

FAA

Development of Health and Usage Monitoring Systems Research and Development Plan

Smiths Aerospace (SA) Project Kick-off Meeting

FAA William J. Hughes Technical Center
Building 210, 2nd Floor Meeting Room
Sept 8, 2004

AGENDA

- | | | |
|--|---|---------------------|
| 08:30 am: Introductions | - | All |
| 08:35 am: FAA HUMS R&D Overview and Project Expectations | - | Dy Le, FAA |
| 09:35 am: HUMS R&D Plan Development Project | - | Amanda Vandepol, SA |
| 10:35 am: Break | | |
| 10:50 am: Technical Discussions | - | All |
| 12:00 pm Lunch | | |
| 01:00 pm Discussion of Remaining Issues (if needed) | - | FAA/SA |
| 02:00 pm Adjourn | | |



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AIR TRAFFIC ORGANIZATION

<http://airportaircraftsafetyrd.tc.faa.gov/>

Development of Health and Usage Monitoring Systems (HUMS) Research and Development Plan

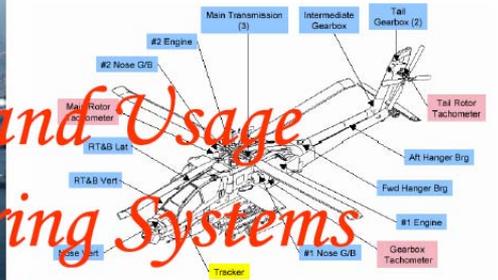
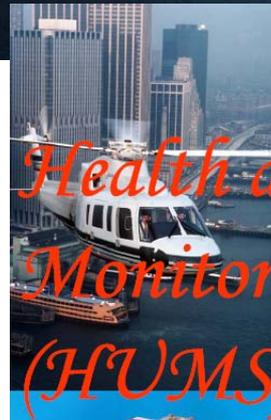
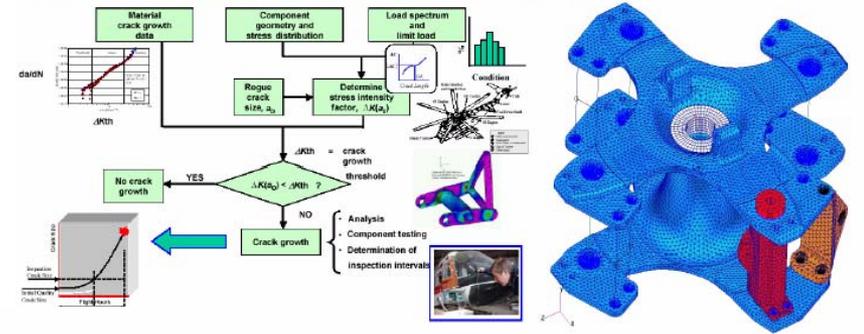
FAA Perspectives

Dy Le

September 8, 2004

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Rotorcraft Structural Integrity and Safety



