

Federal Aviation Administration
REDAC Subcommittee on Aircraft Safety (SAS)
William J. Hughes Technical Center

September 10 - 12, 2014

Director's Conference Room

(Dial-In Access and Video Teleconference capabilities were also available.)

Wednesday, September 10, 2014

8:30 – 8:50	Welcome/Opening comments <ul style="list-style-type: none">• Introductions• Opening remarks/comments (DFO and Chair)	Eric Neiderman (SAS DFO) Kenneth Hylander (Chair)
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Eric Neiderman, Designated Federal Official (DFO), opened the meeting with a “Welcome” to all attendees (both those present and connected through other communication means). Eric proceeded with introductions beginning with Kenneth Hylander, introduced as the new SAS Chair; as well as members and participants. Introductions were made all around including call-ins.

Kenneth Hylander (SAS Chair) thanked Eric for the introduction. Ken provided his biographical background: In brief:

- Current: SVP Corporate Safety, Security and Compliance at Delta Air Lines (Retired)
- Member Board of Directors
Monroe Energy · 2012 - Present
- Chairman - Elect
Flight Safety Foundation · 2012 - Present
- University of Rhode Island
Member of the College of Engineering Advisory Council · 2009 - Present

Ken expressed that he was looking forward to working with everyone, the new challenges, and in particular the focus of this particular meeting. He also noted appreciation of the SAS representation to the REDAC.

Eric Neiderman then reviewed the meeting Agenda and called attention to a new approach and focus on a strategic outlook, adding that the REDAC would benefit immensely from the Subcommittee's experience and perspective, represented by the participants and their candid input. He asked that as members viewed the upcoming presentations, that they focus in particular on the safety implications. Eric also emphasized the:

“Four R's”: Rigor, Responsiveness, Relationships, Resources.

8:50 – 9:05	Welcome	Dennis Filler (REDAC DFO & WJHTC Director)
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Dennis Filler stepped in to extend a warm welcome the group and expressed his appreciation for members traveling to the Technical Center. He stressed that whatever resources were needed to support the SAS team, they would be at the groups' disposal. Dennis briefly reiterated the new tasking from REDAC for all subcommittees Fall meetings: 1) to look at a broader, long-term perspective (10+ years), and 2) provide the FAA advice to support the development of an R&D portfolio that is at once strategic, responsive and addresses future R&D needs.

He stated that while he obviously doesn't know the outcome of the group, through its' critical mass the ideas generated should fuse and energize; using the metaphor of a "miracle idea" the group should herd ideas, and synthesize and develop new and innovative processes. He thanked the SAS for accepting the challenge and was looking forward to the outcome.

9:05 – 9:30	<ul style="list-style-type: none"> • REDAC Tasking – Strategic R&D Plan for the FAA • REDAC and the Subcommittee: Roles and Responsibilities • REDAC and the Subcommittee: Writing Good Recommendations 	Cathy Bigelow
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Cathy Bigelow (FAA) presented *Developing Strategic R&D Plan for the FAA, REDAC and the Subcommittee: Roles and Responsibilities*, and *REDAC and the Subcommittee: Writing Good Recommendations*.

The first presentation covered the rationale for tasking the REDAC to take a broader, longer-term perspective (10+ years) and provide advice to support development of R&D portfolio that is strategic and responsive to future R&D needs. The REDAC will develop two lists:

- Emerging Issues – things that the FAA should get ahead of, and
- Future Opportunities – areas where the FAA could benefit

These lists should be refined to the top 4 or 5 issues and the subcommittees should explain why it is important for FAA to consider each issue. The outcome of this effort is to be a written report that the subcommittees will brief at the fall REDAC meeting. This report will be in lieu of 'normal' reports.

The second presentation addressed the Congressional legislation that authorizes and directs REDAC actions and responsibilities; and described how the REDAC integrates with the development of the annual FAA R&D portfolio.

The third presentation provided a primer on preparing REDAC findings and recommendations that are clear and actionable.

9:30 – 10:15	UAS R&D Portfolio and Strategic Outlook	Chris Swider Sabrina Saunders-Hodge
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NOTE: This briefing was follow-on to the Spring 2014 presentation given by Sabrina Saunders-Hodge and Chris Swider. It also addressed an open Finding and Recommendation (SAS Spring_2014-2) . The presentation was executed through a call-in and the slides presented through WebEx. During the briefing, technical difficulties were encountered with the digital transmissions.

Sabrina Saunders-Hodge (FAA) presented *FY 2015 Year End Aircraft Safety PPT Portfolio Review - Unmanned Aircraft Systems (UAS) BLI A11.I*.

Sabrina addressed the overall program purpose and capabilities, and pointed out the relationship between the UAS R&D and the UAS Integration Office (AFS-80). It was noted that the establishment of an FAA Center of Excellence for Unmanned Aircraft Systems (COE UAS) is currently underway with a Solicitation seeking proposals that closes on September 22, 2014 with a selection and start date in Fiscal Year 15.

Quad charts contained in the briefing were not presented due to technical difficulties.

Chris Swider (FAA) next presented *Unmanned Aircraft Systems SAS Spring 2014 Recommendation 2: UAS R&D Strategy*.

Chris stated that the SAS was briefed at the Spring 2014 SAS meeting on efforts to document UAS research linkages and research needs. The current briefing addressed the open recommendation “Provide an update on FAA efforts to implement our R&D strategy”, and expanded on related aspects and collaboration efforts.

The R&D Integration group considered many sources for UAS requirements and the supporting research. Because of the reaction during the Spring meeting to the UAS Roadmap, Chris stated that a new Appendix in the Roadmap will be released in November. Adjustments have been made in planning and execution to address the changes in scope and priority of ConOps requirements. The UAS Research Inventory & Mapping Database (RIM) is the FAA-maintained repository of UAS research. There are now 72 research areas and 39 data elements. Ultimately the goal is to have a user-friendly interface and public accessibility posted on the FAA website.

Kenneth Hylander (SAS Chair) stated that “What we’ve heard is an outline of the process; what we are looking for was the next level down.” Chris noted that due to current communication difficulties he was not able to get to the Quad Charts. Ken asked what was the difference between the research contained in the Quads and that revealed in UAS Research Inventory & Mapping Database (RIM)?

Chris replied that RIM is a “super set” relying on research funded by other entities that includes both federal and otherwise. He stated that the FAA is identifying the gap and are reliant on a significant amount of non-FAA research such as that conducted by NASA. The Quad Charts (contained in Sabrina Saunders-Hodge PowerPoint supplied to the SAS) reflects FAA research, not that of the RIM.

Questions were posed about how the funding matches up to the overall plan and if the research supports the plan?

SAS membership discussed the need to continue exploring the next level down. The subcommittee requests FAA provide further details on the UAS R&D plan reflecting deliverable validation milestones against the published FAA Integrated UAS roadmap. **Finding & Recommendation SAS Spring_2014-2 remains open.**

Andrew Lacher and Todd Sigler volunteered to synthesize the concern about ‘are we getting the big picture’.

10:30 – 11:15	The Twin Imperatives: New Technology and Environmental Challenges	Christopher Kmetz/ Alan Epstein (Pratt & Whitney)
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Alan Epstein (SAS) presented *The Twin Imperatives: New Technology and Environmental Challenges*. He stated that this presentation was focused on commercial aviation only.

Alan stated that the future airplane is unclear, but the future motor is not. The evolution of jet engine has been to enhance efficiency; we are now 70 years into jet age. Motor efficiency rose from 30 to 55% through the years 1960 to 2010. The evolution of Engine Bypass Ratio and Efficiency BPR 2013-16 is 16%; in the longer term 20-30%. Now we're confronted with maximum power versus stored energy on-board.

Today FAA research is in a clear position to work with inventors. The emerging opportunities are 21st Century CFRs and the means of compliance; emphasis on software – both onboard and off; aircraft communications; an air traffic control flight path that is flexible for quieter aircraft; certification of design systems for compliance by design; and integrated designs (Part 33 or Part 25, or both?)

Alan cited “False Hopes” or things not to work on: electric propulsion; cryogenic fuels; and fuel cells that don't have efficiency of gas turbines.

Alan addressed 21st Century FARs and Compliance: means of compliance (MoCs) are often dated; parts life are limited by design and the industry needs better life and stress prediction; and a change from to performance-based results vs. today's prescriptive requirements.

