Part 101 Modernization

Aviation Rulemaking Committee

Final Report

November 07, 2025

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I. Executive Summary

The Federal Aviation Administration (FAA) established the Part 101 Modernization Aviation Rulemaking Committee (ARC) on April 4, 2025, to review the part 101 regulations within Title 14 Code of Federal Regulations (14 CFR) and make recommendations based on the directives outlined in section 361 of the FAA Reauthorization Act of 2024 ("the Act").[1][2] One of the primary objectives of the ARC is to discuss and make recommendations to the FAA based on the current operations conducted under 14 CFR part 101. Additionally, the Act directs the FAA to review and develop findings to inform a standard for continuous aircraft tracking of high-altitude balloons that transmits, at minimum, the altitude, location, and identity of the balloon that is accessible to air traffic controllers and ensures the safe integration of high-altitude balloons into the national airspace system (NAS).

For clarity, part 101 regulates unmanned free balloons at any altitude. The ARC does not intend to recommend changes that are unique to an altitude range. Therefore, consistent with part 101, this report will use the designation Unmanned Free Balloon (UFB) as opposed to High-Altitude Balloon (HAB). This is not intended to be a change in the ARC's Charter, rather an acknowledgement that the report is not altitude specific.

During the final approval process for this report, United Airlines Flight 1093 struck an object while in flight at roughly 36,000 feet on October 16, 2025. The aircrew declared an emergency, diverted to an alternate airport, and subsequently landed without incident. It is possible that a Class 1 UFB was involved in this incident.[3]

The ARC reconvened to discuss the incident and any potential modifications to this report. The National Transportation Safety Board (NTSB) has opened an investigation, however no reports have been issued to inform this ARC report. The ARC felt it was premature to change its recommendations without NTSB completing its analysis. One of the ARC's activities was to review 13 years (2012 through 2024) of available data. During this review, the ARC did not find a single report of aircraft damage that could be attributed to a UFB. However, if this 2025 incident is attributed to a UFB, the ARC recommends that the FAA should consider this incident with the ARC recommendations. The ARC members would be willing to reconvene and consider modifications to this report if warranted or requested.

[1] FAA Reauthorization Act of 2024, Public Law 118-63, 361. (Jan. 03, 2024).
[2] Part 101 Modernization Aviation Rulemaking Committee Charter (April 04, 2025).
[3] Aimee Ortiz, "A Weather Balloon May Have Cracked a United Plane's Windshield," *The New York Times* (Oct. 21, 2025).

II. Chairs' Comments

The Chairs are grateful to all members for their participation and contributions. Each member organization invested time and resources that enabled its participants to provide subject matter expertise to this ARC. The Chairs' goal was to invite at least one participant from each segment of any discipline related to this ARC, whether a balloon operator segment, manned aircraft operators and manufactures, or standards organization.

Considering the timeframe between publication of the ARC's charter and report delivery date that enabled meeting Congressional direction received via the FAA Reauthorization Act of 2024, the ARC quickly formed, gained mutual trust, and began performing. The ARC, via delivery of this report, accomplished its tasks within roughly seven months.

The Chairs are proud of the analysis completed with the data provided, inclusive of numerous requests for information to FAA personnel. This data was critical to the ARC's analysis and resulting recommendations. The Chairs thank participants for their contributions and attendance so we may continue to modernize our NAS regulations in a continued effort to safely accommodate modern UFBs in the NAS.

III. ARC Charter Overview

A. ARC Tasking

The ARC Charter outlines six principal tasks for the ARC with specific considerations that must be applied to each task. The first four tasks deal with surveillance of UFBs in the NAS, addressing the Act's direction with specific recommendations on the following:

- Tracking Standards.
- Rule Changes.
- Other Regulation Changes.
- New Equipment.

In addition, two other tasks were assigned to the ARC that are not specifically related to surveillance of UFBs:

- Recommendations on the applicability to manned moored balloons or kites.
- Review recommendations from the previous 2017 Part 101 ARC Recommendation Report.[4]

B. ARC Activities

To accomplish these tasks, the ARC organized its activities around the following:

[4] Title 14 Code of Federal Regulations Part 101 Aviation Rulemaking Committee, *ARC Recommendations Report* (Dec. 2017).

