FAA UAS SYMPOSIUM

Type and Airworthiness Certifications

Lead: Wes Ryan

UAS Certification Policy Lead, Aircraft Certification, FAA Small Airplane Directorate

Federal Aviation Administration

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#UAS2017

Workshop 10:
Type and Airworthiness Certifications

- **Lead: Wes Ryan,** Manager, Programs and Procedures (Advanced Technology), FAA Small Airplane Directorate
- **Brian Cable**, Manager, Aircraft Certification Airworthiness Section, FAA Aircraft Certification Service
- **Tim Shaver,** Manager, Aircraft Maintenance Division, FAA Flight Standards Service
- **Mark Giron,** Manager, General Aviation Operations Branch, FAA Flight Standards Services
- **Andy Thurling**, Director of Product Safety and Mission Assurance, AeroViroment

What is "Certification"

- Acknowledgement of FAA requirements met for:
  - Aircraft, Aeronautical Products, Airmen, Mechanics, Controllers, Operators, etc.
- Well-proven, risk-based processes for each
  - They are not all the same thing and do not <u>always</u> apply
  - Each process serves a purpose to manage risk

Why Certify?

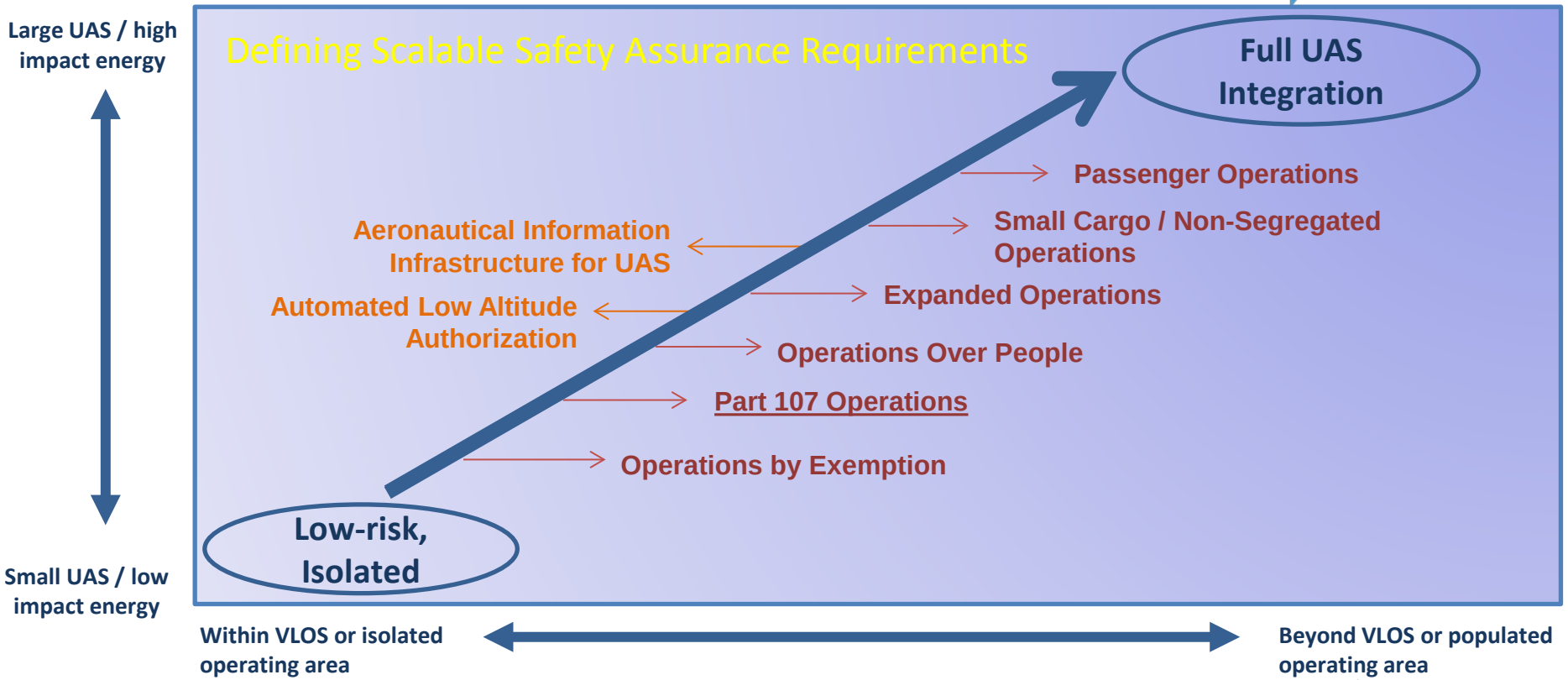
FAA UAS SYMPOSIUM

- FAA must safely manage the airspace and civil aircraft operations
  - Title 49 U.S. Code § 40103(a)(1)
- Manage Operational Risk
  - Apply resources/rigor based on risk
- Certification provides **"Safety Assurance"**
  - Confidence a proposed product or action will meet FAA safety expectations to protect the public