He addressed Certified Design Organization as a goal (addresses increasing work load, less FAA workforce and other issues) and engine certification by analysis as a long term objective that considers design substantiation by analysis and certification for derivative engines.

Software Certification: is growing exponentially; engine code as well - replacing hydro-mechanical processes. New methods needed for software certification. Traditional approaches will not verify highly complex systems adequately. Software certification now drives time and cost.

In summary, R&D needed to improve safety. Although aircraft are now the greenest form of transportation, we need to make them greener and safer. The United States must lead in aircraft and engine innovation; forward looking regulation and oversight should be a goal. Invest in regulatory R&D to facilitate innovation.

11:15 – 12:00	Working Title: UAS/Automation	Andrew Lacher (MITRE)
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Andrew Lacher (SAS) presented *MITRE, Unmanned Aircraft, and Autonomy*.

Andy noted that unmanned aircraft are currently undergoing large transformations and experiencing a clash of cultures; specifically, the aviation culture of safety and the information technology (IT) culture of innovation. Key UAS integration challenges include a lack of “See and Avoid” capability, system reliability, the vulnerabilities of Command and Control Links, air traffic management integration, and crew qualifications and training.

Andy spoke to the Next Big Technology Challenges:

- Beyond visual range of small UAS
- Air Traffic Management Integration
- Surface ops
- Incorporation of non-traditional SW components
- Aviation vs. IT innovation cultures
- Single Pilot Operations, and
- Autonomous Flight

Andy referenced a report released by the National Research Council of National Academies in June 2014 titled “Autonomy Research for Civil Aviation – Toward a New Era of Flight” in which they coined the term of “increasingly autonomous” (or IA systems). IA in civil aviation encounters the issue of Trust vs Trustworthy. There are natural concerns of competency of the system and the trust we have in the system.

12:30 – 1:15 PM	Looking Ahead at Aircraft Safety	John White (ALPA)
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John White (SAS) presented Looking Ahead at Aircraft Safety. John White noted that this was NOT an official ALPA briefing.

John identified four emerging technology issues:

1. Human centered automation
2. New Materials/Structures resiliency
3. Hazardous cargo and devices
4. Personal Electronic Devices

John discussed related strategic challenges:

- Global Competitiveness vs Safety:
- Maintaining Skilled Workforce vs Outsourcing
- UAS Integration in NAS
- Public Demands and Expectations

Lastly John focused on Strategic Opportunities. He stressed the need for revitalization of General Aviation. GA is a pipeline for a skilled workforce. There is also the opportunity to expand alternative fuels and energy sources to make them renewable, affordable and environmentally friendly.

1:15 – 2:30 PM	Working Title: OEM Perspectives	Todd Sigler (Boeing)
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Todd Sigler expressed his appreciation of Dennis Fillers’ opening remarks on the inclusiveness of industry.

Todd has talked with other Boeing reps on other REDAC Subcommittees with the intent of developing synergies on issues that are beyond the scope of this particular committee.

Inputs broken into lines-of-business or categories:

- Stored electrical energy: look at the opportunities over the next 10 year mark, articulate that attention should be on how do we make it safe at its very core.
- Variable geometry on engine surfaces: changing engine nozzle, engine technology, new configurations and new materials
- Alternative materials and chemicals: Halon, CO2, fuels. Look toward consumer-based products. Identify the right activities to supplement regulatory controls.
- Certification by analysis...deployment and the growing costs of getting to the market
- Environmental issues are two-fold. 1) Green - technology maturation; this is a good demonstration of partnerships for low-emission fuels...but it might not be sustainable due to life cycle of fuel source...bio-based vs fossil based; and 2) the Physical environment: more operations in the same space and better technologies...NextGen will promote a technology increase.
- Integration of UAS and products that fly faster than they do today such as hypersonic flight
- Weather enhancements (for example, looking at 2,000 miles from point of departure)
- Physical space of airports both current and future opportunities. Pavement research, capacity restrictions on aprons and taxiways. Lateral and horizontal integration of technologies: recent concern is not performing across the whole, rather investing in whole value stream, not being myopic.
- Human Factors: looking at changing pilot demographics, and changing pilot tasks (flight-to-ground), changes in information rate (pilots are increasing using information in new ways and with new content)
- Virtual aircraft operations (i.e. UAS)
- Cross-cutting elements within the aircraft
- Data collection and management (as related to R&D) common safety goals; there are still risks despite the accident rates being down, and lastly...
- Dealing with “Black Swan” or the once in a lifetime event. There’s a propensity to react; but it’s also a good opportunity to fall back on good sound methods (for example, the US Airways Flight 1529 ditching in the Hudson River) the safety risk analysis of pilot training.

2:30 – 3:00 PM	Transformative Aeronautics Concepts (NASA Aeronautics Research Strategic Analysis, Vision, and Program Planning)	Douglas Rohn (NASA)
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Douglas Rohn presented *NASA Aeronautics Research Strategic Analysis, Vision, and Program Planning*.

There are three mega drivers: global mobility, environmental challenges, and convergence of technology.

By 2050, the International Air Transport Association (IATA) predicts that air transportation may reach a critical global capacity. For aviation, fuel cost has become significantly larger over time. As the global demand for air transportation increases, greenhouse gas emissions will add significantly to global warming unless changes are made. Technology convergence will require that the industry provide assured autonomy for safety critical systems to reduce operating costs, improve performance, increase safety and transform our mobility for on demand aviation.

NASA’s Aeronautics vision for the 21st century is: Transformative (on demand and fast), Sustainable (intelligent and low carbon), and Global (addressing safety, NextGen efficiency, and the environment)

Doug outlined and expanded on the Six Strategic Thrusts noting that it addresses a 20 year or greater outcome. The six thrusts are:

1. Safe, Efficient Growth in Global Operations
2. Innovation in Commercial Supersonic Aircraft
3. Ultra-Efficient Commercial Vehicles
4. Transition to Low-Carbon Propulsion
5. Real-Time System-Wide Safety Assurance, and
6. Assured Autonomy for Aviation Transformation

To focus on these objectives, the NASA Aeronautics Research Mission Directorate (ARMD) structured a new program organization:

- Airspace Operations and Safety Program (AOSP)
- Advanced Air Vehicles Program (AAVP)
- Integrated Aviation Systems Program (IASP)
- Transformative Aeronautics Concepts Program (TACP)

3:00 – 3:25 PM	Working Title: Operators Perspective	James Mangie (Delta)
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Jim Mangie (SAS) presented *Emerging Issues and Strategic Opportunities*.

Jim addressed NextGen (where we are today, and what NextGen looks like tomorrow) and posed the question: “How do we get there?”

If you’re building procedures for an individual aircraft, that’s easy; but if you build procedures into a crowded hub, that’s not easy. So how do you build procedures for a true system view? What will be the roles of the pilot and the controller?

With trajectory-based operations, operational efficiency is metric #1. It will be necessary to predict how much time an aircraft will occupy the limited airspace available. Putting airplanes into and out with as little time as possible to keep the system efficient. Consequently, operators/pilots need to be intimately involved at every step of development.

Jim addressed ADB-S “IN” noting that it may be valuable, but a systemic view needs to happen first.

Questions remain to be researched and answered with respect to Datacomm and weather in the cockpit. Pilots don’t want to be meteorologists so when should weather hazards present alerts and what should the pilot do once alerted?

In summary, a systemic approach needs to consider all aircraft versus a single aircraft. There must be stakeholder involvement. ADS-B must display all aircraft movement, and we must determine how much feasible with Data Comm. Finally, a simplified picture must be considered for weather in the cockpit.

3:25 – 4:00 PM	Working Title: General Aviation Perspectives	Walter Desrosier GAMA
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Walter Desrosier presented *General Aviation Perspectives*.

His topics for discussion included General Aviation Safety, the Pilot/ Aircraft or Human/Machine Systems Interface, Achieving lower minima through technology and procedures, electric propulsion and energy storage, supersonic operational considerations, and finally, technology focus areas.

Certified general aviation piston airplanes (163,000) make up the largest segment of the U. S. civil aircraft population (235,000). GA safety is focused on loss of control (LOC) and small airplane crash protection. The current standards for small airplane crash protection are antiquated. Walt noted the application of automotive industry technologies in GA airplanes. There should be approval processes for installation and operational use of non-required simplified equipment that is appropriate.