Aging Aircraft Research Sponsorship

Aging Aircraft Research

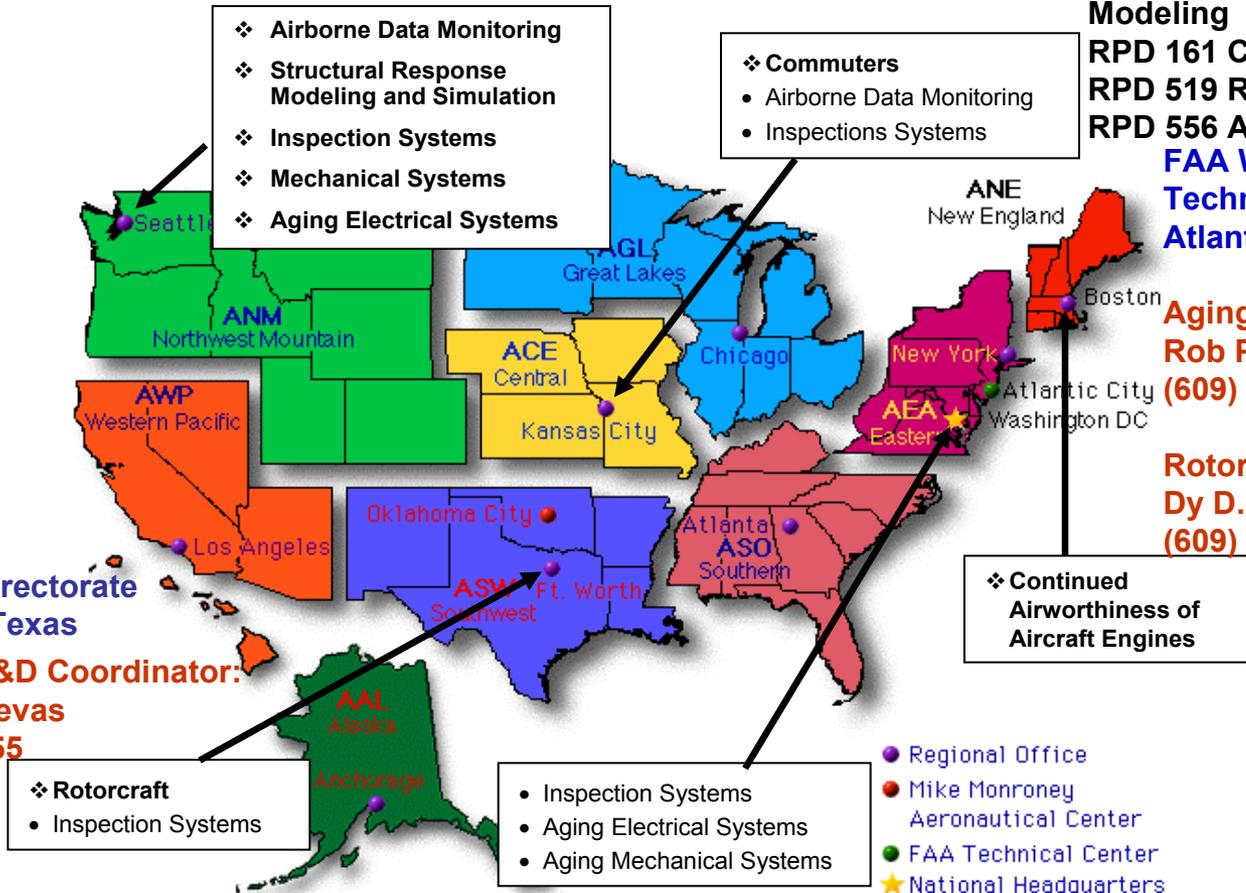
RPD 584 Inspection Systems
 RPD 672 Mechanical Systems
 RPD 673 Electrical Systems
 RPD 510 Aircraft Data Monitoring
 RPD 515 Structural Response Modeling

