Subcommittee for Aviation Safety Report

FAA Research, Engineering & Development Advisory Committee

October 9, 2014

Fall Meeting

- **Sept 10-12, 2014**
- **Atlantic City, NJ**
  - FAA Technical Center
- **Full Subcommittee (minus 1)**
  - First meeting for new chairman
- **Special Tasking:**
  - FY 2017 Guidance Review
  - Emerging and Future Safety Themes

Subcommittee Membership

- **Ken Hylander, Chairman**
- **Dr. Eric Neiderman, DFO**
- **Mark Orr, AVS**
- **Chris Benich, Honeywell**
- **Dr. John Crowley, US Army Aeromedical**
- **Joe Del Balzo, JDA (past subcommittee chair)**
- **Walter Desrosier, GAMA**
- **Christopher Kmetz, Pratt & Whitney**
- **Andrew Lacher, MITRE**
- **Capt. James Mangie, Delta Air Lines**
- **Douglas Rohn, NASA**
- **Todd Sigler, Boeing**
- **John White, ALPA**

REDAC Strategic Task

- **Ensure a balanced, strategic, and well-integrated R&D portfolio**
- **Plan research to meet Administrator's Strategic Initiatives**
- **Task to Subcommittees:**
  - FY 2017 Guidance Review
  - Look ahead 10+ years and develop a list of:
    - Emerging issues (where FAA should get ahead)
    - Future opportunities (where R&D could benefit FAA)

Process

- **Subcommittee homework in advance of the meeting**
- **Subcommittee member presentations to share their industry segment insights**
- **FAA Chief Scientist and Technical Advisor insights**
- **FAA leader presentations on research needs identification and guidance process and ongoing continuous improvement**
- **18 presentations**
- **Much subcommittee deliberation and debate**
- **Summary Report submitted September 24, 2014**

Meeting Summary

- **FY 2017 Guidance**
  - **No Findings or Recommendations**

- **Emerging Issues**
  - **Real Time System-Wide Safety Assurance**
  - **Dependability of Increasingly Complex Systems**
  - **Certification of Advanced Materials and Structural technologies**
  - **High Density Energy Storage, Management and Use**

- **Future Issues for consideration**
  - **Commercial Space Integration with the National Space System**
  - **General Aviation's Role in Safety Systems Development**
  - **Effects of Breakthrough Medical Technologies on FAA Medical Certification Standards**
  - **Identification and Funding of Strategic Research and Development**

Real-Time System-Wide Safety Assurance

- ***Why?***
  - Ongoing advances in sensor and network technology, computation, communications and integration
  - Ongoing advances in data analysis capability
  - Ongoing developments in accelerated data access
  - Ongoing data protection issues
  - Advances in system-on-system modeling and prognostics including integrated human performance monitoring

- ***Research Needs***

  Continued development of real time, continuous, safety analysis and assurance tools including;
    - Data mining and analysis
    - Automated prognostics
    - Safety risk modeling

  Integration of advanced tools into more highly automated safety assurance systems
    - Development of psychological and physiological measures from the human operator that inform the automation
    - Stronger understanding of how human operators and autonomous systems collaborate to improve safety
    - Autonomic properties of self-protection and self-healing

Dependability of Increasingly Complex Systems

- **Software, Automation, and Autonomy**
  - ***Why?***
    - Advances in processing, sensors, networking ongoing
    - Increasingly interconnected and more autonomous systems
    - Continued augmentation of human decision makers with sophisticated systems
    - Require advances in resiliency to design defect, missing or corrupt data and deliberate attack
  - ***Research Needs***
    - Revisions to certification processes and analytical techniques for verification, validation, test and evaluation (Analytical MoC's)
    - Ensure that automation on the flight deck and ground systems are designed and implemented in a way to complement the human operator

Dependability of Increasingly Complex Systems (Continued)

- **Data Integrity**
  - **Why?**
    - Exponential growth in volume and distribution of operational data
    - Increased advocacy for uses of data such as expanded aircraft to ground communications
    - Expanded uses of aircraft and engine health monitoring
    - Mix of certified and uncertified (Commercial off the shelf) systems
  - ***Research Needs***
    - Ensuring the integrity of diverse data from unintentional errors, accidental corruption and deliberate spoofing
    - Regulation and Means of Compliance for the use of Commercial off the Shelf software

Dependability of Increasingly Complex Systems (continued)