General aviation is an ideal platform for the innovation and introduction of new technologies and capabilities. Some examples include mobile devices (wired and wireless) for communication, heads up displays, wearable glasses, near-to-eye technology, voice command and transcription and automation for single pilot operations.

Of late, there has been a broad range of new technologies that are under development and have been introduced. We need to better understand the effects of increasing complexity in GA; and we should look at facilitating retroactive/retrofits and find ways to incentivize.

GA is well suited to hybrid propulsion systems, energy storage, and recharging scenarios. But we need initial and continuing airworthiness safety considerations. When considering technology focus areas software approval and certification is paramount. Other areas include high voltage DC primary power, in-flight atmospheric or wake turbulence detection, ice protection and detection, process and inspection criteria for 3-D printed materials and, lastly, distributed processing (networks).

4:10 – 4:45 PM	Discussion/Summary/Actions	Kenneth Hylander/ Eric Neiderman
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Kenneth Hylander expressed his appreciation for today's presenters and their briefings. They were enlightening and will be the basis for many future discussions. He reminded the SAS members that they need to remain focused on the task at hand as defined by Cathy Bigelow at the start.

Can we distill some of the discussions, the issues, the opportunities and spend a little time now?
Eric Neiderman suggested developing some as homework assignments and revisiting them at the start of tomorrow's meeting.

After much discussion among members, the following issues were elevated for consideration:

- Broader Certification (not limited to Software) (new mechanisms for non-deterministic)(certification by analysis: challenge is how do you do it?)(resiliency against disruptions/deliberate attacks – cyber-physical security)
- Human Centered Automation (as an assistant to the human, but human is ultimate authority)(increasing amount and sophistication of automation driven from efficiency and cost. Distinction between automation and autonomy)(Google example of delivery of goods)
- Revitalization of General Aviation
- UAS Integration in the National Airspace System
- Advanced propulsion, more electric stuff – implications of alternate means of propulsion, vehicles could benefit, energy management, i.e. APU

Ken Hylander stressed that narratives be accompanied with the rationale and towards a certification theme where appropriate.

Joe Del Balzo expressed that SAS should consider a research program with an expanded approach that looks at the role of the pilot and implications in the cockpit. To the best of his knowledge, the FAA is not currently conducting research of the expanded control deck and the issues such as pilot boredom or distractions.

Todd Sigler suggested considerations should include: revitalizing benefits for future pilots in the interest of providing a career path; improving GA safety, getting simplified equipment into the aircraft faster, and certification of ‘new’ equipment. There is a need to define the right level of rigor; how does the regulator decide?

Ken Hylander: Does everything have to go through the full cert process? Is there research that can be done differently for certification?

Jim Mangie said that “Big data” requires research to turn it into an actionable item by pilot. If nothing happens to the data then it’s a lost opportunity, but does not necessary degrade safety.

Ken Hylander noted that the goal should be to identify two or three early opportunities that could be accomplished within the next 10 years.

Meeting adjourned at 4:45 PM.

Thursday, September 11, 2014

8:30 – 9:00	Review of Homework Assignments from Previous Day – Findings and Recommendations Discussions	All
9:00 – 9:15	Opening Remarks – FAA Aircraft Safety R&D Action Items & Recommendations	Eric Neiderman

Eric Neiderman (Federal Designated Official) began the meeting with an anniversary remembrance of the events of September 11, 2001, asked for a period of silence to recognize those who perished and those who are currently serving in the military and troops overseas.

Ken Hylander (Chair) began the meeting with a review of yesterdays' events and a recap of the draft of Emerging Issue and Themes.

Eric Neiderman suggested that since members had an opportunity to review the Quad Charts last evening, it might be beneficial to first gather any thoughts of specific requirements and associated tasks.

Andrew Lacher: "Systems Consideration for Complex Software Intensive System (SDS-01)"

Why is there \$0 funding for FY15? John Lapointe stated that although there was a "Gap concern", funding in FY14 was released but could not be moved into FY15 in time.

Todd Sigler expressed a desire for more transparency in UAS Integration; he cited "Improved Flammability Standards for Aircraft Materials" as example of rulemaking in advance and how the plan supports and compliments broader milestones.

John White: "Preventing Loss of Control in Part 23 with Sensed Angle of Attack & Better Automation (FCMS-03)"
What is the actual sequence of Activities? John asked for an Action Item to clarify this matter. (ACTION ITEM for Bob McGuire)

Jim Mangie expressed concern about the fact that NDE for Critical Engine Components (PS-14-03) is not funded for FY16. He noted that there is a level of uncertainty of older algorithms, and suggested that they formulate a new approach. He also noted being pleased that residual stress work will continue.

Jim Mangie asked why there is no funding in FY17 for Determine Runway Friction from Aircraft Data (TAS-02). He added that there are still concerns about unstable approaches. Andrew Cheng (FAA) replied that they are taking time to review data and are planning to finish the technical portions TAS-02 in FY16.

Ken Hylander stated that the FAA does not appear to have the right criteria for Development of Stable Approach Criteria (TAS-04). Kathy Abbott (FAA) remarked that "Go Around" performance data is not very good; not confident in the existing data. Research should continue and consider the National Transportation Safety Board (NTSB) recommendation.

Todd Sigler commented that the Quad chart for Transport Airplane Risk Analysis Evaluative Metrics (SSM-03) states that “This is an ongoing effort”, yet FY15 and 16 are zero dollars. Kathy Abbott replied that there is a risk in using data since there appears to be under-reporting of rates for defined categories related to failures and malfunction.

Although the research requirement for ASIAs – Commercial (SSM-01) ongoing requirement, FY15 is the final year of R, E & D funding. It is now operational and will be continued under F&E funding.

Ken Hylander expressed concern over the out year funding for Systems Consideration for Complex Software Intensive Systems (SDS-01).

09:15 – 10:00	Aviation Research R&D Strategic Assessment	Dres Zellweger
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Dres Zellweger explained that the genesis of this briefing was the development of a strategic plan for the R&D Division. Dres reviewed the Divisions’ mission statement, core values, and program areas. He was asked to provide an assessment by reviewing industry, government and academia trends and identify the cross-cutting areas. The object was to look forward. Doing so involved using the Plan as a basis and conducting interviews both internal and external.

The “System Trends” revealed:

- Over the next 1- to 15 years, it’s unlikely that aircraft will undergo any major new designs (Boeing 787 is designed to be a better plane for the passengers; Boeing is looking ‘after small successes’). Incremental improvements are expected for lower noise and greater efficiency. Supersonic business jets may be introduced and unmanned aircraft systems will proliferate. NASA and the EC research have ambitious emission, noise, fuel burn, and airfield length goals.
- Propulsion systems (engine designs) will have significant improvements (efficiency, power, noise reduction) over the next 10-15 years. Bio-diesel, Un-leaded avgas and lithium ion batteries will continue their evolution. In the longer term, propulsion systems will feature open rotors, new power sources such as hydrogen or solar cell, and enhancements to lithium-ion batteries). Hybrid engines will be introduced.
- Future aircraft may contain adaptive systems; surfaces that would adapt to the phase of flight and atmospheric conditions. The sensors, flight and engine control will be more integrated. The future will feature more intelligent learning systems. The avionics will be more intelligent leading to intuitive cockpits with more information and display mechanisms such as portables and wear-ables. Aircraft will contain more communications systems: cockpit data, aircraft data collection and passenger systems. The trend is to set up “Digital Twins”.
- Materials will be light, stronger and more durable through the integration of composites, new alloys, hybrid structures and nano-materials. New manufacturing techniques and new structural designs will be developed.

- The aging effect of new materials is unknown, and non-destructive techniques are no longer possible. Structural repair for the new materials is unknown as is ensuring the quality of 3-D printed parts for repair. Testing will have to shift more towards computation fluid dynamics.
- A major concern will be software and digital system characteristics. There will be extensive onboard computer networks and wireless connectivity.
- There will be more complex human-machine interaction, and more autonomous system components.
- There will be issues with air-to-air connectivity with increased complexity simply due to their systems-to-systems nature.

With respect to Airports:

- Pavement life is being extended from 20-to-40 years; but the impact to the environment on pavement is not well understood. There are growing environmental pressures.
- New airport and aircraft materials will require changes in dealing with post-crash impact, especially with respect to fire-fighting.
- As dependence on satellite airports increases, technologies will have to adapt to the smaller airport environments.

