

# REDAC Subcommittee on Human Factors Winter/Spring 2022 | MINUTES

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Meeting date | *March 29-31, 2022*

Meeting location | *Remote (due to COVID-19)*

**Purpose:** Review the RE&D accomplishments and expectations for FY22, and research plans through FY24, and advise FAA on future research

**Tuesday, March 29, 2022**

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**Opening Remarks | Presenter** *Shelley Yak, FAA Director of William J. Hughes Technical Center, REDAC Co-Chair*

Shelley Yak welcomed the subcommittee, and provided an overview of the happenings in the FAA. She mentioned recent retirements, telework, Return-to-Work and the impact on the next Research, Engineering, and Development Advisory Committee (REDAC) meeting. She also discussed National Air Traffic Controllers Association, the Infrastructure Bill and the areas that will receive funding. There will be billions of dollars invested into Airports, Airport Infrastructure and for Air Traffic Control (ATC) Facilities. Staffing changes and retirements were discussed. Discussion of environmental concerns, such as lead-free aviation fuel by 2030, and new engine technologies to reduce pollution and noise, particularly electric power propulsion and sustainable facilities across the FAA. Commercial Space is growing. Unmanned Aircraft Systems (UAS) is making progress with Beyond Visual Line of Sight (BVLOS). She provided information learned from the 2019 Budget submission, and introduced a new program/Budget Line Item (BLI) for 2023, Emerging Technology Accelerator. She also talked about the Research Roadmap to point out the program's priorities and what we will be working on next. Also, discussed was the need for REDAC to provide strategic advice to inform FAA of the opportunities for change and forming partnerships.

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**Welcome / Introductions | Presenters** *Dr. Barbara Holder, Embry-Riddle University, HF Subcommittee Chair*  
*Dr. Bill Kaliardos, Designated Federal Official (DFO)*

Dr. Barbara Holder thanked the subcommittee for making the meetings during COVID productive and informative for the FAA. She asked the group for any referrals for future subcommittee members that would help broaden the expertise base of the emerging areas. She mentioned that Nadine Sarter from University of Michigan and Susan Taylor from Gulfstream have been invited to join the committee as part of the new membership expansion. Barbara notified the committee that she is now with Embry-Riddle University.

Dr. Bill Kaliardos (DFO) reviewed the agenda and the meeting was called to order.

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**Update from Full Committee Meeting | Presenter** *Dr. Barbara Holder*

Barbara briefed the introductory slides. She provided a quick summary of the Full REDAC Meeting from Summer/Fall 2021. She discussed some highlights including Info-Centric NAS, transforming analog to digital, NextGen investments into software enhancement and New Entrants into the system (UAS, Space, Autonomous systems). The full committee discussed what National Aeronautics and Space Administration (NASA) is performing with their focus on air mobility and air/space transformation on a global scale and their sustainability research and how to optimize traffic management including all the various vehicles with minimal environmental impact.

Barbara introduced the various subcommittees and explained the function of the REDAC as well as the goals of the Human Factors REDAC meeting, including the creation of Findings and Recommendations (F&R's). She pointed out that the Winter/Spring meeting is generally to focus on providing strategic guidance.

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**Flight Deck Human Factors Research, NextGen | Presenter *Dr. Victor Quach, FAA NextGen Air/Ground Integration Portfolio Manager***

Bill introduced Dr. Victor Quach to brief the subcommittee on the NextGen Air/Ground Integration Human Factors Research, which is also known as “NextGen Flight Deck Human Factors Research”. Victor provided an overview of the program before briefing the FY22 highlights from the research accomplishments and ongoing and anticipated research in FY23 and beyond.

Barbara had a question on the scope of Flight Crew Displays and Interfaces research with MITRE. Chris Reed had a question about the upcoming task management work stream. Chris DeSenti had a question about “unexpected events” work and the head worn displays (HWD)—are these tied to NextGen evolution? Are the applications for HWD's going to be looked at? How about Fatigue? Bill answered that the research on unexpected events is focused around system failures and in general how to deal with event for which procedures do not exist, or cannot be applied sufficiently. Chris would like to follow up offline to discuss the potential addition of these displays into the fleet and the outcomes of that.

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**Break**

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**Flight Deck Human Factors Research, Core | Presenter *Dr. Chuck Perala, FAA Core Flight Deck HF Portfolio Manager***

Bill Kaliardos asked the committee if there were any questions for Victor prior to the start of the Core Flight Deck briefing. Victor asked Chris DeSenti what need is driving his question on examining long duration wear fatigue for HWD? Chris stated he would coordinate an offline meeting to discuss.

Dr. Chuck Perala briefed the subcommittee on the “Core” Flight Deck Human Factors research. He provided an overview of the BLI before briefing the FY22 research accomplishments and ongoing and anticipated research in FY23.