RPD 161 Commuter Aircraft
 RPD 519 Rotorcraft
 RPD 556 Airworthiness of Engines

**FAA William J. Hughes
 Technical Center
 Atlantic City, NJ**

**Aging Aircraft Research
 Rob Pappas, Program Manager
 (609) 485-6181**

**Rotorcraft Research
 Dy D. Le, Program Manager
 (609) 485-4636**



**Rotorcraft Directorate
 Fort Worth, Texas**

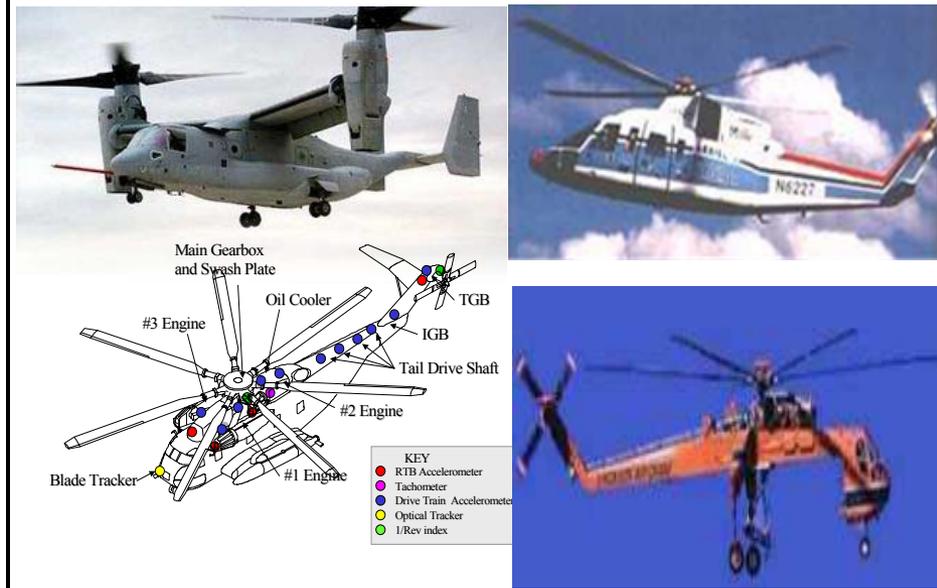
**Rotorcraft R&D Coordinator:
 Edwin G. Cuevas
 (817) 222-5355**

❖ *primary sponsorship for projects,*
 ● *secondary support.*

FAA HUMS R&D Requirements

Program Objectives:

- Provide ACO with data and technical information for HUMS Installations and Maintenance Credits.
- Merge HUMS and fatigue including DT technologies to maximize safety benefits.



Technical Approaches:

- Collaborate with rotorcraft community (e.g., NRTC, RCOE, DoD, NASA, RITA, academia, manufacturers) to conduct a wide range of HUMS R&D.
- Collaborate with DoD and helicopter operators to collect usage data.
- Fully validate and transfer HUMS technologies to rotorcraft industry and users for certification and compliance.

Support:

- AC's 29.2A & 27.1A, HUMS, 20.95,
- FAA Order 8110.9
- Damage Tolerance Rulemaking, FAR's 29.571 & 27.571,

Major FAA HUMS R&D Areas

- HUMS R&D will include efforts covering all aspects of HUMS development and certification.
 - Rotorcraft Operational Development of HUMS
 - Commercial HUMS Validation
 - HUMS On-Board Warning
 - Flight Testing With HUMS-Installed Helicopters

- Additionally, combined DT and HUMS technologies to address safety will also be considered.

Operational Development of HUMS

Technical Objectives:

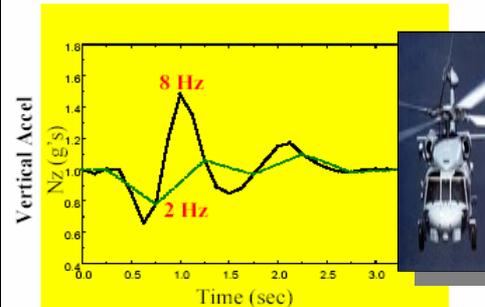
- Determination of HUMS system requirements for various applications and mission mix.

Technical Approaches:

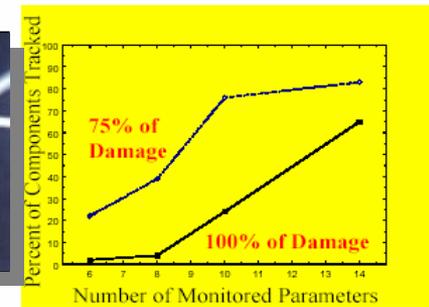
- Conduct assessment and identification of key design parameters and sampling rates required for monitoring systems.
- Conduct the Functional/Usage Hazard Assessment of a HUMS.
- Evaluate various types and levels of severity of system degradation to determine the impact on overall structural monitoring capability.
- Validate FCR algorithms and health monitoring techniques for impending problem recognition.