With the implementation of NextGen;

- New roles for humans with more complex human/machine interactions.
- More autonomous system components will require research into Human Factors issues:
 - To develop partnerships between humans and machines
 - To develop methods to deal with failures, and
 - To properly allocate air/ground-human/machine for the air traffic management of NextGen.

There are cross-cutting issues and growth areas for the Division. The strategic plan should incorporate common issues and facilitate a convergence of research activities particularly with human factors and software, new materials and additive manufacturing, computational fluid dynamics, 'Big Data', and cyber-security.

Andy Lacher commented that that system engineering needs to tie together all cross-cutting activities. FAA should exploit the results of research. The Aviation Research Division has an opportunity to be a growth area since it has an understanding of the total system.

10:15 – 10:45	Budget Update	Mike Gallivan
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Mike Gallivan (FAA) presented *REDAC Aircraft Safety Subcommittee R&D Budget Status*.

The FY14 R,E & D budget request was \$166 million; the appropriation was \$158.8 and was signed on January 17, 2014. The breakdown was: Safety (\$87.2), Improve Efficiency (\$24.3), Reduce Environmental Impacts (\$41.6) and Mission Support (\$5.6).

The FY15 House language included an additional \$2M above the request for UAS research with \$1M was earmarked for the Center of Excellence for UAS. The Committee provides \$6M for alternative fuels research for General Aviation (a \$300,000 increase). Likewise, they provide \$3.5M above the budget request for NextGen environmental research (aircraft technologies, fuels and metrics).

Mike provided charts showing the FY15 Budget Request at the top level as well as a detailed breakdown of the enacted FY14. He pointed out that the Debt Ceiling and Sequestration are not issues for the FY15 Budget request. He also noted that this year is the election for both House and Senate seats which may result in a sequestration issue in FY16.

10:45 – 12:05	AVS FY17 Strategy Guidance & Research Requirements	Mark Orr
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Mark Orr (FAA) distributed a Memorandum *AVS Strategic Guidance for Development of the FY 2017 Research, Engineering, and Development (R,E & D) Safety Requirements Portfolio*. The document was signed by Peggy Gilligan, Associate Administrator for Aviation Safety issued on May 19, 2014.

Mark said that the memo defines the desired future state, and provides strategic guidance that are important to the AVS mission in FY17 and beyond. It is not intended, however, to exclude or restrict proposed research requirements. The guidance provided is intended to emphasize areas of aviation safety risk that AVS and their Technical Community Representative Groups (TCRGs) should consider when developing research proposals.

Mark also presented a listing of prioritized requirements for FY14, FY15, and FY16.

This presentation addressed Action Item #2 from the 2013 Fall meeting. The SAS agreed to close this item.

John White asked if there is a link between this guidance and the Administrator's (AOA-1) Strategic Initiatives released in February?

Mark replied that this memo does not deviate from those initiatives, although due to timing it was developed separately. The basis for the guidance was the adoption of a risk-based approach. There are three elements to consider: AOA-1 Initiatives, the AVS Plan and the National Aviation Research Plan (NARP).

Chris Kmetz: This memorandum doesn't seem to talk about the strategy of what AVS should be doing in the future.

Ken Hylander: There's a lot of work on defining emerging risks by looking at what's changing and the likely outcomes. There should be an inclusion of information from CAST and ASIAs.

Eric Neiderman also questioned to address the issues before they become a problem?

Mark replied that high interest, high priority issues must find a sponsor who would fund that research and that the R&D group has to more strategic.

12:30 – 13:15	Working Title: Aviation Medicine Perspectives	John Crowley (US Army)
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John Crowley provided a background and introduction on Aviation Medicine Perspectives. This is Aerospace Medicine; it includes both medical or non-medical (i.e. human factors) like fatigue.

John suggested that the FAA's Civil Aeromedical Institute (CAMI) and U.S. Army Aviation Center of Excellence at Fort Rucker in Alabama, leverage each other's capabilities and resources.

- Revitalize research examining the effects of medical technology on clinical health and occupational safety aviation personnel
- Fatigue research program with modeling operator state monitoring
- Develop methods and standards for new wave of affordable, portable, digital technology, to rapidly assess safety enhancements and flight safety concerns
- Maintain capabilities for iterative R&D; remain flexible in short term to address emerging aeromedical topics like crashworthiness

13:15 – 14:05	Aviation Research Needs to 2050	Kathy Abbott
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Kathy Abbott's presented *Today's Human Factors Challenges, Tomorrow's Vision*.

Kathy referenced the European Commission's *Flightpath 2050 – Europe's Vision for Aviation* report.

The characteristics of civil aviation are that it is dynamic, complex, market drive and is affected by rapidly changing technology. The biggest challenge to aviation safety is complacency.

Kathy pointed out that the safety continuum requires a balance between too little rigor and too much. System safety should seek to establish an appropriate balance in regulatory approach and to achieve safety objectives while imposing the least burden on society.

The "Vision" is to provide more flexible, robust operations, enhance human effectiveness, effective aircraft to air traffic integration, improve integration between ops and safety/maintenance and dispatch, improve risk assessment, conduct effective data analysis, and a timely sharing of lessons learned on an ongoing basis. Human factors research is needed to support the vision.

Kathy presented highlights of the September 5, 2013 final report of the Performance-based operations of the Aviation Rulemaking Committee/Commercial Aviation Safety Team, Flight Deck Automation Working Group.

The report found that pilots frequently mitigate safety and operational risks and the aviation system is designed to rely on that mitigation. Although flight deck automated systems have improved and been successful, there are vulnerabilities in pilot interaction especially in demanding situations adding complexity.

There is a need for effective synergy of the Human/Automated Systems (from U.S. Air Force). Human Factors research.

Mark Orr (FAA) assembled perspectives on future potential research by reaching out to the Chief Scientists and Technical Advisors (CSTAs) for input and briefings. A selected subset provided the following briefings.

**Russell (Rusty) Jones, Senior Technical Specialist for Nondestructive Inspection
NDI/Composite Materials Maintenance**

- Composites Long Term (Bonding)
 - Effects of bond line thickness
 - Surface preparation
 - Analytical model
 - Adhesive certification
 - Environment and aging effects
- Inspection Methods and Repairs
 - Standardizing inspection methods
 - Methods that work for multiple part thicknesses
 - Inspection techniques for determining bond strength and weak bonds (the Holy Grail)
- Aging Effects
 - Age and environment effecting the degradation of composite materials
 - Moisture absorption
 - Loss of strength
 - Exposure (continued) to HERF and lightning
 - Effect of repairs to parent structure
- Certification Efficiency
 - Modeling
 - Fatigue and damage tolerance rule
 - In-situ inspection
 - Health monitoring systems
- Workforce Education
 - Industry has concerns over a lack of qualified composites workforce
 - Design engineers
 - Inspectors
 - Repair technicians

**Joseph Pellettiere, CSTA for Crash Dynamics
Crash Dynamics**

- Establish one method of demonstrating crashworthiness
 - A single approach that applies to metallic and composite, double and triple deck, and blended wing.
- Composite special conditions
- Accepted process for M&S validation
- 2020 Time frame for implementation
- Implementation of a Single Process
- Anthropometric Test Device (ATD) is 40+ years old
- New aircraft seating configurations require different testing methods such as side facing, oblique, etc.
- Plan for future certification testing needs

Michael Gorelik, CSTA for Fatigue and Damage Tolerance
Fatigue and Damage Tolerance

Dr. Michael Gorelik began his briefing with the question of “What Causes Failures?” He presented a chart that reflecting field data suggesting that fatigue is the predominant failure mode in service (55% of aircraft component failures) and it is expected that this trend will continue for metallic materials.

The emerging technology considerations focus on

- New materials
- New manufacturing technologies
- Model-based certification
- Cradle-to-grave digital frameworks.

Additive Manufacturing (AM) (such as direct metal laser sintering) is moving into the mainstream. With the AM process, new challenges need to be considered: variation in equipment and processes, the lack of standardization, a limited level of manufacturing parameters and failure mechanisms, a lack of industry databases, and the development of capable NDI methods.

The next few slides addressed materials, components, and processes. There are uncertainties in materials, equipment and process performance, resulting in uncertainties in the final parts.

Dr. Gorelik addressed model verification and validation (V&V), the U.S. Air Force “Digital Thread Concept”, and completed his briefing with “Challenges vs. Enablers”. This featured increasing the use of process intensive material technologies, and moving towards models-based certification.