Maggie Ma questioned if the Maintenance Human Factors procedures research was the project considering immersive technologies? It was not the original intent of the research, Chuck responded. Maggie's second question was regarding the pilot fatigue ultra-long range study; is this a collaboration between Boeing and the FAA? Ashley Awaad from FAA Civil Aerospace Medical Institute (CAMI) responded that they are not currently collaborating but they are always open to doing so and would like to have a discussion about it at some point. Also discussed was that a former Boeing employee involved in the Boeing fatigue study is now working at FAA.

Angel Millan from Boeing asked about the Human Factors Gap analysis. He shared there is an opportunity for collaboration between stakeholders. He spoke on the new committee on incorporating Human Factors into the Safety processes. There is already an FAA representative on the committee but he isn't sure he is in Human Factors. Angel will forward that person's information to Chuck.

Dave McKenney of MITRE asked about Advanced Vision Systems—is the CAMI work being done by one main office or is it different projects? Chuck responded with, all new projects start with a review of all past information and research on the topics. It was asked, where is the repository of old project reports? It depends on the research, members can reach out to Chuck for anything specific, but there are various online research databases at FAA such as (pasted in the zoom chat):

ANG-C1 Human Factors Division Reports link: [www.hf.faa.gov](http://www.hf.faa.gov)

CAMI Reports link: [https://www.faa.gov/data\\_research/research/med\\_humanfacs/oamtechreports/](https://www.faa.gov/data_research/research/med_humanfacs/oamtechreports/)

Volpe HF Reports link: <https://www.volpe.dot.gov/our-work/safety-management-and-human-factors/human-factors-publications-and-papers>

Volpe Reports Link: <https://www.volpe.dot.gov/library>

Jack Barker had a question on Operational Acceptability of New Automatic Takeoff and Landing Operations Performed by a Single Pilot and Optional Dual Pilot Crews; is the focus on that part 135 Ops or 121? Chuck thought it was 121, but it is still planned research, he would like to hear any insight that they might have on it. Jack will forward that information.

Barbara Holder asked about single pilot operations (SPO) and reduced crew—is the focus on the capability of some automatic take off systems or is it on how are we going to enable safe single pilot and reduce crew operations for take-off? Barbara spoke on how this is a hot topic and asked if it can be expanded to talk about those operations more broadly. Chuck is open to any direction or information that she can provide and pointed out it will be a multi-year project.

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**FAA NextGen Updates | Presenter** *Tara M. Gibson, FAA NextGen HF Division Manager (ANG-C1), Acting Deputy Director, NextGen Portfolio Management and Technology Development Directorate (ANG-C)*

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Tara Gibson gave her presentation on the Info-Centric NAS Vision, formally known as Charting Aviation’s Future and NAS 2035.

Barbara inquired about the budgets labeled “NextGen”—are they going to change to Info-Centric? Tara noted that the names probably won’t start changing until we turn the next chapter on NextGen.

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Barbara opened the floor to the subcommittee members for comments, concerns or questions.

Philip Smith had a question about Electronic Flight Bags (EFB), will we see increased use of complexity and issues in terms of its use? Do we anticipate some new uses? Chuck said it was not currently in the portfolio. Bill also mentioned that Aviation Safety (AVS) would also be the driver of that research. Dave said that the use of EFBs is becoming more complex and playing a major role in how pilots do their job. Jack Barker also spoke on the complexities and thought there should be more standardization and that training should be more hands on. Cheryl Quinn asked about the evaluation of how it is used. Barbara spoke on the connections and displaying the EFB content on the forward displays, multi-function displays and managing that. Bill pointed out the large amount of past HF research and guidance on EFBs, and made the recommendation that the FAA provides an overview of the EFB HF research history for the next meeting, including addressing Dave’s question about how that research has been applied in the industry.

Maggie talked about the International Civil Aviation Organization (ICAO) group publishing competency-based training and assessment. She thought that aircraft maintenance HF can borrow some best practices for a starting point. Bill asked if it translates to a need for research by the FAA. Dave said there is an ICAO training that Kathy Abbott and Barbara Adams (FAA) are working on with trying to differentiate between competency-based training vs proficiency. Barbara mentioned that she and Dave were already engaged with some of the ICAO efforts, and would be happy to share that information with the subcommittee. It was also noted that competency based training and evidence based training are not the same, and that both are potential options in the United States (U.S.), and not intended to be replacements for current training. The following link was provided in the zoom chat window:

ICAO document Doc 10098: <https://store.icao.int/en/manual-on-competency-based-training-and-assessment-for-aircraft-maintenance-personnel-doc-10099>

Barbara Holder brought up a gap in looking at the use of immersive tech for training (virtual and mixed reality) and applying that to various operational roles for training credit. What kinds of technologies should be used for what kind of training or skill development and what kind of credit can you get from the training. Is this a focus going forward? Chuck mentioned that the Emerging Pilot workforce has some work on Augmented Reality (AR) and Virtual Reality (VR), and those are on the sponsor's radar but not sure of the priority. Bill said that is probably a question for AVS, which can be addressed.