Data Rate and Parameter Assessments

Data Rate Assessments
Effect of Inadequate Data Rate



Monitored Parameter
Damage Assessments



Outputs:

- Technical information required to support HUMS certification requirements and processes.
- Complete system operational requirements including ground based COTS, on board monitors, and recording systems to be included in AC.

Commercial HUMS Validation

Technical Objectives:

- Evaluation of HUMS during the design, fabrication, installation, and flight tests to assure that the means of compliance practices are adequate and just for the systems intended.



Technical Approaches:

- A commercially developed HUMS system will be installed and evaluated using the HUMS AC.
- Using WJHTC's S-76 flying test bed and/or other aircraft, usage credit and maintenance action issues will also be addressed.
- Flight-tests are to be conducted using scripted flights for validation of flight condition algorithms and measure loads.

Outputs:

- Technical information and processes required for the design, fabrication, installation of HUMS.
- Outputs will also include assessments of rotorcraft fatigue spectrums and mission profiles that will be used in damage tolerance and fatigue spectrum definition.

HUMS On-Board Warning

Technical Objectives:

- Assessment of on-board warning/display devices.
- Assessment of pilot interface with operational aspects of the system.



Technical Approaches:

- Evaluate HUMS display devices and the types of information to be displayed or audible.
- Assess HUMS information display or warning reliability and functionality.
- Study human factor interface.

Outputs:

- Guidelines for pilots or ground-based personnel required to respond to on-board warning and display devices.

HUMS Flight Tests

Technical Objectives:

- Validation and assessment of various aspects of HUMS via flight testing using commercially-developed HUMS and accessory prototypes.



Technical Approaches:

- Conduct assessment and identification of key design parameters and sampling rates for monitoring systems.
- Conduct the Functional/Usage Hazard Assessment of a HUMS.
- Install HUMS prototype systems on several different types of rotorcraft to validate flight condition recognition algorithms and health monitoring techniques.
- Evaluate various types and levels of severity of system degradation to determine the impact on overall structural monitoring capability.

Outputs:

- Technical information including data and processes for:
 - Ground-based COTS, on board monitors, and recording systems.
 - FCR algorithms and monitoring techniques
 - Design, fabrication, installation of HUMS
 - Guidelines for pilots or ground-based personnel required to respond to on-board warning and display devices.
 - Typical rotorcraft fatigue spectrums and mission profiles that will be used in damage tolerance and fatigue spectrum definition.

Development of HUMS R&D Plan

Overview

- In collaboration with HUMS community, the FAA is supporting the development of HUMS R&D plan.
- ID essential HUMS R&D to provide technical information including data for HUMS installations and maintenance credits.
- Define critical HUMS issues and quantify gaps.
- Develop milestones that prioritize tasks.
- Develop HUMS output requirements & formats.
- ID resources and develop costs required to complete R&D.
- Develop HUMS R&D exit criteria.

- HUMS Roadmap R&D plan needed in 1st Quarter of FY05.

Smiths Aerospace HUMS Contract

- Contract Award - July 29, 2004
- Firm Fixed Cost - \$50K
- Period of Performance – July 29 – Oct 29, 2004
- FAA COTR – Dy Le – (609) 485-4636
- Smiths PI – Amanda VandePol – (616) 241-7560

State of HUMS Technologies

- Review issues that arise with the certification of HUMS described in the AC, and to assess the current operational HUMS systems developed or being used, specifically
 - certification procedures included in AC-29-2C, Section MG-15,
 - commercial-of-the-shelf (COTS) issues,
 - capabilities of HUMS used to support rotorcraft damage tolerance approaches for continued airworthiness issues,
 - advanced and demonstrated sensor technologies,
 - past and current research and demonstration on the use of HUMS to provide on-board warning to flight crew, and
 - past and current flight testing efforts with HUMS-installed helicopters.