Gilbert K. (Chip) Queitzsch, CSTA for Engine System Dynamics
Propulsion System Challenges

Chip Queitzsch presented a single slide *Propulsion System Challenges*.

He highlighted the following;

- Updating Rules and Guidance
 - Engine design is evolving beyond what was envisioned when the rules were written
- Incorporate analysis in certification
 - Many of the rules are based on full engine tests
 - When is it appropriate to use analysis in lieu of a test?
- Maintenance Credit for Engine Monitoring
 - Replace some periodic manual inspections with continuous automated monitoring?
 - What level of monitoring system validation is required
 - Human vs. automated detection reliability
 - Manual vs. automated record keeping accuracy
 - Timeliness of fault capture and action
- Evolution of Manufacturing, Materials, and Design
 - Additive manufacturing has potential benefits, but the risks are not well defined
 - Introduction of new materials challenges the historical compliance approaches (e.g. fabricated fan blades in lieu of forged titanium)

- Turbine engine performance cycle is introducing new icing challenges
- Electric propulsion will likely present many unexpected challenges

**Mark Rumizen, Sr. Technical Specialist for Aviation Fuels
Aviation Fuels Technology**

There has been both intentional and unintentional shifts in fuel chemistry and composition. Alternative jet fuels and unleaded AvGas represent the former; changing fuel production/distribution infrastructure and contamination represent the latter. Each case creates an R&D need for new test methods and improved combustion modeling.

**David Walen, CST for Aircraft Lightning, High Intensity Radiated Fields, and Electromagnetic Interference
Aircraft Electromagnetic Compatibility**

David identified the following aircraft technology trends

- More critical electronic systems
- Distributed, modular, integrated aircraft electronic systems
- Shorter electronic system design cycles
- Aircraft structures with complex mix of metals and composites

These trends have an impact on aircraft EMI effects protection

- Laboratory qualification tests are complex and time-consuming.
- Distributed systems are exposed to more severe lightning and HIRF environments
- Commercial integrated circuits have increased susceptibility to atmospheric neutrons (single event effects)

Today's Aircraft Electromagnetic Protection Approach includes:

- Qualify aircraft electronic equipment using laboratory bench tests (such as RTCA/DO-160)
- Install equipment in well-protected aircraft avionics bays
- Perform aircraft-level lightning, HIRF, and electromagnetic compatibility tests
- Develop concepts for electromagnetic qualification tests on individual electronic modules
- Derive methods to demonstrate that the aircraft and installed systems have appropriate lightning and HIRF immunity before the aircraft is built
- Develop aircraft environment definition for atmospheric neutrons (single event effects)

**Peter F. Skaves, CSTA for Advanced Avionics
Advanced Avionics**

Peter focused attention on the E-enabled aircraft. Aircraft operators and manufacturers have identified many potential economic and safety benefits using E-enabled technology and software applications. Recent designs for aircraft systems have included connectivity to "non-governmental services. These designs can introduce cyber security vulnerabilities beyond the scope of current airworthiness regulations and traditional systems safety assessment methods.

Peter then identified current FAA AVS cyber security activities:

- Policy Statement: Establishment of Special Conditions for ASIS
- RTCA SC-216 Aeronautical Systems Security
- Research and Development Activities
 - collaborative R&D high priority activities with OEMs, Air Force, suppliers, operators, and maintainers
 - Review of industry standards
- Training

3:45 – 4:30	SAS Strategic Research Initiative	Joe Del Balzo
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Joe Del Balzo said that he had prepared a short document on the role of the pilot in an advanced cockpit automation environment and that it applied to the air traffic controller in an automated ATC facility. He also incorporated thoughts on the maintenance technician, FAA inspectors, and the aircraft certification specialist as well. However, having the benefit of the past two days of presentations and discussions, he wished to set aside the prepared paper (which all members can read and digest later) and provide some thoughts more important to the task and challenge issued by the REDAC and Dennis Filler.

AVS has a process in place to develop the tactical part of the research portfolio, but it does not address strategic plan. Peggy Gilligan issues guidance prior to AVS developing the portfolio. But dollars are always limited. So the priority is for tactical research, based on today's environment. The process doesn't lend itself to long-term research. SAS would normally note the gap, criticize, and recommend; but REDAC has issued the challenge to help them refine the process. So it's necessary for us (SAS) to help FAA develop a more strategic portfolio. The challenge is how do we do it, what's the process, and what should the research portfolio contain?

Todd Sigler: FAA's time is spent on the "What". What the FAA needs is more help on "How". That's SAS' challenge.

John White: NASA's charter is to do so 15-25 years ahead; the current FAA process is tactical. What's the link between NASA and FAA? Perhaps the transition of research from NASA to the FAA is an avenue worth exploring

Dres Zellweger: That's a huge process; not trivial.

Todd Sigler: We need the right type of research to operationalize that concept; it would help us with a flow down effect and help articulate the How.

Andrew Lacher: We must consider comprehensive, enterprise-system-level type engineering. That approach requires a cultural change in management. We'd have to be resilient - continue to support the tactical, but incorporate a long-range strategic plan.

Dres Zellweger: That would require a focused effort; I would recommend a separate, special committee with a sunset date to come up with a process.

Todd Sigler: The question is how to leverage data sets to support regulations on future technology? What is the right level of rigor?

Ken Hylander: This is a worthy topic. It just isn't obvious that there is a process.

Mark Orr: Bear in mind that we don't have a way to include the strategic right now.

Eric Neiderman: So from the discussions, there is a general agreement to set money aside. But the question becomes how do we do it?

Michael Gorelik: I would suggest looking at other agencies to see if they have addressed the same challenge and how they do it.

Eric Neiderman: Take for example the Department of Homeland Security – they have high risk, with high return.

Mark Orr: It's more than regulations...there's guidance, awareness of workforce, standardization, training. Approaching the idea of data used for safety.

Walter Desrosier: A rhetorical question: Why not develop a process like AVS currently has, but with an approach to the "strategic"?

Ken Hylander noted the time and suggested that this discussion be closed and that the membership review the list of possible topics, narrow the focus, refine the titles and assign "homework" for candidate submissions.

Architecture of Future Complex Systems: Assigned to Andrew Lacher/Chris Kmetz/John White

The group discussed potential subtopics to be considered:

- autonomy
- culture
- human centered automation (the role of the human in an automated environment)
- training

Real-time System Safety Assurance ('Monitoring'): Assigned to John Cavolowsky

Materials and Manufacturing: Assigned to Doug Rohn.

Energy Storage: Assigned to Walter Desrosier.

The group discussed potential subtopics to be considered:

- propulsion
- inspection technologies and techniques
- High-density energy storage

General Aviation Safety: Assigned to Walter Desrosier.

The Chair suggested a fifth focus area in light of the previous discussion – a **Process to Identify and Develop a Prioritization Process for the Strategic R&D Needs.** This write up was assigned to Todd Sigler.

The meeting was adjourned at **4:45 PM.**

Federal Aviation Administration
REDAC Subcommittee on Aircraft Safety (SAS)

William J. Hughes Technical Center

September 10 - 12, 2014

Director's Conference Room

(Dial-In Access and Video Teleconference capabilities were also available)

Friday, September 12, 2014

8:30 – 9:00	Review of Homework Assignments from Previous Day – Findings and Recommendations Discussions	SAS Members
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The Chair, Ken Hylander welcomed everyone present and on the phone, and restated the agenda for today. Ken requested that the authors of the assignments present their papers.

Todd Sigler began with the reading of his submission:

Identification and Segregation of strategic R&D Needs

Today's R&D identification and prioritization process is not suited to ensure adequate focus on and allocation for long-term, emerging needs. The current environment is dominated by known, near-term needs and reacting to unforeseen activities (pop-ups, budget challenges, etc) which severely limit FAA's ability to set aside resources for long-term R&D. To be successful in the long run, and leverage the resources available today while meeting the FAA's stated strategic goals, the process to identify and prioritize R&D needs must be rooted in an 'enterprise' view of the FAA's statutory mandate to "promote safety". Looking at today's extremely safe aviation industry, many stakeholders agree that the way to maintain, and certainly to improve, requires a cross-cutting (multi-disciplinary) approach to addressing the remaining known and emerging new safety risks.