“Safety Assurance”

- Comes from combination of factors
  - **Airworthiness** – Condition for safe flight for its intended use
  - **Design** – Verify design, engineering, construction, etc. meet applicable requirements in certification basis
  - **Pilot** – Train for aircraft and level of risk
  - **Maintenance –** Repair/replace prior to failure
  - **Operation** – Limitations sufficient for the expected/acceptable level or risk
  - **Airspace** – Level of integration, traffic exposure, controller involvement, and equipage

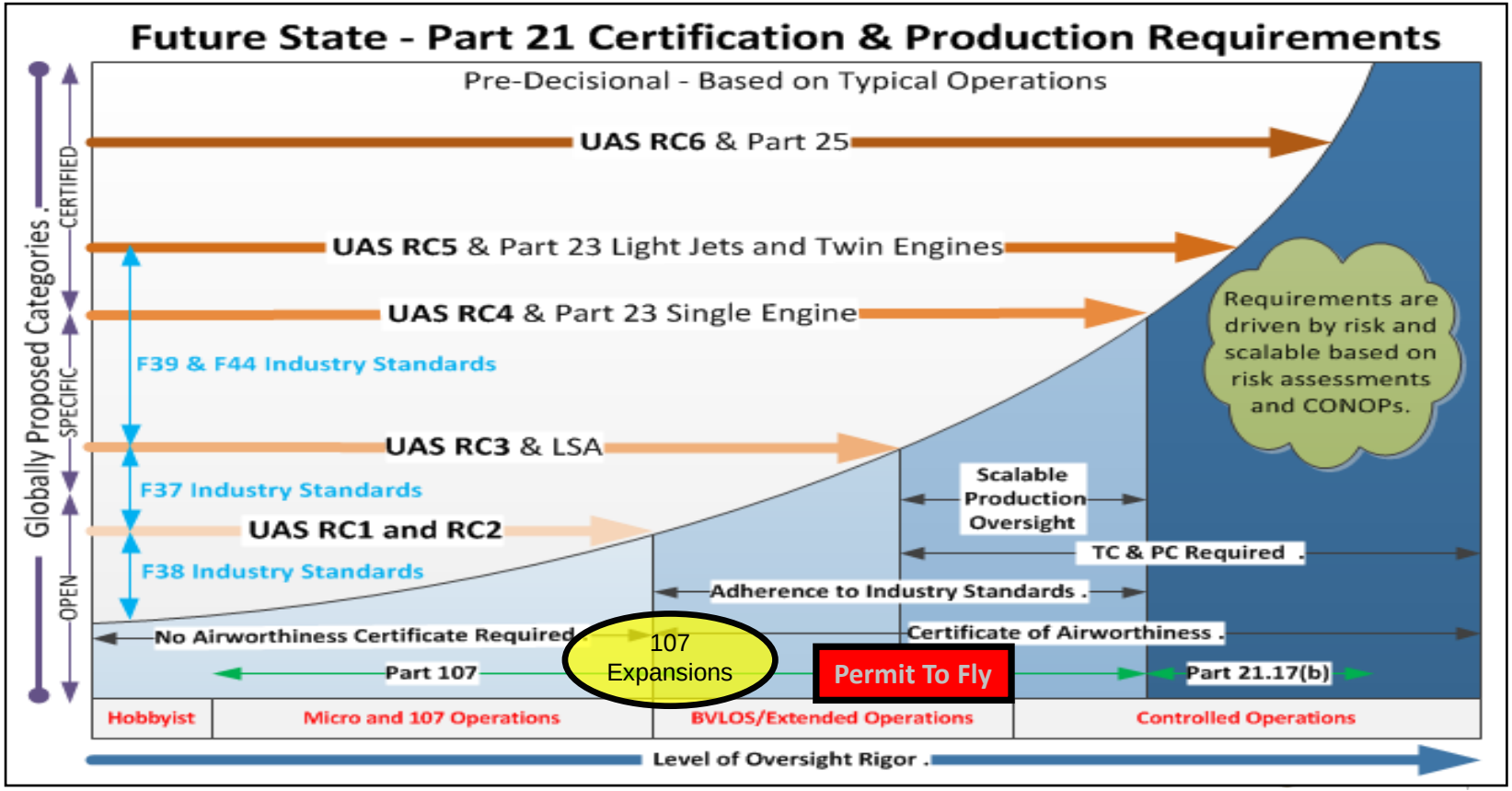