Identification of Growth in HUMS

- Using OEM's HUMS extensive knowledge, identify growth in HUMS requirements to satisfy current needs for existing and new rotorcraft.
- hardware, software, and performance and applications

Identification of Current HUMS R&D

- Assess and identify HUMS R&D activities being conducted by the rotorcraft industry, HUMS developers (OEM), academia, and government.
- OEM's HUMS R&D activities involved with RITA, United Kingdom Civil Aviation Authority (CAA) Helicopter Health Monitoring Advisory Group (HHMAG), and the Society of Automotive Engineers (SAE) E32 committee.

Gap Analysis and R&D Requirements

- ➔ Based on OEM's extensive HUMS experience with various developed systems, identify gaps between current capabilities and capabilities required for HUMS.
- ➔ Base on gap analysis results, develop R&D requirements addressing the identified gaps.
- ➔ For each gap, identify a strategy and research and development requirements to eliminate the gaps.
- ➔ Produce an outline of future research projects addressing project goals and requirements, costs, and research duration.

Exit Criteria and Performance Metrics

- Based on results of previous tasks, develop performance metrics and exit criteria for each HUMS R&D identified and projected.

HUMS Research and Development Plan

- Develop HUMS Research and Development Plan including
 - a road map that summarizes a systematic approach to address the gaps identified in task 4, including the exit criteria and performance metrics identified in task 5.

Key Milestones & Deliverables

Outputs/Tasks	Aug 04	Sept 04	Oct 04
<i>HUMS R&D Plan Contract Award</i>			
<i>Kick-off Meeting</i>			
<i>Project Review Meeting</i>			
<i>SA Monthly Reports</i>			 
<i>SA Draft Final Technical Report</i>			
<i>FAA Revised Draft Final Technical Report</i>			
<i>SA HUMS R&D Plan Final Technical Report</i>			

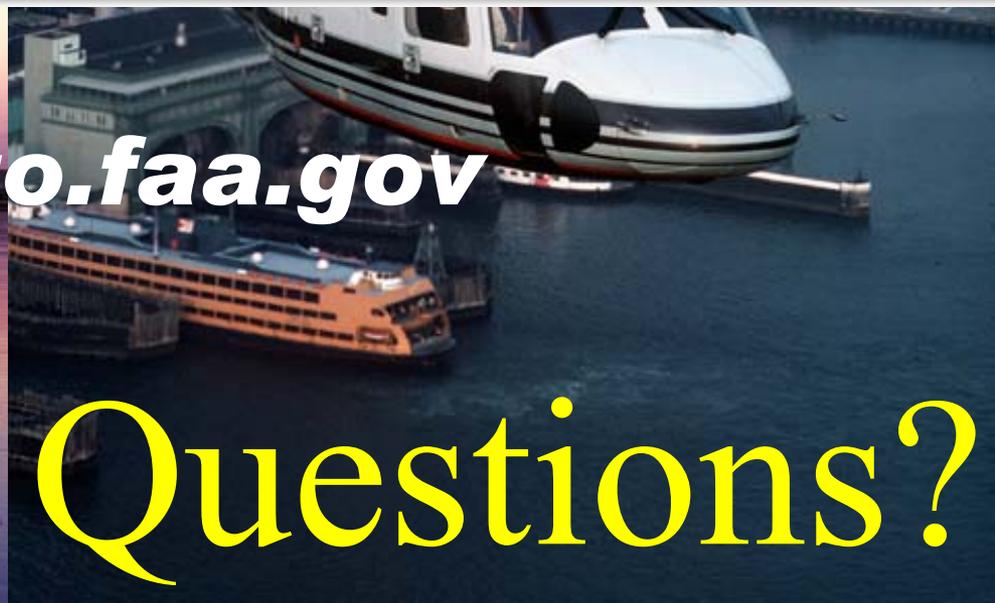
Email: Dy.Le@faa.gov

Phone: (609) 485-4636

Fax: (609) 485-4004



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Questions?