In this vein, the subcommittee recommends FAA conduct the research needed to support the development of a sustainable process to enable

- The identification of long-term (strategic) R&D needs based using SMS principles at the aviation system level.*
- Further, the FAA needs a funding approach that will 'protect' the critical elements of long-term R&D needs*

Todd stated that the key was a risk driven approach. There was a short discussion around the table about the definition of "long-term". The consensus was to leave "long-term" undefined for the purposes of this write-up.

The next submission was read by Chris Kmetz:

Influence of the Architecture of Future Complex Systems

As we move towards increasingly complex system-of-system architectures in aviation which consist of both airborne and ground-based interconnected components, the following issues becoming increasingly important as we pursue an enterprise systems engineering approach:

Software, Automation and Autonomy

Software development and certification for onboard systems is increasing in complexity, sophistication, and size (lines of code) as previously independent mechanical, pneumatic, and hydraulic functions are replaced by highly integrated electrics and electronics. Advances in computer processing, sensors, networking, and other technologies are also enabling the aviation system to continue to augment the human decision-makers with sophisticated automation. Within the foreseeable future we expect humans will be in the loop on the flight deck and will thus maintain the role as the final authority for safe operations

As technology evolves, these automation systems becomingly increasingly interconnected and moving increasing towards autonomy where the machine is intelligent, perceiving, deciding, learning, acting, etc. often without human direct engagement (i.e., without human-in-the-loop). Ensuring that these sophisticated, adaptive, interconnected, and non-deterministic automation systems remain resilient to a range of expected and unanticipated circumstances is a concern.

Our current mechanisms and policies for oversight and certification of these systems to ensure they operate robustly in safety-critical situations are not keeping pace with technology advancements. These software-intensive automation systems must be resilient to design defects, missing or corrupt data, and deliberate attacks. We may require revisions to certification processes as well as new analytical techniques for verification, validation, test and evaluation that can generate the data necessary for a safety determination. We may require new software and system architectures that ensure that the authority of automation systems match the level of robustness which has been determined.

Analytical MoCs for DO-178 DAL A and B software are necessary. Fundamental research is needed to develop methodologies, frameworks, and algorithms enabling streamlined software architectures, testability, and certifiability.

R&D will be needed to ensure that automation on the flight deck is designed and implemented in a way to compliment and not replace the human pilot.

Data Integrity

There has been an exponential growth in the volume of electronic data associated with operations and advocacy for more frequent, or continuous, inflight aircraft-to-ground communication continues to build. Such ubiquitous communication can provide safety and operational benefits beyond location tracking, depending on available bandwidth and its cost. Safety and operational value of expanded uses for engine and aircraft health monitoring systems are growing. These systems of systems typically utilize aircraft and engine data governed by numerous certification requirements, delivering that data to the ground by several largely-uncertified means, and analyze it employing substantial COTS software and hardware. By its nature, COTS hardware and software have essentially no ability to be certified in the manner of purpose-built onboard systems.

Ensuring the integrity of this diverse data set from unintentional errors, accidental corruption, and deliberate spoofing is important to ensure the reliability of aviation operations.

Consideration of the certification regulations and MoCs for use of COTS software and hardware in ground-based applications for safety-significant functions is required.

Updated FARs and Means of Compliance

The pace of transport category innovation has accelerated with the advent of new architectures, expanded use of structural composites and advanced metallics, etc. Aspects of existing engine and aircraft FARs were developed long ago and should be examined for modernization in light of the latest design, development, and testing technologies. Some prescriptive certification MoCs may no longer be producing the desired result when applied to current high and ultra-high bypass engines.

Research should be undertaken to ensure a proactive framework for timely and flexible requirements and means of compliance are in place to handle near term engine and aircraft architectural advancements without undue burden.

Advanced modeling and/or hybrid model-based and rig-based MoCs should be investigated for enhanced efficacy in lieu of some full up engine tests, for example.

Sophisticated high-fidelity subsystem tests are increasingly employed by OEMs in early development to reduce risks in full-up engine or aircraft testing. In some cases these subsystems enable testing that cannot be reliably or repeatability performed in an engine ground test or in flight.

A review of current and near term validation technologies should be conducted, and approved methods for use of all adequate techniques and technologies as acceptable MoCs should be developed.

As aircraft systems inevitably become more integrated in the drive for improved safety and efficiency, the lines between engine and aircraft certification responsibility become blurred, and even today substantial overlap exists. This can create duplicative work or lead to unacceptable gaps. Examples include electronic integration, air systems integration, etc. Current and future large transport aircraft don't and won't split neatly down FAR 33 / FAR 25 lines.

A means to address in the FARs increased integration while ensuring complete coverage and clear responsibility without excessive redundancy should be studied and proposed.

Andrew Lacher expressed concern that within the section “Software, Automation and Autonomy” that there not be too much emphasis of “on-board” systems; that perhaps there should be a de-emphasis of the flight deck and pilot. He wanted to ensure that the “final responsibility” still lies with the human.

John Cavolowsky stated that he's worried about establishing architectures that in the future might be mutable. We have to consider the right level of engagement in the future.

There followed a general discussion by various members about “Data Integrity” and the methodologies that are appropriate with a diverse set of systems.

Douglas Rohn presented the next submission:

Supporting the Certification of Advanced Material/Structural Technologies

As aircraft designs drive towards advanced performance, new material systems and structural concepts will continue to be introduced that are disruptive to the current ways of designing, building and maintaining airframes and engines.

The FAA needs to stay ahead of these changes to make certification decisions and build its knowledge in order to support regulations, standards, guidance materials, training, etc. that maintain safety. Some of these changes have already been introduced in the industry. One example is the use of composites and bonded joints. How to know actual bond strength and how to inspect for proper bonds in repairs is are current issues that have not been satisfactorily addressed.

Other changes will be brought in soon and begin to accelerate in the future, such as use of additive manufacturing. Given that this is a process-intensive technology, standardization, variation in process, resulting properties, and uncertainties in failure modes need more scrutiny.

A broad area for the future is NDI. For many material systems and structural designs, the inspection processes are falling short of being able to catch flaws, thus driving to more modeling and analysis. Another area is computational material methods which will require a deep understanding as they are used in the design process.

Doug emphasized that the key is detection of failure modes and the drive to be more predictive.

The next submission was read by John Cavolowsky:

Real-Time System Wide Safety Assurance

Why is this important to the FAA and global growth of aviation? *Commercial aviation is the safest mode of transportation. This enviable record results from decades of continuous improvement in reaction to known hazards, incidents, and accidents. As aviation exploits technology advances to enhance the capacity, efficiency, and uses of the NAS, it will be vital to recognize and quickly mitigate emerging safety issues in real time before they become hazards.*

The focus of this strategic research effort *is to enable the development of a real-time, system-wide safety assurance system. The ongoing advances in sensor and networking technology, computation, communications, and integration can be combined with advanced data analytics to accelerate access and protection of sensitive data. This will enable discovery, alerting, and mitigation of anomalous events, at a progressively more rapid pace, and will enable unprecedented insight into system operations, health, and safety. These advances, applied broadly within the aviation system and combined with system-of-systems modeling and prognostics, offer a new vision of real-time, system-wide safety assurance. Strategic research in this area will deliver a progression of capabilities that accelerate the detection, prognosis, and resolution of systemwide threats.*

Over the next decade, *continued development of safety analysis and assurance tools such as data mining and analysis, automated prognostics, and safety risk modeling will substantially improve the ability to gain insights and develop mitigations from the growing amount of available aviation system data. These improvements will dramatically improve safety assurance within the next decade, by reducing the time to analyze, identify, and mitigate safety risks from what can now take months down to days.*

In the subsequent decade, *the integration of advanced tools into a more highly automated safety assurance system will enable continuous systemwide safety assessment. This advance will lead to rapid identification of safety issues and corrective actions before the issues become hazards. Such an automated system will evolve over the decade to be near-real-time as confidence increases in continuously validated system judgments.*

Thereafter, the automated safety assurance system will become integrated with real-time operations to help create an aviation system that exhibits the autonomic properties of self-protection and self-healing. In this future, human operators and autonomous systems will collaborate to ensure an optimal mix of actions — from immediate operational adjustments to far-term system and infrastructure changes — in order to minimize safety risks.

Walter Desrosier addressed:

High Energy Electric Storage, Management and Use

Future aircraft will continue to expand the use of electrical energy technologies and capabilities such as replacement of traditional hydro-mechanical systems and future applications for auxiliary power systems, dynamic structure and electric propulsion.