- Understanding the regulatory landscape and current operations, including reviewing the current classifications of UFBs.
- Reviewing available safety data related to UFB operations to understand the potential benefits and/or risks of recommendations.
- Reviewing current surveillance technologies either used by the FAA or the industry to surveil UFBs.
- Surveying platform capabilities, costs, and other constraints by type of operation to support an economic analysis of any recommendations.
- Developing recommendations based on available technologies, platform capabilities, and economic effects.

As prescribed by the Charter, ARC membership reflected a cross-section of stakeholders with representatives from research and educational organizations, balloon manufacturers and operators, government agencies, and industry associations.

The ARC held seven plenary sessions of various durations, normally one or two days, beginning in May 2025 and concluding in October 2025. ARC members hosted several meetings at various locations, including Aerostar facilities in Sioux Falls, SD and Washington, DC, Windborne in Palo Alto, CA, and the FAA Central Service Center in Fort Worth, TX. The ARC also held two meetings outside the routine plenary sessions to discuss potential notification requirements and to address an incident potentially involving a Class 1 UFB.

IV. Background and Overview

A. U.S. Regulatory Landscape

1. 14 CFR Part 101: Moored Balloons, Kites, Unmanned Rockets, and Unmanned Free Balloons

Within the United States (U.S.), 14 CFR part 101 provides platform requirements and operational rules for moored balloons, kites, unmanned rockets, and UFBs. Part 101 regulates each type of system based on characteristics described in § 101.1. All UFBs must follow the regulations outlined in part 101 subpart D if any of the following characteristics (§ 101.1(a)(4)) apply:

- Carries a payload package that weighs more than four pounds and has a weight/size ratio of more than three ounces per square inch on any surface of the package, determined by dividing the total weight in ounces of the payload package by the area in square inches of its smallest surface.
- Carries a payload package that weighs more than six pounds.
- Carries a payload, of two or more packages, that weighs more than 12 pounds.

- Uses a rope or other device for suspension of the payload that requires an impact force of more than 50 pounds to separate the suspended payload from the balloon.

Any UFB that does not have any of these characteristics is only subject to 14 CFR 101.7 (Hazardous operations).

If the UFB has any of the above characteristics, it is subject to subpart D, including:

- Section 101.33 Operating limitations.
- Section 101.35 Equipment and marking requirements.
- Section 101.37 Notice requirements.
- Section 101.39 Balloon Position Reports.

2. 14 CFR Part 91: General Operating and Flight Rules

Part 91 of Title 14 CFR generally applies to all aircraft operating within the NAS, including operations up to 12 nautical miles (nmi) from the coastline. However, 14 CFR 91.1 specifically excludes application to any aircraft or vehicle governed by part 101 subparts B, C, or D. Hence, current part 91 regulations do not apply to any aircraft or vehicle being considered by this ARC.

That said, any application of Automatic Dependent Surveillance-Broadcast (ADS-B) technologies to UFBs regulated by part 101 must consider the ADS-B requirements provided in part 91. These considerations are addressed in this ARC's recommendations.

B. International Civil Aviation Organization (ICAO) Regulatory Landscape

For international operations, operators must comply with ICAO regulations for UFBs, found in International Civil Aviation Organization Annex 2 – Rules of the Air.[5] These regulations are reasonably harmonized with FAA regulations, with UFBs classified as Light, Medium, or Heavy. Although individual payload weights may vary due to metric measurements versus imperial, they provide a similar framework to part 101.

The limitations on ICAO heavy UFBs generally correlate to UFBs that are subject to part 101 subpart D, however, current ICAO regulations for Heavy balloons have three significant differences compared to current part 101 regulations:

- A radar reflective device is not required if a balloon is equipped with a device that allows continuous tracking beyond the range of ground-based radar.
- If operated in an area with ground-based secondary surveillance radar in use, the UFB must be equipped with a transponder with pressure-altitude reporting capability.

[5] ICAO Annex II Tenth Edition, Appendix 5-1 (July 2005).

- If operated in an area with ground-based ADS-B equipment in use, the UFB must be equipped with an ADS-B transponder with pressure-altitude reporting capability.

In addition, ICAO regulations designate two classes of UFBs, Light and Medium, that reasonably correlate to the limitations associated with UFBs not subject to part 101 subchapter D.