**Action:** Recommends that the FAA provides an overview of the EFB history for the next meeting.

Barbara asked the committee to think of the gaps that were not discussed on Day 1 and have them ready for Day 2. She also would like to discuss Single Pilot and Reduced Crew on Day 2.

Bill adjourned the meeting for the day at 4:00 ET.

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## End of Day 1

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**Wednesday, March 30, 2022**

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**AVS Human Factors Research Roadmap | Presenters *Dr. Hannah Baumgartner & Colleen Donovan, AVS HF Specialists***

Bill Kaliardos thanked everyone for their participation and opened Day 2 of the meeting.

Kathy Abbott introduced the AVS Human Factors Research Roadmap Overview and pointed out that this is a living document similar to the UAS Research Roadmap in how it will document what is currently happening and what will be researched in the future. It is still under development. On another topic, Barbara had questions for Kathy regarding the competency-based training from ICAO and the questions from the meeting a day prior about AVS. Kathy pointed out that competency-based training is one option for training and is not designed to replace the traditional training but to offer a training alternative based on competency-based training and assessment. Maggie asked what lessons learned could be applied to maintenance work. What lesson learned can be adopted? Kathy indicated that it is still a work in process and has yet to be fully adopted. Kathy will send Maggie the name of the Boeing representative that they have already been collaborating with.

Colleen Donovan introduced Dr. Hannah Baumgartner, a principle investigator at CAMI, who provided a brief overview of the AVS HF Research Roadmap.

Kathy wanted to reinforce that this roadmap will help identify how the research will map to the policy needs of different parts of AVS.

Phil Smith asked how this process ensures that the “buckets” talk to each other, and supports research that would work for multiple buckets.

Dr. Baumgartner wrapped up her presentation by stressing that this is a living document and is a work in progress.

Bill offered that this document will help the REDAC committee view all of the research being done by AVS, outside of the four HF portfolios.

Barbara inquired about the ownership of the document. Colleen said Kathy will be the official owner, Lisa Thomas will be the research liaison on the aircraft certification side and they are also trying to get a person on the Flight Standards Human Factors side.

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**ATC Human Factors Research, NextGen | Presenter *Karl Kaufmann, ATC NextGen HF Portfolio Manager***

Karl Kaufmann briefed the subcommittee on the NextGen Enterprise ATC Human Factors research. He provided an overview of the BLI before briefing the FY22 research accomplishments and ongoing and anticipated research in FY23 and beyond.

Maggie had a comment related to considering human readiness level. She added a link to the chat window:

Maggie posted these links:

<https://www.osti.gov/servlets/purl/1645947>

[https://www.hfes.org/Portals/0/Documents/DRAFT%20HFES%20ANSI%20HRL%20Standard%201\\_2\\_2021.pdf?ver=2021-01-06-142004-860&timestamp=1609964482681](https://www.hfes.org/Portals/0/Documents/DRAFT%20HFES%20ANSI%20HRL%20Standard%201_2_2021.pdf?ver=2021-01-06-142004-860&timestamp=1609964482681)

Phil Bassett (Cavan Solutions) commended the research that Enterprise is doing with the amounts of data increasing and automation for both controllers and Traffic Management Units (TMU) because they are looking at redoing TFMS and looking at some of the human factor elements that are in play.

Cheryl liked the focus on Info Centric NAS and request to ensure that the availability of data fits into the decision making.

Bill wanted to make note of the F&R from the Summer/Fall 2021 meeting regarding the ATC research plans that will address skill degradation and “Training Air Traffic Controllers for Increased Automation Use” and to keep this in mind because some of this discussion will be brought up again during that time.

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**Break**

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**ATC Human Factors Research, Core | Presenter *Dan Herschler, ATC Core HF Portfolio Manager***

Dan Herschler briefed the subcommittee on the Core ATC Human Factors research. He provided an overview of the BLI before briefing the FY22 research accomplishments and ongoing and anticipated research in FY23 and beyond.

Chris DeSenti had a question on measurement and mitigation strategies for controller performance strategies. Dan indicated that those things would be more for an F&E program, however they would be looking at it as more of a laboratory study to come up with general guidance for mitigation strategies. Chris spoke on the challenge of talking about deskilling as an abstraction and not speaking on the evolution path and how deskilling is measured.

Phil brought up the fact that some of the characteristics of current technology being worked on or proposed, and what Dan briefed overlap, and thought there is room for a cross coordination between them.

Barbara had a concern about this creating brittleness in the system and adding workload to the controllers with new automated data streams. She asked if ways are looked at to maintain flexibilities for potential disruptions and is the system resilient to it. Dan brought up previous work on the resilience of the systems done under the F&E program a couple of years ago and is working on the Tech transfer to AJM. He also noted that the ATC Core research is about general skills, and not tied to skills for specific programs or technologies. Dan is open to the committee creating an F&R around this. Cheryl asked if this is captured in the HF plan that was discussed earlier, and Dan said no that was for AVS but there was discussion on potentially merging these plans or creating a plan that is parallel to this path. He thought there are opportunities for collaboration. Dave highlighted what Chuck and MITRE are doing on automation dependency and he is available to discuss the parallels offline.

