonstration
 - Mock certification using AC MG15
 - Direct load measurement – direct evidence
 - Military usage vs Civil usage
 - Flight regime recognition – indirect evidence
 - Validate methodologies (Sikorsky vs Army)



HUMS R&D Roadmap

- Legends:**
- Technology Demonstration
 - Technology Development
And/or Validation



HUMS Research Wrap-Up

- 10 year research program (FY06-FY15) developed to validate MG-15
- Research conducted with US Army AEH, ARL and CERDEC, GE-Smiths, GoodRich, NASA Glenn, ERAU, Acellent, HAI, and Sikorsky
- Research ended in FY15 with a revision to the AC expected in FY 2016
- FAA attended AHS CBM & HUMS meeting in Huntsville February 2015 to wrap up research program
 - FAA/Researchers meeting held for recommendations to AC-MG15 update.



Current HUMS Research Reports

– Current HUMS Reports to be published:

- Development and Validation of Structural Usage and Loads Monitoring Methods for Use in Determining Rotorcraft Usage Credits (Sikorsky)
- Application of Rotorcraft Structural Usage and Loads Monitoring Methods for Determining Usage Credits (Sikorsky)
- Accuracy Assessment of HUMS Regime Recognition Algorithms (HAI)
- Results of Health and Usage Monitoring System Fleet Data Analysis for Usage Credits (AED)
- Summary of US Army Seeded Fault Tests for Helicopter Bearings (AED)
- Rotorcraft Maneuver-To-Maneuver Damage with Structural Usage Monitoring System (SUMS) Data (AED)
- Rotorcraft Spectrum Reliability Comparisons by Endurance Limit Adjustments (AED)

AC MG-15 Update (1)

– Team Scope

- Review HUMS research reports for applicability to the AC 29-2 AC MG-15.
 - Provide updates based on research, certification experience, and EASA's recently issued AMC 29.1465

– Team Members

- | | |
|--------------------------------|------------------------|
| – Matt Fuller | – Sponsor for Research |
| – Robert Grant | – Structures |
| – Liz Brandli | – Software |
| – Mark Wiley | – Electrical |
| – Andy Shaw | – Avionics |
| – Matt Wilbanks | – Mechanical Systems |
| – Rao Edpunganti / Eric Haight | – Power-plant Systems |

AC MG-15 Update (2)

- The structure of the draft updates to the AC has essentially remained the same ... including these major topical areas:
 - Installation
 - Ground-Based System Certification Guidance
 - Credit Validation
 - Instructions for Continued Airworthiness

AC MG-15 Update (3)

- AC proposed changes will include:
 - Incorporation by reference EASA AMC 29.1465 for VHM systems classified as “Minor”
 - Installation
 - Clarification on Catastrophic Systems and Mitigating Actions
 - Systems Safety FHA and DAL Assignments
 - Examples of Systems with Different DAL’s
 - Clarification on “Credit” definitions and “Usage”
 - 27/29.1309 guidance for software and airborne electronic hardware

AC MG-15 Update (3)

- Ground-based system proposed updates:
 - Removed Independent Verification and DO-178 requirements
 - Added requirements for Data Management (Data Quality, Data Integrity, Data Processing, and Data Security)
 - Added guidance for Ground-based tools and qualification based on Criticality and output dependence using RTCA DO-330



AC MG-15 Update (4)

- Credit Validation proposed AC updates:
 - Usage Credit
 - » Approach used in HUMS for Usage Credit is to replace the CWC usage with the actual usage and recalculate the Remaining Useful Life (RUL)
 - » Regime Recognition Accuracy Issues
 - » Reliability impact of using actual usage
 - Added Usage Credit Methodologies
 - » CWC spectrum refinement (part number approach)
 - » Individual component damage assessment (Serial Number approach)
 - Regime Recognition Algorithms
 - » Validation requirements
 - » Accuracy requirements
 - Validation of Structural Usage Monitoring Systems (SUMS)

Note: The AC does not contain guidance for Regime Recognition Accuracy requirements.

Note: The AC does not address reliability impacts associated to using usage monitoring systems in deriving information such as fatigue life RUL calculation.

AC MG-15 Schedule

- Initial Draft AC under FAA Management Review
- FAA Internal Review June 2016
- Public Comment Nov 2016