Risk-Based Integration Strategy



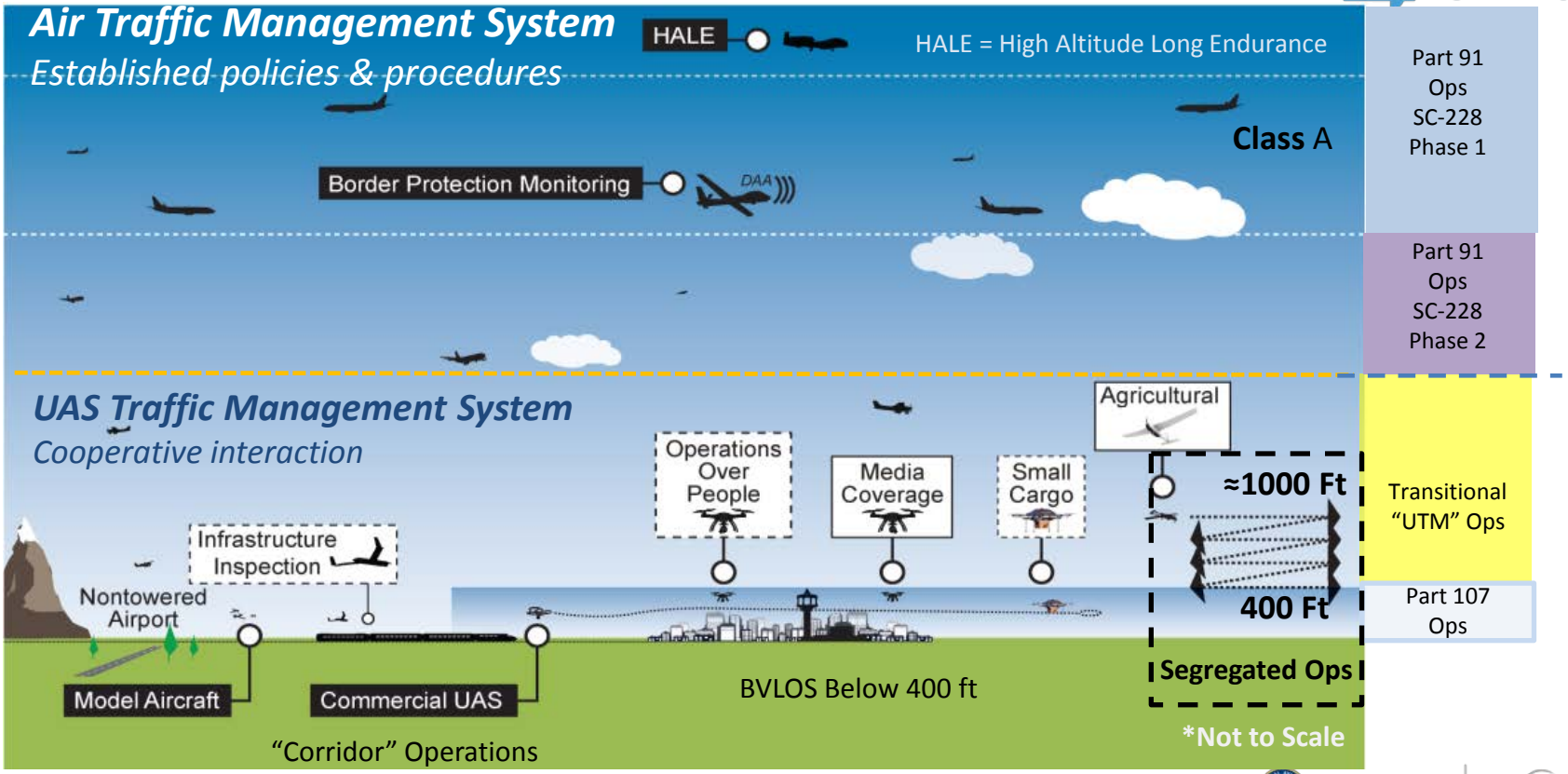
Tiered Regulatory Structure

- Low risk – small UAS under 107
  - Purely an operational rule – no airworthiness or design
  - Waivers allowed for some of the 107 bounds
- Levels of risk beyond 107
  - Exceeding 107 boundaries may require airworthiness requirements to be applied
  - Identifying the certification path for “medium risk” UAS
- When operational integration and risk rise to a sufficient level, Airworthiness & Type Cert/Production Cert are needed