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### **FAA Responses to Findings and Recommendations from the last meeting (S/F 21')**

1. Training Air Traffic Controllers for Increased Automation Use
2. Update Alerting Systems Standards

**Training Air Traffic Controllers for Increased Automation Use:** Bill started the discussion on the F&R's from the last meeting. Bill asked if the updates were sufficient for the first F&R on deskilling. Phil said that the response doesn't give proper credit to FAA and the potential for degradation, and needs to know the impact on teamwork not just individual skills. Chinita pointed out that the committee need to provide an updated F&R on this because it has been released to the REDAC so anything that requires additional information must be updated in the F&R. Chris said the bottom line is we will get an update in Summer/Fall FY22 meeting and that this discussion is not the conclusion of this. Chinita clarified that if the subcommittee is satisfied with the response to getting updates between the two meetings then that is sufficient. It can serve as an action item as opposed to an F&R, however, if any additional information or further response is requested before needing to be rewritten as a new F&R. Bill wanted to follow up on the briefing during the next meeting so that a decision can be made on closure. Phil suggested that skill degradation might be best studied in a naturalistic setting (facility) versus a laboratory etc.

Barbara and Bill asked Phil for a few words to describe the additional information that they would like to be updated on during the Summer/Fall FY22 meeting.

**Updating Alerting System Standards:** Bill asked if anyone had additional questions or if there were any comments on the Updating Alerting System Standards F&R. Chuck commented that there is a multi-year research plan for Human Factors design standards for new and advanced flight deck alerting systems. Angel (Boeing) didn't think the F&R was described in sufficient detail, and he looks forward to getting more information in the next meeting. Bill asked specifics on what would be needed. Angel wanted more human performance metrics and how to characterize the different levels of alerts. Bill requested Angel to write an action item for more updates on those points during the next meeting in the fall, similar to the last action item. Maggie asked for the proposals for the new research before the next meeting and if it can be shared with the researchers? Bill said that FAA can share what is known about the research planning at that point.

Bill asked if this F&R from the last meeting was final and on the REDAC site, Chinita said yes it was and can be shared with the research performers. Barbara agreed.

Barbara asked Angel and Maggie to draft an Action on what type of detail they need the committee to provide for the next meeting. Bill said there are actions for more information for both of the F&R's from the Winter/Spring Meeting.

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### **Break**

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### **Discussion of ATC and Flight Deck HF Research Gaps, and Homework Assignments | All**

Phil asked Evan to send the F&R's from the last meeting to the members so they could write new recommendations or action items.

Barbara asked for the dates for the winter 2023. March 28-29 and April 4-5 were suggested. The next meeting will probably be in person in Washington DC. She reminded the subcommittee that the REDAC information is public and available online. The Full REDAC is April 14<sup>th</sup>.

Barbara started the discussion on the Actions based on the F&R discussion. Phil, Angel and Maggie all have Actions to write.

Barbara initiated to write an action for an overview of the EFB research for the next meeting.

Barbara opened it up to the committee for proposals for F&R's based on the discussions from day 1.

Chinita pointed out that the F&R doesn't have to be a deficiency; it can be a positive issue that the committee recommends to continue.

An F&R is needed to support expanding the AVS HF research roadmap across other areas. Dave would like it tied together across all the BLIs.

Chris DeSenti made a comment that he assumed we would get a deeper dive on the roadmap, and request an action for a follow up. Barbara commented that if it was adopted across areas it could be really valuable. Cheryl added we can recommend it as a best practice and needs a more substantive briefing on it and to make it as comprehensive as possible so it can be used as a model for similar plans for other areas. Bill wanted clarification on the term "expanded" what does that really mean?

Barbara asked for volunteers to draft another F&R on this subject. Chris DeSenti volunteered to draft it and send to Barbara, she would add additional notes.

Bill asked is it an actual F&R? Chinita answered that if it is considered an action to expand the roadmap to the broader programs then yes, it is a recommendation. Dan asked if it should include the potential benefit. Chinita added that the more information in the F&R that identifies the utility and the impact, the better.

Phil mentioned that the subcommittee needs to be adequately informed on what research the FAA has already done before we determine the need for a finding.

A member asked what the current processes are for EFBs, does the FAA have the guidance already, and is it working?

**Action:** Barbara asked if Phil and Dave will assist her in writing the action on making sure the committee is informed on what processes and guidance are already in place for EFB's and is it working and then determine if there are any gaps.