This requires the development and application of new high energy storage, management and distribution technologies and systems which presents new potential hazards to aircraft and operations. A R&D program is needed to understand and assess the applicability of various high energy generation and storage technologies in aviation products and operations to ensure the appropriate standards and safeguards for the design, certification, maintenance and operation of these new systems.

This should include consideration of fuel cell and battery technologies, high voltage power management and distribution systems, electric motors, wire protection and personnel safety appropriate for both commercial and general aviation aircraft.

Walter predicted that the need for alternative power will increase as new systems develop and are introduced and integrated into aircraft.

Walter Desrosier also addressed the next and last submission:

General Aviation Safety

General aviation is an important part of the US air transportation system and a pipeline for highly qualified pilots and mechanics which are vital to the continued safe growth of aviation.

The REDAC SAS supports the R&D initiatives in the portfolio which target improvements in GA safety such as weather technology in the cockpit and preventing loss of control. In order to make significant improvements in GA safety and enable revitalization of this sector, a strategic R&D program is needed to evaluate safety enhancements through the application of technologies which improve situational awareness, aircraft operational protections, automation and autonomy which make it easier to fly in the NAS.

The objective of this R&D initiative would be to coordinate with other R&D initiatives and identify application within GA aircraft using safety continuum principles to ensure an appropriate level of rigor to enable these safety enhancing technologies to be installed in both retrofit and new applications.

After all papers were presented, Ken Hylander thanked the authors and contributors for their thoughtful work. Eric Neiderman volunteered to consolidate the inputs, refine and standardize the language and format, and prepare a briefing package to accompany the SAS recommendations. He would then pass the results to Ken Hylander to distribute to the Committee for review and comments.

9:45 – 10:55	Aviation Medicine R&D – Deep Dive	Estrella (Star) Forster
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Estrella Forster *presented REDAC SAS Fall 2014 Review FY14 Accomplishments - Aeromedical TCRG BLI A11.j – Aeromedical*. This comprehensive “deep dive” presentation on the Civil Aerospace Medical Institute (CAMI) was a carryover from the 2014 Spring Meeting.

The Civil Aerospace Medical Institute is located at the Mike Monroney Aeronautical Center in Oklahoma City, Oklahoma. It is the medical certification, research, education, and occupational health wing of the FAA's Office of Aerospace Medicine. The goal of their activities is to enhance aviation safety. The principal area of concern at CAMI is the human element in flight—pilots, flight attendants, passengers, air traffic controllers—and the entire human support system that embraces civil aviation. They study the factors that influence human performance in the aerospace environment, find ways to understand them, and communicate that understanding to the aviation community at large.

CAMI also conducts aerospace medical certification. About a half-million airman medical certificates are issued each year on the basis of physical examinations. new internet-based system was developed to manage this huge data influx; call the Document, Imaging, and Workflow System. It receives about 1,800 examinations each day. It is now possible for reviewers to resolve the medical cases on standard office work stations. Medical records are stored in digital form. This permits fast retrieval, review, and accuracy in determining a certification decision.

CAMI also conducts aerospace medical education through various programs. Staff members train and evaluate the performance of Aviation Medical Examiners (AME's), a specialized group of over 3,700 physicians worldwide in approximately 100 countries. Specialists also train civil aviation pilots and FAA aircrews in physiology and global survival skills. Aeromedical information is disseminated to the aviation community in both print and online publications, lectures and demonstrations through the National Aviation Safety Program. Specialized aerospace medical library services are also available.

CAMI conducts aerospace Human Factors Research. Their scientists study the behavior and performance in both laboratory studies and while at work in aviation environments. This is particularly true with tasking between operators and computers, aircraft and displays.

Medical issues are studied by CAMI scientists, engineers, and technical specialists. There are two primary laboratories that support this effort: the Bioaeronautical Sciences Research, and Protection and Survival Research Labs.

The Bioaeronautical Sciences Research supports accident investigation through medical and toxicological analysis in the Toxicology Lab. Scientists and researchers develop analytical procedures and evaluate pilot performance-related aspects of drugs and alcohol. They maintain medical and accident databases that support research, and they conduct atmospheric radiation research and analysis with respect to aircraft occupant safety and health.

The Protection and Survival Research conducts evacuation research, improving occupant survivability in the event of an aircraft accident. This includes smoke evacuation under realistic conditions, as well as water landing simulations in large scale pools. They also conduct research into the physiological aspect of altitude and environment to support protective systems and safety procedures. Lastly, they conduct medical and vision research to support the certification of aircrew.

CAMI also administers FAA occupational health programs for agency employees at Mike Monroney Aeronautical Center. They provide professional advice and technical knowledge to the Federal Air Surgeon and other agency officials.

Estrella's PowerPoint presentation featured many photographs of the facilities, laboratories, and working staff. She also addressed the need for continual maintenance and upgrades to CAMI's physical assets. (\$1.8M R&D Funding; \$18M F&E for Labs, Equipment and Maintenance)

SAS members inquired about support for Commercial Space Transportation. Estrella replied that CAMI does not have a defined program with funding from AST. There are implications to air traffic control with the introduction of CST and considerations for crew and commercial passengers.

Members also inquired about a research program into the physiology of fatigue. Estrella said that this concern is falling between the cracks because there isn't a specific item in aviation medicine or human factors in FY15/FY16.

Estrella Forster invited SAS to consider holding one of its' upcoming meetings at CAMI so they can witness and see the facility and all it has to offer first hand.

Key Hylander thanked Estrella for an extremely enlightening presentation. This close Action Item #1 from the 2013 Spring meeting.

10:55 –	Weather Decision Making	Warren Fellner
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The *Weather Decision Making* presentation from Finding and Recommendation SAS Spring_2014-1: Weather and Decision-making will be presented at the 2015 Spring meeting.

10:55 – 11:50	AVS – Next Steps -Moving Beyond Just the Prioritization Process	Mark Orr
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Mark Orr presented *Next Steps - Moving beyond just the prioritization process*.

The primary purpose of AVS-sponsored research is "...support the development of regulations, standards, and guidance materials needed to meet the FAA safety goals and objectives."

The AVS R&D Program has a structured process to prioritize R&D projects and to document funding decisions based on Safety Management System (SMS) and project management principles. According to Mark, the program allows AVS to respond to changing budgets and safety needs to permit organizations to accomplish their mission, to justify and account for these activities to Congress.

Mark briefed the AVS Vision through a Life Cycle approach (Outcome based, driven by safety risks, and an active sponsorship). Project-based research requirements include approving the initial project, and measuring and managing it to obtain the outputs in support of the sponsor's implementation plans.

He noted that Andy Lacher gave a presentation on the MITRE research process to the AVS R&D team in July 2014. There were many apparent similarities and some differences.

AVS Strategic Guidance for FY16 and FY17 is focused on CAST and the GAJCS. FY18 guidance will consider input from this SAS meeting and add consider future trending.

This presentation addressed Action Item #6 from the 2014 Spring SAS meeting. The SAS recommended closing that Action Item and opening a new one that asks for periodic updates on AVS prioritization process with emphasis on balance between short- and long-term research.

11:50 – 12:00	Wrap Up	Ken Hylander
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Chris Kmetz suggested that the SAS Members should consider getting a briefing on AST's Commercial Space Transportation, including the COE.

Ken Hylander stated that he was very impressed. He remarked on all the preparation work, the homework by members, and the enlightening and intelligent discussions

Eric Neiderman noted that the target date for the next Subcommittee on Aviation Safety is March 24-26, 2014 with the location as yet undetermined, but will likely be either here again at the FAA William J. Hughes Technical Center or at FAA National Headquarters in Washington, DC. It is emphasized the SAS members request that sponsors give presentations.

Eric requested that the members complete a survey (sent separately) and provide feedback on this process.

Key Hylander adjourned the meeting at Noon.