- Light UFBs are limited to a combined payload mass of less than 4 kg (8.8 lbs). Otherwise, they are regulated in a similar way to UFBs not subject to part 101 subpart D.
- Medium UFBs are limited to a combined payload mass of less than 6 kg (13.2 lbs). Medium balloons must provide a notification of launch to Air Traffic Control (ATC) but otherwise are regulated the same as a Light UFB.

V. UFB Characteristics / Operations

A. UFB Categorization / Class

As detailed in § 101.1(a)(4), UFBs are subject to subpart D if certain characteristics are met, principally related to the mass characteristics of the payload. For the purposes of this ARC report, any UFB that is not subject to subpart D will be referred to as a **Class 1 UFB**. If the UFB is subject to current subpart D regulations, it is referred to as a **Class 2 UFB**. The distinction between Class 1 and Class 2 UFBs reflects the potential hazard a UFB may pose to manned aircraft within the NAS. As discussed during the ARC meetings, members believe Class 2 UFBs pose a greater risk to aircraft due to the payload areal density, mass, or suspension device break strength. Therefore, Class 2 UFBs are subject to more restrictive regulations as outlined in subpart D.

ATC procedures outlined in Order JO 7110.65 effectively distinguish between Class 1 and Class 2 UFBs, if not by name. Specifically, 9-6-1 (Application) states "*These procedures apply to unmanned free balloons that carry payloads as described in 14 CFR section 101.1(a)(4).*"[6] There are no ATC procedures documented for Class 1 UFBs.

The ARC recommends adopting this UFB class distinction in part 101 as there has been confusion as to what requirements are levied on Class 1 UFBs. Although § 101.1(4)(a) specifies the subset of UFBs for which subpart D is applicable, § 101.31 states subpart D applies to the "operation of unmanned free balloons" with no distinction. This leads some to interpret that subpart D applies to all UFBs, despite applicability per § 101.1.

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[6] FAA Order 7210.632A, Air Traffic Organization Occurrence Reporting Including Change 1 and 2, Section 6 (Oct. 01, 2020).

Creating two distinct classes for UFB in part 101 subpart D, using the same structure as for unmanned rockets in part 101 subpart C, accomplishes two goals. First, all UFB regulations would be contained within subpart D. This would allow new regulations to be levied against Class 1 UFBs within subpart D. Secondly, it should eliminate any confusion as to requirements for each class.

B. Annual Operations

As the FAA does not track statistics on part 101 UFB operations, the ARC reviewed information provided by UFB operators to the ARC, publicly available data, and available operator support organization data to estimate the total number of annual UFB operations. The ARC divided Class 1 and Class 2 UFBs into different subcategories to better represent current UFB operations and help frame the ARC's recommendations (Table 1). An explanation of each Class 1 and Class 2 UFB subcategory follows.

UFB Class	**Flights**	**% Total Operations**
Class 1 (currently not subject to part 101 subpart D)	77,200	99.0%
Class 2 (currently subject to part 101 subpart D)	810	1.0%
Total Annual Operations	**78,010**	**100.00%**

Table 1 – UFB Annual Operations by Class

C. Class 1 UFB

Class 1 UFBs are generally smaller UFBs that account for approximately 99% of all operations in the NAS. There are a diverse set of operators and a wide range of applications for Class 1 UFBs. As such, the ARC found it most useful to subcategorize Class 1 UFBs by the type of operator. Radiosondes are a specific application flown by several types of operators, but are a consistent payload and mission. Given the number of radiosonde flights, they will be considered a separate subcategory.

Class 1 UFB Annual Operations	Flights	% Class 1 Operations	% of Total Operations	Typical Mission Cost
Radiosondes	73,000	94.6%	93.6%	< $450
Commercial	3,000	3.9%	3.9%	< $3,000
Scientific/Academic Research	500	0.6%	0.6%	< $5,000
STEM Programs	500	0.6%	0.6%	< $1,000
Recreational	200	0.3%	0.3%	< $750
Total Class 1 Operations	**77,200**	**100.0%**	**99.0%**	

Table 2 – Class 1 UFB Annual Operations

1. Radiosondes

Predominately flown by the National Weather Service (NWS), radiosondes are lightweight, battery-operated sensors that typically weigh less than 3.5 oz (100 g) and are normally flown as payloads to latex weather balloons to provide in-situ measurements of the atmosphere, called soundings. Under normal launch conditions, the balloon ascends to an altitude of 100,000 ft (~ 30 km), bursts, and descends under a parachute. The entire flight lasts between two and three hours. It is worth noting that the payloads are not actively recovered by the operator.