Risk-Based Regulatory Approach



Airspace Integration



Defining Scalable Safety Assurance Requirements

Discussion

FAA UAS SYMPOSIUM

www.faa.gov/uas

Workshop 8:
Understanding Safety Risk Management

- **Lead: Wes Ryan,** Manager, Programs and Procedures (Advanced Technology), FAA Small Airplane Directorate
- **Gerald Pilj**, Aviation Safety Engineer, Safety Engineering Team, FAA Safety and Technical Training Services
- **Rob Pappas,** Manager, Program and Data Management, FAA UAS Integration Office
- **Jeffrey Smith**, Aviation Safety Inspector, Compliance Philosophy Focus Team, FAA Flight Standards Service
- **Jenn Player,** Director of UAS Technologies, Bihrle Applied Research Inc.

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FAA UAS SYMPOSIUM

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Backup Slides

Key UAS Strategic Priorities

FAA UAS SYMPOSIUM

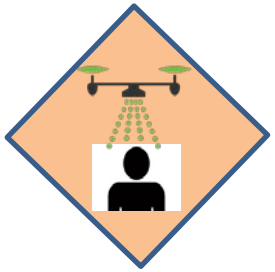
Safety: *Enable safe UAS operations within the NAS*

Adaptability: *Create an environment where emergent technology can be safely and rapidly introduced into the NAS*

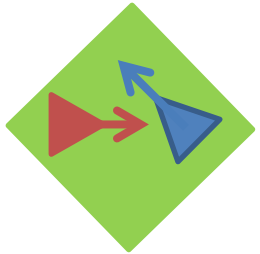
Global Leadership: *Shape the global standards and practices for UAS through international collaboration*

Key UAS Technology Priorities

Security: *Positive Identification and Management of all UAS in real-time*



Protecting Public: *Standards that protect people & property on the ground*



Protecting Other Aircraft: *Combine ground and airborne technology with operational limitations to maintain well clear*

Enabling Civil UAS Access

FAA UAS SYMPOSIUM

Rapid Industry Growth

Open Market & Airspace

Rapidly Evolving Use Cases

Innovative Technology

Low Regulatory Burden

Judicious Integration

Defined CONOP & Mitigations

Standardization

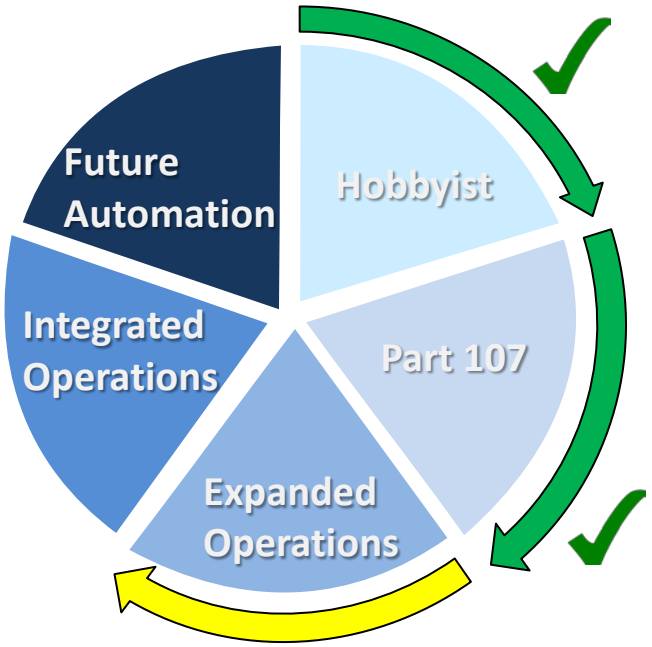
Risk Based Regulations

FAA Safety Goals

Seek Balance to Enable Access

Risk-Based Introduction of UAS

- Hobbyist/Recreational Operations
- Low Altitude Small UAS
  - In line of sight of operator
- Operations Over People
  - (Future)
- Beyond Visual Line Of Sight
  - Operations (Future)
- Integrated/Controlled UAS Operations
- Future Automation – “Pilotless” Ops



Future Rulemaking and Waivers

Foreign Authorities – Similar Ideas

OPEN:

Low risk

Low involvement of Aviation Authority

Limitations: Visual line of sight, Maximum Altitude, distance from airport and sensitive zones