In Attendance

Kathy Abbott
Allan Abramowitz
Vicki Ahlstrom
Kenneth Allendoerfer
Cathy Bigelow
Daniel Brock
John Cavolowsky (SAS)
Andrew Cheng
John Crowley (SAS)
Curtis Davies
Joe Del Balzo (SAS)
Walter Desrosier (SAS)
Stephanie DiVito
Hossein Eghbali
Jorge Fernandez
Dennis Flath
Estrella Foster

Mike Gallivan
Wendell Griffin
Michel Hovan
Ken Hylander (SAS Chair)
Cliff Johnson
Chris Kmetz (SAS)
James Knight
Ken Knopp
Danko Kramar
Andrew Lacher (SAS)
John Lapointe
Xiaogong Lee
Jim Mangie (SAS)
Eric Neiderman (FAA DFO)
Mark Orr
Maria Paine
Joseph Pellettiere

Steve Ramdeen
Alanna Randazzo
Douglas Rohn, (SAS)
Chinita Roundtree-Coleman
Todd Sigler (SAS)
Peter Sparacino
Paul Tan
John Valasek
Isidore Venetos
Tong Vu
Ed Weinstein
Jim White
John White (SAS)
Michelle Yeh
Dres Zellweger

AGENDA

Wednesday, September 10, 2014

8:30 – 8:50	Welcome/Opening comments <ul style="list-style-type: none"> • Introductions (all) • Opening remarks/comments (Chair & DFO) 	Kenneth Hylander (Chair) Eric Neiderman (SAS DFO)
8:50 – 9:05	Welcome	Dennis Filler (REDAC DFO & WJHTC Director)
9:05 – 9:15	REDAC Tasking – Strategic R&D Recommendations	Cathy Bigelow
9:15 – 9:30	SAS Chair Instruction/Presentation	Kenneth Hylander
9:30 – 10:15	UAS R&D Portfolio and Strategic Outlook	Chris Swider Sabrina Saunders-Hodge
10:15 – 10:30	Break	
10:30 – 11:15	Working Title: Operators Perspective	James Mangie (Delta)
11:15 – 12:00	Working Title: UAS/Automation	Andrew Lacher (Mitre)
12:00 – 12:30	Working Lunch	Cafeteria
12:30 – 1:15	Looking Ahead at Aircraft Safety	John White (ALPA)
1:15 – 2:00	Working Title: OEM Perspectives	Todd Sigler (Boeing)
2:00 – 2:15	Break	
2:15 – 3:00	Working Title: Aviation Medicine Perspectives	John Crowley (US Army)
3:00 – 3:45	The Twin Imperatives: New Technology and Environmental Challenges	Christopher Kmetz/ Alan Epstein (Pratt & Whitney)
3:45 – 4:30	Discussion/Summary/Actions	Kenneth Hylander/ Eric Neiderman
6:30	Group Dinner: <i>Gourmet Italian Cuisine & Pizzeria</i> , 324 S Pitney Rd, Galloway, NJ 08206	(609) 652-1398

Thursday, September 11, 2014

8:30 – 9:00	Review of Homework Assignments from Previous Day – Findings and Recommendations Discussions	All
9:00 – 9:15	Opening Remarks – FAA Aircraft Safety R&D Action Items & Recommendations	Eric Neiderman
9:15 – 10:00	Transformative Aeronautics Concepts	Douglas Rohn (NASA)
10:00 – 10:15	Break	All
10:15 – 11:00	Aviation Research R&D Strategic Assessment	Dres Zellweger
11:00 – 11:15	Budget Update	Mike Gallivan
11:15 – 12:00	AVS Strategy Guidance & FY2017 Requirements	Mark Orr
12:00 – 1:00	Lunch	Cafeteria
1:00 – 1:45	Aviation Research Needs to 2050	Kathy Abbott
1:45 – 2:15	FAA CSTA Presentation – Airframe Structures	Joseph Pellettiere Michael Gorelik
2:15 – 2:45	FAA CSTA Presentation – Avionics, Cyber, & Comm	Peter Skaves
2:45 – 3:00	Break	
3:00 – 3:45	Working Title: General Aviation Perspectives	Walter Desrosier
3:45 – 4:15	Working Title: Strategic Outlook	Joe Del Balzo
4:15 – 5:00	AVS - Moving Beyond the Process	Mark Orr
5:00 – 5:10	Wrap up – Homework Assignments, Action Items, etc.	All
6:30	Reception – hors d’oeuvres 3 South Buffalo Ave., Ventnor, NJ 08406	Eric’s Bungalow

Friday, September 12, 2014

8:30 – 9:00	Review of Homework Assignments	SAS Members
9:00 – 10:30	Aviation Medicine R&D – deep dive	Estrella (Star) Forster
10:30 – 10:45	Break	
10:45 -11:15	Aviation Alternative Fuels	Mark Rumizen
11:15 – 11:30	Weather Decision Making	Warren Fellner
11:15 – 11:45	SAS Spring Actions & Recommendation Review	Kenneth Hylander/ Eric Neiderman
11:45 – 12:00	SAS Feedback/Future Planning	Kenneth Hylander
12:00 Noon	Adjourn	

DISPOSITION OF SAS FINDINGS AND RECOMMENDATIONS

Fall 2014 SAS Meeting

SAS Spring_2013_24: Flight Deck/Maintenance/System Integration Human Factors and NextGen Human Factors
Recommendation: The Subcommittee recommends that, for funding and functional purposes, AFS and AVS explore the possibility of closely aligning human factors research requirements with the other research areas they support, even though those issues fall outside of the traditional human factors portfolio. For instance, research on artificial vision and the complexity of instrument approaches both support increasing airspace capacity, which is a NextGen issue. Additionally, the Subcommittee recommends that more support and priority be given to human factors research that supports significant new or revised regulation.
Not addressed at the 2014 Fall meeting. **CLOSED**

SAS Fall_2013_3: Alignment of Human Factors Research
Recommendation: The Subcommittee recommends that, for funding and functional purposes, FAA explore the possibility of closely aligning human factors research requirements with the other research areas they support, even though those issues might fall outside the traditional human factors portfolio.
Not addressed at the 2014 Fall meeting. **REMAIN OPEN**

SAS Spring_2014-1: Weather and Decision-making
Recommendation: There is a significant body of knowledge about how people deal with probabilistic information for decision making in situations involving risk. It is recommended that the Weather program get sufficient understanding, using such information where appropriate, to help them design weather forecast displays, decisions support tools, and associated training that make use of probabilistic weather information.
Not addressed at the Fall 2014 meeting. **REMAIN OPEN**

SAS Spring_2014-2: UAS R&D Strategy
Recommendation: The FAA should develop a holistic implementation plan to include a detailed R&D strategy which would address the research needs from both the regulator and airspace operator perspectives. The SAS requested further details on the UAS R&D plan reflecting deliverable validation milestones against the published FAA Integrated UAS Roadmap. **REMAIN OPEN**

ACTION ITEMS
Fall 2014 SAS Meeting

2013 Spring Carry Over Action Item:

Action Item 1: Provide deep-dive of Aeromedical program at the Spring 2014 meeting. **CLOSED**

2013 Fall Carry Over Action Item:

Action Item 2: AVP will brief the SAS on the development of the list of emerging risks in the AVS Strategic Guidance. **CLOSED**

2014 Spring Carry Over Action Items:

Action Item 2: Mark Orr will provide a presentation at the next SAS meeting that shows examples of how pop-ups are working and their impact on other projects and programs. **CLOSED**

Action Item 3: (Kathy Abbott) Kathy will provide information regarding FY 16 HF requirements that were not funded in FY 16. **CLOSED**

Action Item 4: (Mark Orr) Mark will provide information on prioritized requirements list with Mendoza Line for FY 15 and FY 16. **CLOSED**

Action Item 5: (Gary Pokodner) John White asked for a briefing on WTIC and Part 121 operations. Identify the correlation between better weather information in the cockpit and weather related accident reduction and PART 121 efficiency. **REMAIN OPEN**

Action Item 6: Mark Orr will set aside one hour at the next SAS meeting to discuss improvements to the AVS prioritization process that focus on other successful programs like MITRE. Joe asked that principal participants be there in person. Topics will include risk tradeoffs in technical approach and execution quality for both short- and long-term frameworks. Joe added that Dres and Dennis Filler should participate and Andy should show examples of successful prioritization at MITRE. This is not intended as a redesign of the AVS Prioritization Process but FAA customers and their need for products should be identified. There should be a balance between short- and long-term research. **CLOSED**

Action Item 7: Eric Neiderman will provide an explanation of SDSS core capability at the next SAS meeting. **REMAIN OPEN**

Action Item 8: Eric Neiderman will provide information regarding the NASA Ames tool to track safety cases. **REMAIN OPEN**

2014 Fall New Action Item:

Action Item #1: Provide periodic updates on AVS prioritization process with emphasis on balance between short- and long-term research. (Mark Orr)