There are over 1,000 sites worldwide that launch radiosondes two times per day, normally at 0000 Greenwich Mean Time (Zulu/Z) and 1200Z. As part of the Upper-Air Observations Program, the National Weather Service (NWS) operates 92 of those sites across North America and the Pacific Islands. NWS also aids an additional ten stations in the Caribbean as part of the Cooperative Hurricane Upper Air Stations.[7] These soundings are vital for improving weather forecasting models and informing local stations of their current weather conditions. Depending on the weather conditions, some stations will opt to launch additional soundings at 0600Z and/or 1800Z. These additional soundings are particularly helpful on days with an increased chance of severe weather events and help local meteorologists inform the public. Under normal operating conditions, NWS stations launch, at minimum, 204 radiosondes per day, accounting for more than 94% of Class 1 UFB operations annually. NWS reports the typical cost of a radiosonde flight is $425.

[7] National Weather Service, *Upper-Air Observations Program*. *See also*, National Weather Service, *NWSM 10-1402 Radiosonde Observations Handbook* (Dec. 08, 2023).

2. Commercial Operators

In recent years, a growing number of commercial ventures have begun employing Class 1 UFBs to leverage relatively low-cost flight hardware for a range of purposes. Common commercial uses include remote sensing and aerial imaging, atmospheric and environmental monitoring, telecommunication and networking experiments, and technology validation at near-space altitudes. The compact size of these payloads allows for rapid deployment and short development cycles while still achieving meaningful data collection and demonstration of objectives.

Flight durations vary depending on platform design, ranging from a few hours to multiple days at altitudes up to 100,000 feet. Payloads often include miniaturized cameras, scientific sensors, or communications hardware and may be powered by batteries or small solar arrays. Typical launch costs range from several hundred to several thousand dollars, depending on payload complexity, endurance, and recovery requirements. These commercial uses represent a growing segment of the UFB community, reflecting broader trends towards lower-cost, high-agility approaches to atmospheric and stratospheric research.

3. Scientific/Academic Research

Scientific/Academic Research operators use a different set of balloons and often carry heavier payloads. This group typically consists of researchers working at national laboratories or university students. One subset of these balloons is called a heliotrope, which is a passive solar hot air balloon. Unlike the latex balloons used for radiosondes, heliotropes ascend and then float at an altitude of 60,000 ft (~ 20 km). The maximum flight duration for one of these balloons is around 14 hours. Additionally, heliotropes can only operate between sunrise and sunset, as they generate lift using solar radiation and cannot float or ascend at night. Heliotrope size varies depending on the payload weight and will usually be around 3 – 10 m in diameter.[8] The payloads for these balloons are typically heavier (> 4 lbs) than other Class 1 UFBs.

The cost of launching a heliotrope varies depending on the operator. Including the balloon envelope, tracking methods, and launch equipment, the typical cost for one flight is less than $5,000 for university operators. Depending on the scale of the project, they can cost as little as $50.[9]

Helium zero-pressure balloons are another type of balloon used by Class 1 UFB operators. These are more expensive than heliotropes and are not typically used at the university

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[8] *See e.g.*, Daniel Bowman et. al, "Multihour Stratospheric Flights with the Heliotrope Solar Hot-Air Balloon," *American Meteorological Society, Journal of Atmospheric and Oceanic Technology* (Jun 08, 2020).
[9] Cost estimate based on ARC member subject matter experience.

level. Unlike heliotropes, helium zero-pressure balloons can operate at night and typically have a longer flight duration to the order of multiple days or weeks.

4. STEM Programs

There are various science, technology, engineering, and mathematics (STEM) programs that launch UFBs. These educational groups typically consist of educator-led groups of students that launch Class 1 UFBs for the purpose of achieving related educational objectives. These launches aim to give concrete learning opportunities to study topics such as physics, wave propagation, weather/atmospheric conditions and patterns, platform engineering, etc.