Like Our 107 Rule

SPECIFIC

Increased risk

Operations Authorisation with operations manual

Specific qualification of drone, personnel, equipment based on safety assessment

Waivers/Exemptions/Future & Part 21 Changes

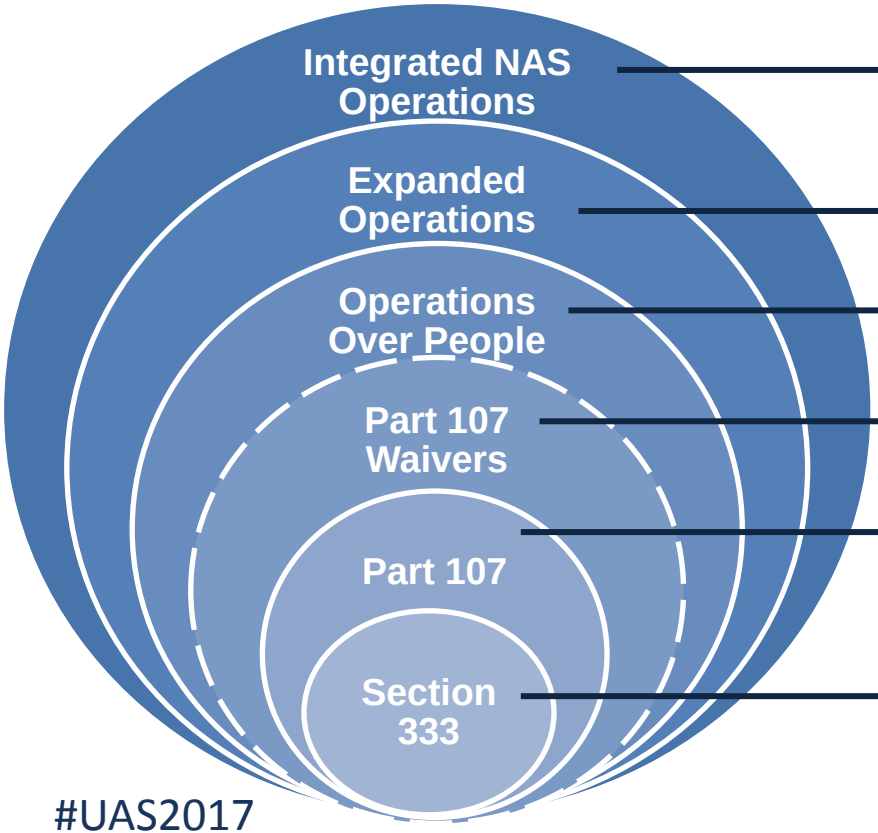
CERTIFIED

Regulatory regime similar to manned aviation

EASA and Authority Certificates

Like Our 21.17(b) Rule

Building the Regulatory Framework



- Interaction with ATC
- Safety achieved via compliance to conventional aircraft operating principles

- Expand part 107 to facilitate low altitude operations through Airworthiness certification

- Expand part 107 to incorporate standards for flight over non-participating people -

- Case-by-case Permission for use cases that inform future regulatory expansion

- Regulatory framework for routine sUAS operations
- Safety achieved through VLOS and operating limitations

- Case-by-case exemptions granted to existing regulations
- Enabled non-recreational UAS operations before Part 107 finalized
- Safety achieved with operating conditions and limitations

Ways of Gaining Safety Assurance

- Airworthiness & Type Certification
- Design Certification Process
- Maintenance
- Pilot/Operator
- Operational Integration

Airworthiness & Type Certification

- Risk-Based Approach
  - FAA Evaluates Proposed Concept of Operation and Operational Risks
- Design Certification Process (Type Cert)
  - Low Risk = Applicant Showing, Applicant Finding
  - High Risk = Direct FAA Involvement - Finding of Compliance to Applicable Requirements
- Airworthiness Certification
  - Condition for safe flight for intended use
  - “Special” (Experimental, R&D, Etc.)
  - “Standard” Airworthiness

Design Certification Process

- Design Requirements = Certification Basis
  - Driven by aircraft, intended use, area of operation, and airspace integration
  - Los Angeles ACO is Focal for Type Cert
  - Directorate is Policy Lead
  - Special Class §21.17(b)- following Order 8110.4C
- Early Certification Efforts
  - Segregated with CONOP limitations on TC sheet
- Future
  - Expanded Operations as equipage and procedures for safe integration are defined and understood

Maintenance

- Plays Important Role in Certification and Continued Operational Safety
  - Expectations based on aircraft, complexity, intended use, area of operation, and airspace integration
  - Formality of maintenance program must be scalable
- Repair/Replace Flight Critical Components
  - Can significantly reduce system/component contribution to failures in service

Pilot/Operator

- Scalable Training Requirements
  - Based on type of aircraft, level of skill required, etc.
  - Remote Pilot Certificate, Sport Pilot, Private Pilot, Commercial Pilot, etc.
- Expectations Driven by Risk to Public
  - UAS present a unique challenge, because the operator has no “skin in the game”