Barbara asked the subcommittee for any other F&R's for research gaps. She had two for discussion. First, the Congressional information around the use of Virtual Reality (VR) technology for training. There is a lack of training airplanes and simulators across the industry and VR is being leveraged as a replacement because the others aren't available. Is there any work being done to look at VR for credit in training? She feels that is a gap. Dan thought that is a question for Flight Standards since they determine the airman certification documents. Barbara wishes to talk about this next meeting and said she can present this to Flight Standards as well.

Dave asked is this is for an action item or an F&R. What can you use the training for? Can they be used to maintain proficiency for skills lost when they are not performing their job? Can VR or other ways be used to stay proficient with their skills? Dan thought this might be an F&R for recurrent training needs.

Dave will assist in writing the F&R on using VR technologies to assist in maintaining proficiency for credit.

Barbara's second gap is Pilot State Monitoring in SPO. In SPO or reduced crew scenarios, how do you detect the state of the operator so that the automated system can mitigate any issues the operator might have? Should the subcommittee start looking at ways to monitor the state of the pilot, alerting for a degraded state and then what the mitigation for that

degraded state would be? Chris DeSenti asked where specifically she saw the gaps. Cheryl talked about the intersection of changes to operations and safety and the Human Factors implications on implementation and operations.

Barbara thought it could be useful to provide the industry with some guidance on what is acceptable or not. She would like to discuss again tomorrow along with any additional areas they see gaps in. Cheryl would like more information on the Info Centric NAS roll out at the next meeting, such as to address questions about how information management will change the human role.

Meeting adjourned. 4pm ET

## **End of Day 2**

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**Thursday, March 31, 2022**

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### **Review of Homework Assignments | All**

Bill went over the agenda for the day and Barbara reviewed the homework assignments from day 2. There is an F&R on the AVS Roadmap and a possible F&R on VR Technology for Training and 4 Actions. A discussion is required if they all need to be submitted now or wait until next meeting.

Human Factors research roadmap. This F&R was drafted by Chris DeSenti. The subcommittee recommends that the roadmap be expanded to include Human Factors work across all of the FAA BLI's.

Cheryl said the ATC should also do a separate but similar roadmap of HF work. Bill thought separating it out would be a better approach. Collen Donovan talked about the last sentence, thought it was misleading, the current version does go across all BLIs in AVS, just not all of the ATC BLIs. Colleen suggested it would be better to have a separate recommendation that states the ATC portfolio should develop their own similar roadmap and then later down the road, it can be combined into one roadmap. She thought it should be signed by AVS-1 so it gets that higher level of support.

Barbara asked Chinita if the subcommittee can create one recommendation; that ATC create their own roadmap and that we also support an AVS roadmap that will eventually be combined. There was further discussion on whether to write one finding with two recommendations or write one finding for each recommendation. Chinita clarified that each finding should have a separate recommendation, however you could add enough language to sufficiently link the findings to the multiple recommendations.

Bill asked Barbara to go through the entire list of F&R's and then to further discuss at the end of the day.

**Other Possible Finding & Recommendations and Action items:**

- VR/AR technology for training and how to address the issue of skill degradation and proficiency.
- Request for additional information on Info Centric NAS in the next meeting
- FAA Response to the ATC training needs and possible research in a naturalistic setting
- EFB research briefing from the FAA at the next meeting
- Review of the FAA’s research on SPO and Reduced Crew Operations

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**FAA Budget Update)| Presenter *Elizabeth Delarosby, FAA RED Budget Analyst, Manager***

Elizabeth Delarosby provided an update on the FAA FY22 budget and then a few things on the 2023 and 2024 budgets.

Chris DeSenti asked about the origin of the budget targets. Elizabeth responded that they are provided by OST and OMB usually around February and they are subject to change.

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**Beyond Visual Line-of-sight Rulemaking and UAS Traffic Management Update, Part I| *Jarrett Larrow, UAS Integration Office***

Bill introduced the next presenter, Jarrett Larrow from the UAS Integration Office (AUS). He provided an overview of Beyond Visual Line-of-Sight (BVLOS) and UTM updates.

Bill asked a question about the ARC report and the proposed categories for Ops and certification levels, is there any preliminary reactions to that yet? Jarrett pointed him to the ARC recommendations. The Industry is requesting multiple levels of certification based on flight rules categories and automation and the FAA is still processing this information.

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**Break**

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**Beyond Visual Line-of-sight Rulemaking and UAS Traffic Management Update, Part II| *Jarrett Larrow, UAS Integration Office***

Jarrett continued his overview of the BVLOS and UTM. Phil asked about the nature of the non-concur votes on the report, they seem to be in the critical research areas. Jarrett responded that the concurs-with-comment were generally over subtle refinements to the overall concepts and the non-concurs were about disagreements on ARC concepts such as the right of way, the proposal to update 91.113 and privacy. However, he suggested to look at the actual report for such details. UAS BVLOS Report:

[https://www.faa.gov/regulations\\_policies/rulemaking/committees/documents/media/UAS\\_BVLOS\\_ARC\\_FINAL\\_REPORT\\_03102022.pdf](https://www.faa.gov/regulations_policies/rulemaking/committees/documents/media/UAS_BVLOS_ARC_FINAL_REPORT_03102022.pdf)

A question from the chat was asked about the term “environmental justice” in the document, Jarrett reiterated that there is a strong push to make sure all the voices that wanted to be heard could be heard.