Based on ARC member experience, more than 99% of these educational UFB payloads' weights can be categorized under Class 1 operations. Flight durations vary from as little as one hour to several weeks at an altitude of 40,000 ft. These payloads are typically powered using only solar power and cost around $75. As these payloads are only solar powered and carry no batteries, the onboard electronics do not operate at night.[10]

On rare occasions, STEM programs may launch a Class 1 UFB with a more substantial payload, but still under four pounds. These balloons often carry batteries, cameras, and other sensors to an altitude of ~ 100,000 ft prior to bursting. The payloads then return to earth under a parachute and are recovered by the launch team. These launches cost in the range of $500 to $600.[11]

5. Recreational Operations

Latex balloons, flight components, and complete kits are available online to the general public. The cost of these kits typically ranges from $400 to $700 and includes everything needed to fly a Class 1 UFB, excluding the lifting gas. Most kits enable the addition of optional equipment such as cameras or other sensors.

In a review of some of the kits available online, few, if any, reference the need to comply with part 101 or any other regulatory constraints on the balloon's operation. It is difficult to estimate the number of recreational flights that are made annually, but many have been documented on social media and other sites.

D. Class 2 UFBs

As per § 101.1(a)(4), Class 2 UFBs will have:

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[10] *See e.g*. Wyoming NASA Space Grant Consortium, *An Educator's Guide to High-Altitude Ballooning* (July 31, 2024).

[11] Cost estimate based on ARC member subject matter expertise.

1. A single payload package weighing more than four pounds and a weight/size ratio of more than three ounces per square inch,
2. A single payload weighing more than six pounds,
3. A payload, consisting of two or packages, weighing more than 12 pounds, or
4. A rope or device of suspension with an impact force greater than 50 lbs.

There is no regulatory maximum payload mass. There are a smaller number of Class 2 UFB operators compared to Class 1 operators, some of which fly balloons across the full range of payload masses.

The ARC found it to be more effective to analyze the Class 2 UFB market by payload mass rather than by different operators. For the purposes of this report, Class 2 UFBs are classified in three payload ranges.

Class 2 UFB Annual Operations	Flights	% Class 2 Operations	% Total Operations	Typical Mission Cost
Medium Payload < 100 lbs (45.4 kg)	500	61.7%	0.6%	>$10,000
Heavy Payload 100 lbs (45.4 kg) to 1,000 lbs (454 kg)	300	37.0%	0.4%	>$100,000
Very Heavy Payload > 1,000 lbs (454 kg)	10	1.2%	0.0%	>$1,000,000
Total Class 2 Operations	**810**	**100.0%**	**1.0%**	

Table 3 – Class 2 UFB Annual Operations

1. Medium Payloads

Medium payloads represent the low end of Class 2 UFB with payloads weighing less than 100 pounds (45.4 kg). There is no specific minimum payload, payloads weighing only a few pounds could be considered Class 2 if they exceed any of the limitations in § 101.1(4)(a).

Systems with medium payloads can typically launch with limited launch crew and equipment, making them more suitable for more tactical or flexible launch operations. They can often be launched from unimproved areas with little infrastructure.

2. Heavy Payloads

Heavy payloads are classified as having payloads weighing more than 100 pounds (45.4 kg) but less than 1,000 pounds (454 kg). Besides the likely increased consequence of a Mid-Air Collision (MAC) or other incident, heavy payloads typically require more crew members, specific launch equipment, and more ground infrastructure.

3. Very Heavy Payloads

Very heavy payloads are classified as having payloads weighing more than 1,000 lbs (454 kg). Currently there are fewer than 10 flights flown in the NAS each year by a small number of operators. As with heavy payloads, the likely consequence of an incident increases with the increasing payload weight. UFBs with very heavy payloads require more crew members, significantly more robust ground handling equipment, and more restrictive launch sites, flight paths, and recovery areas.

E. Airspace / Altitude Characteristics

Depending on the application, UFBs can operate across a broad range of altitudes, sometimes exceeding 160,000 ft (~ 49 km) mean sea level (MSL). As such, any surveillance technology should be appropriate for every class of airspace.