- **Updated Federal Aviation Regulations (FARs) and Means of Compliance**
  - ***Why?***
    - Pace of innovation
    - Existing FARs developed long ago and need reconsideration in light of modern design, development and testing techniques
    - Some prescriptive Means of Compliance may not be producing the desired results
    - Subsystem testing can not always be reliably repeated in full up testing or in flight
    - Blurred lines between aircraft and engine system responsibility
  - ***Research Needs***
    - Ensure a proactive framework for timely and flexible certification requirements and Means of Compliance to handle near term engine and aircraft architectural advancements
    - Review current and near-term validation technologies and approved methods to ensure use of all adequate techniques and technologies as acceptable Means of Compliance

Certification of Advanced Materials and Structural Technologies

- ***Why?***
  - New material systems and structural concepts continue to be introduced
    - Integrated engine and airframe designs
  - New manufacturing techniques continue to evolve which drive issues of standardization, process variation and uncertainties in failure modes which need to be understood
    - Additive manufacturing
  - Some traditional inspection processes fall short of reliably being able to catch flaws driving additional work to ensure safety margins

- ***Research Needs***
  - Technical methods to stay abreast of changes
  - Continued evolution towards more performance-based standards
  - Application of computational material methods (ICME) to streamline the certification process in lieu of physical testing and inspection

High-Energy Density Storage, Management, and Use

- ***Why?***
  - Continued evolution away from traditional electrical systems to improve performance and decrease operating costs
  - Steady increase in electrical components
  - More integrated systems and avionics

- ***Research Needs***
  - Understand and assess the applicability of various high-energy generation and storage technologies in aviation products and operations
  - Emphasize developing safe power technology
  - Provide data for appropriate:
    - Standards and safeguards
    - Implementation, certification and maintenance

Commercial Space Integration into the NAS

- ***Why?***
  - Worldwide expansion
  - Growing US industry of both human and cargo space flights
  - Current mechanisms for NAS safety focus on setting up restricted airspace for launch and recovery
  - Current focus on Space Vehicle Occupant safety vs public safety

- ***Research Needs***
  - Establish necessary guidelines for operational procedures, policies and regulations to protect both vehicle occupants, the public and other aviation operations
  - Increased medical certification standards for passengers and crew of space vehicles
  - Cabin safety and emergency procedures/egress/survival

General Aviation's Role in Safety Systems Development

- ***Why?***
  - Significant community size
  - Pipeline for qualified pilots and mechanics
  - Unique incubator for introduction of new safety technologies in a timely manner
  - Build on continued emphasis on GA Joint Steering Committee recommendations and preventing loss of control
    - Situation awareness
    - Aircraft operational protection
    - Automation and autonomy that makes it easier to fly in the NAS

- ***Research Needs***
  - Coordinate with other FAA R&D initiatives and identify safety applications for GA aircraft using safety risk continuum principles to ensure:
    - Appropriate level of rigor
    - Applicability to retrofit and new aircraft applications
    - Rapid installation

Effects of Breakthrough Medical Technologies on FAA Medical Certification Standards

- ***Why?***
  - Medical science advancing at an unprecedented rate
  - Ongoing approvals of novel drug therapies and revolutionary surgeries
  - Historic medical conditions may not now need to end flying careers
  - Some new medical treatments may pose yet unknown risks to safe flight

- ***Research Needs***
  - Support aerospace medicine program to examine effects of emerging medical technologies including:
    - Surveillance of medical research
    - Re-examination of existing medical standards
    - Understanding the effects of new medical developments on performance, safety and certification

Identification and Segregation of Strategic R&D Needs

- ***Why?***
  - In the view of the subcommittee, the current research prioritization environment is prone to be:
    - Dominated by known, near-term needs
    - Reactive to unforeseen forces: pop-ups and budget
    - Lacking a consistent, cross-cutting, multi-disciplinary approach to address the remaining known and emerging new safety risks
    - Limiting on true long-term R&D focus and funding

- ***Research Needs***
  - FAA conduct research to support the development of a consistent, sustainable, process that is:
    - Rooted in an enterprise view of FAA mandate to promote safety
    - Inclusive of a funding approach that protects the long term R&D needs

Conclusions

- **The Subcommittee for Aircraft Safety appreciates the FAA's efforts to keep Research, Engineering & Development focused on the emerging and future needs**
- **The subcommittee also appreciates the opportunity to contribute to the process**
- **We stand ready to assist in the future**

- **Questions?**