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Aeronautical Knowledge Exam Topics

- Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation
- Airspace classification and operating requirements, and flight restrictions affecting small unmanned aircraft operation
- Aviation weather sources and effects of weather on small unmanned aircraft performance
- Small unmanned aircraft loading and performance
- Emergency procedures
- Crew resource management
- Radio communication procedures
- Determining the performance of small unmanned aircraft
- Physiological effects of drugs and alcohol
- Aeronautical decision-making and judgment
- Airport operations
- Maintenance and preflight inspection procedures

Operational Integration

- Integration Driven by Managing Risk
  - Highly Limited for New Novel Aircraft (Exp.)
  - Operating Limits Removed as FAA Gains Assurance in Operational Safety
- Goal: Protection of People/Property and Other Aircraft
  - Technology Solutions to Avoiding Other Aircraft
- Segregated vs. Integrated Operations
  - As Level of Integration Grows, so do Requirements for Cert, Equipage, Ops Procedures, Configuration Management, etc.

Hobby/Recreational Aircraft

FAA UAS SYMPOSIUM

- Hobby/recreational operators do not need FAA permission to fly, but they must fly safely at all times:
  - Avoid manned aircraft
  - Maintain visual line-of-sight
  - Fly only for hobby/recreation
- They must register and mark their UAS before flying outdoors
  - UAS between 0.55 pounds and 55 pounds may register online

The Small Commercial UAS Rule

- First rules for routine operation of small UAS (<55 pounds) Effective August 29, 2016
- No Operations Over People, Near Airports, etc.
- First Layer of the Onion for Unmanned Integration

Flexibility to Innovate

FAA UAS SYMPOSIUM

Part 107 was written to create operational flexibility for pilots in two ways:

1. Permits individuals to request authorization to fly in controlled airspace (typically around airports)
   - Rule enables routine operations in uncontrolled airspace only (not near airports)
2. Permits individuals to request waivers to certain provisions of the rule, e.g.:
   - Nighttime
   - Over people
   - Multiple UAS per pilot
   - Beyond visual line-of-sight
   - Above 400 feet

Waiver-able Provisions of Part 107

- Operation from a moving vehicle or aircraft (§ 107.25)
- Daylight operation (§ 107.29)
- Visual line of sight aircraft operation (§ 107.31)
- Visual observer (§ 107.33)
- Operation of multiple small UAS (§ 107.35)
- Yielding the right of way (§ 107.37(a))
- Operation over people (§ 107.39)
- Operation in certain airspace (§ 107.41)
- Operating limitations for small UAS (§ 107.51)

Online portal available at www.faa.gov/uas/request_waiver/

Lessons - Beyond Part 107

- Waivers and Pathfinder projects helping us decide future rule priorities
  - Learning from limited extended line-of-sight ops in remote areas, working towards BVLOS
  - Showing criticality of airspace integration, including equipage for Command and Control (C2) and Detect & Avoid
- Developing industry standards for operations over people and expanded operations

Expanding Beyond Small UAS

- "Pathfinder" projects will help us decide future rule priorities
  - Learning from limited exposure of extended line-of-sight ops in remote areas, working towards BVLOS
  - Will help address airspace integration, including equipage for Command and Control (C2) and Detect & Avoid
- Developing standards for operations over people and expanded operations
  - Proposed rule for operations over people targeted for release by end of 2016

Future Technology Opportunities

- UAS will safely prototype technology that will revolutionize flight
  - Automation & Flight Control Technology
  - Auto Collision Avoidance - Air/Ground
  - Automatic Landing Systems
  - Refuse to Crash Logic
  - Propulsion Systems
- Passenger carrying, highly automated aircraft

Enabling Transformational Flight

Uber – Future Transportation

- Need To Build Steps Towards Future
- Partnerships - Industry, FAA, NASA, Academia, Municipalities
- Key is How Automation Can Perform Pilot Functions Safely

EHang from China

Airbus from Europe

Joby from USA

JOBY AVIATION

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Evolo from Germany

Uber – Envisions a Vertical Future

New Legislative Requirements

- FAA Extension, Safety, and Security Act of 2016, Subtitle B – *UAS Safety*
- 13 sections, 23 mandates, including:
  - Standards for remote identification of UAS
  - Guidance for manufacturer safety information
  - Pilot project for UAS hazard mitigation at airports and for critical infrastructure
  - Pilot program for an unmanned aircraft system traffic management
  - Process to limit or prohibit UAS operations over fixed site facilities
  - UAS collision testing and modeling