The floor was opened up to questions for Jarrett. Kevin Williams asked is Provider of Services (PSU) the same thing as USS. Urban Air Mobility built out a new entity called PSU which is similar but not the same as USS. They will have more interaction with ATC. Kevin wanted clarification of if it is a type of de-confliction service by a private entity? Jarrett agreed that it is similar, however it is meant to be a sharing environment where operational intent is shared and not just a single provider.

Jack Baker had a question from a safety perspective about what type of research has been done on the HF issues associated with trying to manage 1-to-many operations. Will there be research on that before allowing it to happen? Ferne Friedman-Berg mentioned the one ongoing research project for 1-to-many operations. They are aware of the issues that can change depending on the type of 1-to-many operations. They are just getting started on trying to understand the research base and identify gaps.

Chris DeSenti had a question on Vehicle-to-Vehicle spectrum, how to make decisions on that. Jarrett pointed out the research effort with MITRE to break down the problem and help make recommendations. Bill mentioned that NASA seems to be running a lot of research on this topic.

Bill brought up that the FAA is already deciding that the flight deck is no longer part of the type certification of UAS for these BVLOS systems. He wondered about the new things UAS brings to the table and such as the displays for navigational purposes, the displays needed for decision making. He would like for the UAS community to make a case for why things are different from what already exists for manned aircraft. Jarrett agreed that they should take as many lessons from manned aviation but to also allow them to adapt new needs as appropriate.

Barbara asked if anyone is tracking the Human Factors issues as they occur so they are addressed as this is being developed. Ferne Friedman-Berg pointed out that they do track research gaps overall across all lines of business and are working with Human Factors personnel throughout the FAA. They try to build these gaps into their research plan but just because they track the gaps doesn't mean that the FAA owns it. Wes Olson commented that he hasn't seen the support to fund Human Factors Standards research outside the FAA. Most companies want to promote what they've developed. Unless the FAA changes its HF requirements process the standards or guidance probably won't come from the FAA so do they plan on changing those requirements? It's incumbent on the government to sponsor this research.

Dave had two issues. First is the different work stations and how they are not standardized, it's been an issue for a long time. Secondly, the design part of the control station is being approved as part of the operational approval and not part of the cert (design approval). This is a Human Factors issue: to certify an automated system but then pushing it to operations. Jarrett pointed out that when you put it all on design you challenge the flexibility of the whole system. The ARC recommends unique training for the different types of aircraft.

Bill asked Jarrett if their office can take a more proactive role in involving the subcommittee as needed.

Colleen added this comment in the chat: FYI- the FAA regulatory and guidance is needed in this area... so research could feed those documents. The FAA's AUS office isn't a policy office, but other offices can and do put out UAS regulatory and guidance materials, such as AFS-400 and AIR-600.

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## **HF Final Subcommittee Findings and Recommendations, and Wrap-up | All**

Barbara asked if there is as F&R based on the BVLOS presentation that was given.

Regarding the UAS BVLOS issue, Jack Barker would like an action on what is the Human Factors need to be looked at and which specific research areas. Barbara mentioned we could request for regular briefings on the activities and we could also recommend research that will shape policy. She also needs inquire about who tracks and addresses the Human Factors issues systematically. Dave mentioned what Colleen put in the chat about the FAA's regulatory guidance, he feels that this subcommittee is the best place to bring up the issues. He also feels there needs to be standardization. Steve Lang wanted better briefings with more information. Dan mentioned the work that NextGen Human Factors division did about 10 years ago on UAS control stations. Phil mentioned the HF group in the UAS office. They have primary responsibility for the research and that NASA also does a lot of work on UAM but what was presented today doesn't reflect that. Bill wanted to clarify from Phil that he was speaking of AUS not UAS, also that they have a Human Factors person not a group, and they wouldn't be the people who creates the research requirements. Cheryl said that UTM was designed as community supported concept for controlling traffic outside of the normal FAA airspace and it will be interesting to see

how research can be done to inform standards for these operator displays and separations services, pilot controls. She spoke on the need for standardizations because each manufacturer has a different way.

Bill suggested on doing an F&R on control stations and standardization.

Barbara said they can draft an F&R that speaks to the need for research that informs the standards and policy. She also would ask for more briefings to establish a link to the people actually doing the work. There was further discussion on if this should be an F&R or an Action. Chinita clarified that anytime you request a deep dive or a briefing; that is an action. If you make a recommendation on an action that you want the FAA to take, that is an F&R. Briefings, deep dives and additional information can be requested through an action.

Barbara believed there perhaps should be regular briefings on the UAS Human Factors issues, through an action item.