Critical phases of UFB operations include the ascent and descent through portions of the NAS with manned aircraft operations. Typical ascent rates for a UFB can be as fast as 800 to 1,200 feet per minute (4 to 6 meters per second) with descent rates of 1,200 feet (6 meters per second) or faster. At these rates, the update rate of any surveillance technology will affect positional accuracy of the UFB.[12]

VI. Safety Reporting Data

A. Overview

It is important to note that the ARC does not presume or conclude from its review of safety reporting data that UFB operations are inherently without risk. To the contrary, the ARC relied on data from various sources (e.g., the Aviation Safety Reporting System (ASRS) maintained by the National Aeronautics and Space Administration, FAA Mandatory Occurrence Reports (MOR) from the Comprehensive Electronic Data Analysis and Reporting (CEDAR), and the Voluntary Safety Reporting Program to enhance its understanding of the frequency and outcomes of safety reports involving UFB operations over the past 13 years. Indeed, all NAS activities carry some inherent safety risk and the FAA's mission is to provide the safest, most efficient aerospace system in the world. This

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[12] *See* National Aeronautical and Space Administration, *Scientific Balloons* (2014); National Aeronautical and Space Administration, *The Super Pressure Balloon (SPB)* (Oct. 03, 2022).

includes identifying, assessing, and mitigating risk. Therefore, although the data reviewed did not reveal previously unknown safety concerns involving UFB operations, the ARC is mindful that it must be willing to reconsider, re-examine, and evolve beyond the safety assumptions that were made in the 1960s when making regulatory recommendations for a growing industry.

To ensure the ARC members had valid information on which to base recommendations, select ARC members reviewed MOR Data and Voluntary Safety Reporting Programs (VSRP). This deidentified data was not made available to the ARC members at large but was reviewed and generally summarized by a two-person subgroup for the purpose of maintaining confidentiality of the reports, regardless of type.

The summaries below capture the safety data collected and analyzed by select ARC members. The ARC considered calendar years 2012 through 2024 and queried appropriate databases for incidents involving a "balloon" (and likely misspelled derivations, e.g. "ballon" and "baloon") and "UFB." The information analyzed did not include sufficient data to determine and include the size of balloons or type of balloon operator. To ensure transparency, the select ARC members skewed to including any reported data if there was any chance the report could be a UFB, while not considering reports involving other uses of "balloon," such as "ballooned upon landing." The ARC did not attempt to differentiate between sizes of balloons, nor estimate the distance between the balloon and any aircraft if the data involved an aircraft.[13] The ARC considered the following primary criteria for considering a report, but was conservative in excluding any possible reports:

- Whether the report could be attributed to a high-altitude balloon.
- Whether the report would "inform the ARC" (e.g., if the report identified an issue that dealt with lack of notification or visibility, where use of a transponder or additional information to either pilot or controller could be a solution).
- Whether the balloon struck an aircraft or there was a reported and/or verified MAC.
- Whether there was any effect on air traffic operations from the perspective of pilot (e.g., corrective/evasive maneuvers) or controller (e.g., vectoring aircraft off their planned route of flight or issuing derelict balloon phraseology).

[13] Atmospheric factors considerably affect reporter accuracy. Balloon size and shape vary depending on atmospheric position, and perceived color is significantly affected by time of day, atmospheric conditions, and weather.

B. MOR Data

MOR data is reported by ATC, as mandated under FAA Order JO 7210.632A.[14] MOR data captures a full spectrum of occurrences, from sightings of unmanned aerial systems or unidentified anomalous phenomena activity to expressions of concern or inquiry. These expressions of concern or inquiry encompass "proximity or operation of an aircraft, either airborne or on the surface, including near mid-air collision notifications from a flight crew." Not all notifications or inquiries are the result of direct damage to aircraft.

The ARC reviewed 378 MORs, of which 257 included some reference to "Balloon" activity between 2012 through 2024. The FAA collects and analyzes safety information in various forms, including MOR data, in the interest of identifying, tracking, and taking corrective action to mitigate risks to aviation safety.

Among the MOR data reviewed, the ARC identified 17 reported balloon "strikes"[15] to manned aircraft, and two of those "strikes" reported damage as a result. On one occasion, a pressurized aircraft traveling at greater 300 knots above 15,000 ft. reported potential windshield seal damage because of the balloon strike. On the second occasion, a pilot reported needing to restart an engine. Both aircraft landed without incident, e.g., declaring an emergency or diverting from their intended destination.