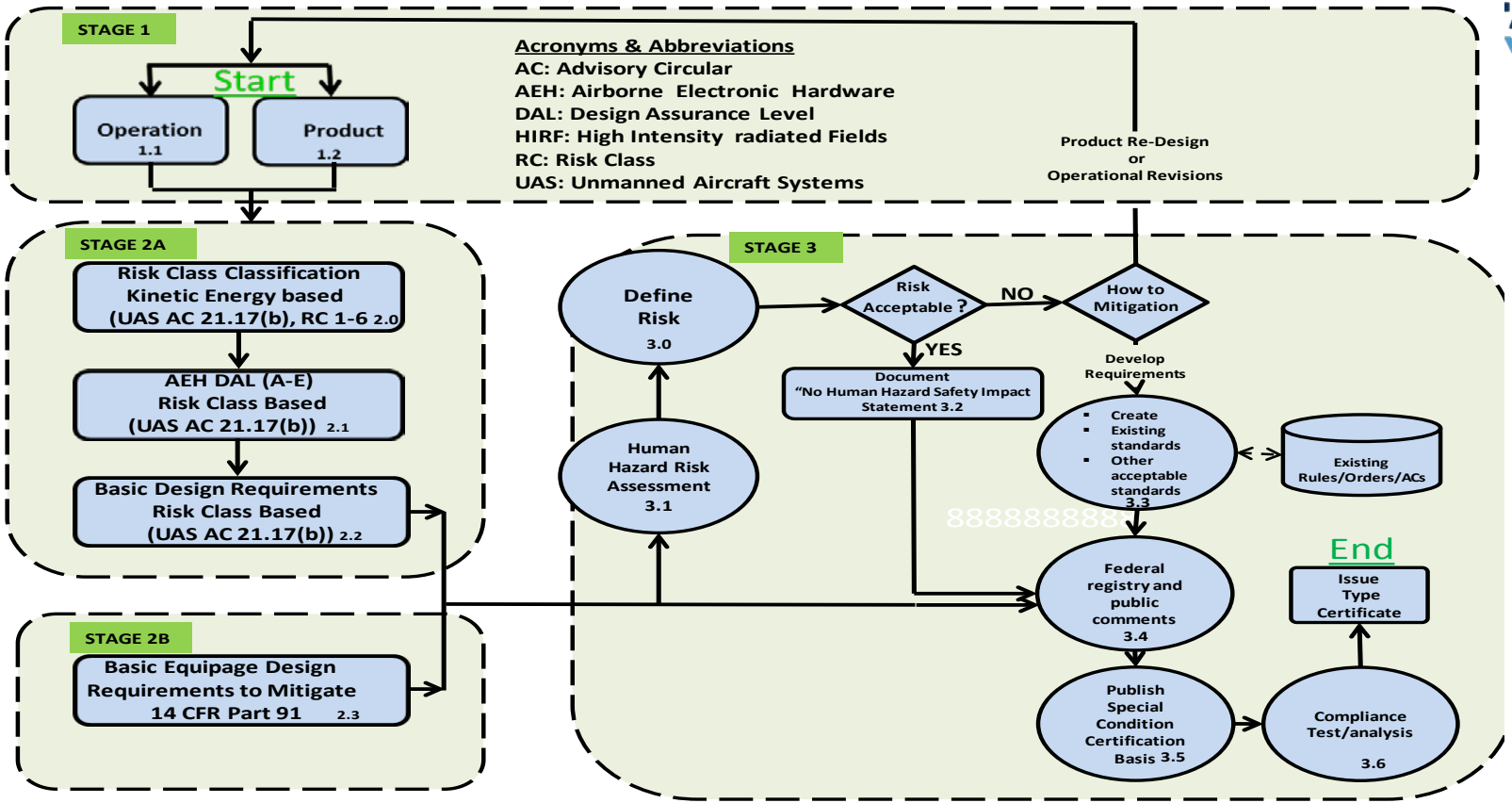
Lessons – LA ACO Certification

- Working Pathfinders and 13 Projects (Current Reg. Structure)
  - Ranging in Size from 5 lb. to 15,000 lb.
  - Exercising our §21.17(b)
  - Informing Future Rule Changes Necessary
  - Must address part 91 operational integration early in the project – We don't want to Type Certify things that can't operate!
- Long Term
  - We don't want to be in the model airplane TC/PC business, UNLESS operational risk warrants it

Summary – Safety From Experience

- We have a history of finding ways to bring new technology into the National Airspace System safely
- We are already using a well-proven risk-based approach to safety
- Society Recognizes a Balance for FAA Rigor vs. Safety Improvement
- UAS Certification will lead to future technology benefits for manned aviation