Barbara would also like an F&R on what we want the FAA to do. Dave suggested an F&R on what lessons needs to be standardized and harmonized. Dan thought the case should be made on why it's in the FAA's best interest to do this. Cheryl thought a better understanding about how the operational approval works and what leverage they have, would be better.

Barbara asked for a volunteer to draft the UAS F&R. Cheryl volunteered. Barbara will draft the action for more briefings and the F&R will be the statement of concern.

F&R: HF Research Roadmap. Chris has edits and Barbara will send the updated version out to the subcommittee when it's complete. Bill had some issues with some of the wording. Chris is going to reword the F&R to include the additions based on the discussion from that day.

F&R: VR Tech for Training. Phil needs wording about how to prevent or minimize skill degradation occurring in the first place instead of how to return to proficiency. Barbara asked Dave to update the F&R with the additional information Dan provided in his briefing. Bill mentioned the work that the Agency might have already done and to start there. Maggie mentioned the EASA link. Angel added to the chat about VR for flight training, and would like to mention it in the training paragraph.

VR/AR Tech for Training reference link (posted by Angel): <https://www.easa.europa.eu/newsroom-and-events/press-releases/easa-approves-first-virtual-reality-vr-based-flight-simulation>

Barbara asked for additional comments and edits on the following Actions:

Possibility for a separate ATO HF Roadmap

FAA Response to the prior F&R on ATC Training needs related to automation

EFB Research Briefing.

Review of Research on Reduced Crew operations

FAA Response to the prior F&R on Alerting Systems Standards

Barbara would like to have the updates by April 1<sup>st</sup> or April 4<sup>th</sup> at the latest. The updates are needed by April 7<sup>th</sup> for the Full REDAC.

Date for the 2023 Winter/Spring meeting is March 28<sup>th</sup> in Washington, D.C.

**Meeting Adjourned-4:20pm ET**

## Agenda

### DAY 1 – Tuesday, Mar 29, 2022

Time	Topic	Presenter
1:00 ET (30 min)	Opening Remarks	<b>Shelley Yak</b> , FAA Director of William J. Hughes Technical Center, REDAC Co-Chair
	Welcome / Introductions	<b>Dr. Barbara Holder</b> , Embry-Riddle University, HF Subcommittee Chair; <b>Dr. Bill Kaliardos</b> , FAA Designated Federal Official (DFO)
	Update from Full Committee Meeting	<b>Dr. Barbara Holder</b> , HF Subcommittee Chair
	Opening Subcommittee Discussion	<b>All</b>
1:30 ET (30 min)	Flight Deck HF Research, NextGen	<b>Dr. Victor Quach</b> , FAA Flight Deck NextGen HF Portfolio Manager
2:00 ET (15 min)	<b>Break</b>	
2:15 ET (45 min)	Flight Deck HF Research, NextGen (cont.)	<b>Dr. Victor Quach</b> , FAA Flight Deck NextGen HF Portfolio Manager
	Flight Deck HF Research, Core	<b>Dr. Chuck Perala</b> , FAA Flight Deck Core HF Portfolio Manager
3:00 ET (15 min)	FAA NextGen Updates	<b>Tara Gibson</b> , FAA NextGen HF Division Manager (ANG-C1), Acting Deputy Director NextGen Portfolio Management and Technology Development Directorate (ANG-C)
3:15 ET (15 min)	<b>Break</b>	
3:30 ET (30 min)	Discussion of Flight Deck HF Research Gaps; Homework Assignments	<b>All</b>
4:00 ET	<b>End of Day 1 Session</b>	

**DAY 2 – Wednesday, Mar 30, 2022**

<b>Time</b>	<b>Topic</b>	<b>Presenter</b>
<b>1:00 ET</b> (30 min)	AVS Human Factors Research Roadmap	<b>Dr. Hannah Baumgartner &amp; Colleen Donovan</b> , AVS HF Specialists
<b>1:30 ET</b> (30 min)	FAA ATC HF Research, NextGen	<b>Karl Kaufmann</b> , FAA NextGen Enterprise HF Portfolio Manager
<b>2:00 ET</b> (15 min)	<b>Break</b>	
<b>2:15 ET</b> (30 min)	FAA ATC HF Research, Core	<b>Dan Herschler</b> , FAA ATC Core HF Portfolio Manager
<b>2:45 ET</b> (15 min)	FAA Responses to Findings and Recommendations from the last meeting (Summer/Fall 2021)	<b>All</b>
<b>3:00 ET</b> (15 min)	<b>Break</b>	
<b>3:15 ET</b> (45 min)	Discussion of ATC and Flight Deck HF Research Gaps; Homework Assignments	<b>All</b>
<b>4:00 ET</b>	<b>End of Day 2 Session</b>	

**DAY 3 – Thursday, Mar 31, 2022**

<b>Time</b>	<b>Topic</b>	<b>Presenter</b>
<b>1:00 ET</b> (15 min)	Review of Homework Assignments	<b>All</b>
<b>1:15 ET</b> (15 min)	FAA Budget Update	<b>Elizabeth Delarosby</b> , FAA RED Budget Analyst, Manager
<b>1:30 ET</b> (30 min)	Beyond Visual Line-of-sight (BVLOS) Rulemaking and UAS Traffic Management (UTM) Update, Part I	<b>Jarrett Larrow</b> , UAS Integration Office
<b>2:00 ET</b> (15 min)	<b>Break</b>	
<b>2:15 ET</b> (30 min)	Beyond Visual Line-of-sight (BVLOS) Rulemaking and UAS Traffic Management (UTM) Update, Part II	<b>Jarrett Larrow</b> , UAS Integration Office
<b>2:45 ET</b> (15 - 45 min, as needed)	HF Final Subcommittee Findings and Recommendations, and Wrap-up	<b>All</b>
<b>4:00 ET</b>	<b>Meeting Adjourned</b>	

**Attendee List****DAY 1 – Tuesday, March 29, 2022**

<b>Name</b>	<b>Organization</b>
Adam Hendrickson	FAA
Al Secen	FAA
Angel Milan	Boeing
Ashley Awwad	FAA CAMI
Barbara Adams	FAA
Barbara Holder	Embry-Riddle University
Bill Kaliardos	FAA
Carl Bernsten	Booz Allen Hamilton
Cheryl Quinn	NASA
Chinita Roundtree-Coleman	FAA
Chris DeSenti	MITRE
Chris Reed	Jet Blue
Chuck Perala	FAA
Colleen Donovan	FAA
Dan Brock	FAA
Dan Herschler	FAA
Dave McKenney	MITRE
Divya Chandra	Volpe
Doug Rodzon	FAA
Eddie Austrian	Fort Hill Group
Evan Harvey	Humanproof
Hailey Abaee	FAA
Ian Johnson	FAA
Jack Barker	ALPA
Jeff Dressel	FAA
Jon Schleifer	FAA
Karl Kaufmann	FAA
Katrina Avers	FAA CAMI
Kelley Krokos	FAA
Kelvin Courtney	FAA
Kenneth Allendoerfer	WJHTC
Kevin Comstock	ALPA
Kevin Siragusa	Fort Hill Group
Kevin Williams	FAA
Kylie Key	FAA CAMI
Lisa Thomas	FAA
Maggie Ma	Boeing
Mark Orr	FAA
Marlo Allen	Quasars, Inc.
Monique Moore	FAA
Phil Bassett	Cavan Solutions
Philip Smith	Ohio State University
Rany Azzi	FAA
Slava Guznov	FAA
Steve Lang	Cavan Solutions
Thomas Van Dillen	FAA CAMI
Todd Lewis	FAA
Tracy Lennertz	Volpe
Victor Quach	FAA
Wes Olson	MIT Lincoln Labs

**DAY 2 – Wednesday, March 30, 2022**

<b>Name</b>	<b>Organization</b>
Abigail Pasmore	ALPA
Adam Hendrickson	FAA
Al Secen	FAA
Angel Milan	Boeing
Ashley Awwad	FAA CAMI
Barbara Adams	FAA
Barbara Holder	Embry-Riddle University
Bill Kaliardos	FAA
Bryan Lesko	ALPA
Carl Bernsten	Booz Allen Hamilton
Carrie Smith	FAA
Cheryl Quinn	NASA
Chinita Roundtree-Coleman	FAA
Chris DeSenti	MITRE
Chris Reed	Jet Blue
Chuck Perala	FAA
Colleen Donovan	FAA
Dan Brock	FAA
Dan Herschler	FAA
Dave McKenney	MITRE
Divya Chandra	Volpe
Doug Rodzon	FAA
Eddie Austrian	Fort Hill Group
Evan Harvey	Humanproof
Ferne Friedman-Berg	FAA
Hailey Abaee	FAA
Ian Johnson	FAA
Jack Barker	ALPA
Jarrett Larrow	FAA
Jeff Dressel	FAA
Jon Schleifer	FAA
Karl Kaufmann	FAA
Katrina Avers	FAA CAMI
Kelley Krokos	FAA
Kelvin Courtney	FAA
Kenneth Allendoerfer	WJHTC
Kevin Comstock	ALPA
Kevin Siragusa	Fort Hill Group
Kevin Williams	FAA
Kylie Key	FAA CAMI
Lisa Thomas	FAA
Maggie Ma	Boeing
Mark Orr	FAA
Marlo Allen	Quasars, Inc.
Monique Moore	FAA
Phil Bassett	Cavan Solutions
Philip Smith	Ohio State University
Rany Azzi	FAA
Russ Tokarski	
Slava Guznov	FAA

Steve Lang	Cavan Solutions
Thomas Van Dillen	FAA CAMI
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**DAY 3 – Thursday, March 31, 2022**

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