§ 21.17(b) UAS Process Flow (DRAFT)



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Wes Ryan, Manager, Programs and Procedures (Advanced Technology), FAA Aircraft Certification Service

Wes Ryan has been with the Federal Aviation Administration (FAA) for 15 years and manages the Technology Programs & Procedures Branch in the Small Airplane Directorate in Kansas City. He has helped lead emerging technology initiatives for the FAA in avionics, light sport aircraft, electric propulsion, and unmanned aircraft, and was instrumental in bringing safety enhancing glass displays, GPS moving maps, and envelope protection autopilot technology into light GA aircraft.

Mr. Ryan is currently the certification policy lead for the Aircraft Certification service for UAS design requirements and the type certification process. His goal is to see the safe integration of UAS into the NAS, and to leverage UAS technology to improve safety of manned GA aircraft through transformational flight concepts in the next decade.

Brian Cable, Manager, Aircraft Certification Airworthiness Section, FAA Aircraft Certification Service

Brian Cable joined the Federal Aviation Administration (FAA) in 1999. He is currently the manager of the Airworthiness Certification Section, AIR-113.

His section is responsible for developing and implementing regulations and policy for the issuance of airworthiness certificates, special flight permits, and special flight authorizations. Mr. Cable was previously the manager of the Special Projects section within AIR-200.

Prior to joining the FAA, he spent 16 years at Patuxent River working for the US Navy as a flight test engineer certifying systems for both fixed wing and rotary wing aircraft.

Tim Shaver, Manager, Aircraft Maintenance Division, FAA Flight Standards Service

Tim Shaver serves as the Manager of the Federal Aviation Administration's (FAA) Aircraft Maintenance Division, AFS-300, in Aviation Safety's Flight Standards Service (AFS). AFS-300 consists of six branches staffed by 65 aviation safety professionals, including aviation safety inspectors, aviation safety engineers, program managers, technical writers, analysts and other support staff. Under Mr. Shaver's leadership, the division's work activities directly affect certificate oversight, surveillance, and technical support of our stakeholders by developing and implementing policy, guidance and regulations for aviation safety inspectors and industry operations.

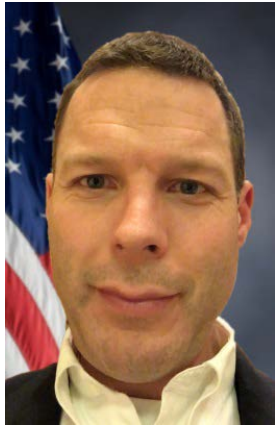
Additionally, the division ensures the airworthiness of civil aircraft through a proactive approach and keen awareness to innovative changes affecting regulations, performance standards and maintenance practices, as well as national policy governing the certification, inspection, and surveillance of the various maintenance entities and practices. His areas of responsibility include general aviation, air carrier, and commercial operators, airmen (mechanics, repairmen, designees, and parachute riggers), avionics, and air agencies (aviation maintenance technician schools and repair stations).

Mark Giron, Manager, General Aviation Operations Branch, FAA Flight Standards Services

Mark Giron is the manager of the Federal Aviation Administration's (FAA) General Aviation Operations Branch, and currently serves on special assignment working to support unmanned aircraft integration into the national airspace system.

He recently led a rulemaking team to explore expanding small unmanned aircraft operations beyond what current regulations allow for, including night operations, multiple aircraft operations and operations beyond visual line of sight.

Mr. Giron is a former airline pilot, spacecraft and aircraft design engineer, and is an active general aviation pilot and flight instructor.



Andy Thurling, Director of Product Safety and Mission Assurance, AeroViroment

Mr. Andrew J. “Andy” Thurling is currently Director of Product Safety and Mission Assurance at AeroVironment in Simi Valley, California.

Mr. Thurling is a Distinguished Graduate of the USAF Test Pilot School as well as the Air Force Institute of Technology. He has held several positions as a test pilot and as an instructor at the Test Pilot School. His career in the Air Force culminated as Commander of the Flight Test Squadron responsible for testing the nation’s newest unmanned aircraft.

Mr. Thurling has over 2,300 hours of flight time in more than 35 aircraft types and was awarded the 2011 AUVSI “Operations Award” for leading the flight testing of AV’s revolutionary liquid Hydrogen powered Global Observer aircraft.

Mr. Thurling is currently leading airworthiness, certification, and airspace access strategic efforts for AeroVironment. He is active internationally as a subject matter expert to the JARUS working group developing the Specific Operational Risk Assessment process.

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