The ARC also reviewed and categorized 60 additional MORs as disruptions to the NAS for failure to follow procedures, airspace incursions and/or traffic conflict, and issues with transponders. Finally, the ARC reviewed and categorized another 50 MORs as positive validation that safety systems were working properly, such as: ATC receiving and relaying information on the whereabouts of UFBs to pilots to validate a pilot report; and reports documenting UFB operators following proper procedures.

C. ASRS Data

In contrast to MOR reporting, ASRS reporting is publicly available to all NAS participants as a confidential and non-punitive means to identify safety incident/situation reports.[16] Report forms vary only slightly based on the reporting party (General; ATC; Maintenance; Cabin; unmanned aircraft system (UAS)/Drone). Otherwise, users are prompted to describe the event or situation, and consider other elements of the event/situation, such as human performance, corrective actions, and "perceptions, judgements, decisions."

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[14] FAA Order 7210.632A, *Air Traffic Organization Occurrence Reporting Including Change 1 and 2*, Section 6 (Oct. 01, 2020).

[15] Among the reports, pilots were often unable to confirm whether "strike" was with a high-altitude balloon or UAS.

[16] Advisory Circular No. 00-46F, Aviation Safety Reporting Program (Apr. 02, 2021).

The ARC identified 50 ASRS reports between 2012 and 2024 using the search criteria described above. Of these 50 reports, the ARC determined that 13 lacked sufficient clarity to classify as UFB incidents that would inform the ARC's review. These reports often consider birds and UAS as alternative possible explanations. This narrowed the ARC's review to 37 total reports. Of the 37 reports that the ARC considered, 32 resulted in evasive maneuvers, effects to operations, or general disruptions to the NAS. Of the total reports considered, the ARC found only one instance of a reported MAC. This MAC did not result in any reported damage to the aircraft. The ARC also identified two reports indicating safety systems working positively.

D. VSRP Data

In addition to MORs, air traffic controllers can document potential safety concerns by submitting reports through an FAA voluntary safety reporting program. These deidentified reports, due to their voluntary and sensitive nature, were reviewed by two ARC members with appropriate access. Only generalized data in summary form was released to the ARC members.

Of the data analyzed, the ARC identified 104 reports between 2012 and 2024 using the search criteria described above. Of these 104 reports, the ARC determined that 26 lacked sufficient clarity to classify them as UFB incidents that would inform the ARC's review. This narrowed the ARC's review to 74 total reports.

Of the 74 reports that the ARC considered, 68 resulted in evasive maneuvers, effects to operations, or general disruptions to the NAS. Of the total reports considered, the ARC found only one instance of a reported MAC. This MAC did not result in any reported damage to the aircraft. The ARC also identified two reports indicating safety systems working positively.

E. Safety Reporting Data Summary

Data Type	UFB Mentioned	Informs ARC	Strike	Effect to Operation
MOR Data	378	257	17	60
ASRS Data	50	37	1	32
VSRP Data	104	74	1	68
Total	**532**	**368**	**19**	**160**

Table 4 - Combined ASRS, MOP, and VSRP Data for CY2012-CY2024

VII. ATC Surveillance Methods

A. Overview

The preferred method of surveillance for air traffic control in the NAS is Automatic Dependent Surveillance-Broadcast (ADS-B).[17] ADS-B is an advanced surveillance technology that combines an aircraft's positioning source, aircraft avionics, and a ground infrastructure to create an accurate surveillance interface between aircraft and ATC.

The FAA also surveils the NAS with traditional ATC transponders that employ cooperative surveillance, whereby a radar interrogates a transponder which replies with a squawk code and an indicated altitude as set by the operator. However, traditional ATC transponders do not meet current FAA regulations for operations in Class A airspace. As the majority of UFB operations occur at altitudes within or above Class A airspace, the ARC did not consider these transponders as a technology to meet the tasks specified in the ARC charter.

The operation of both these types of transponders is primarily regulated in part 91. As § 91.1 specifies that UFBs are not subject to part 91, there is no current requirement to equip any UFB with a transponder.

The ARC reviewed the current ADS-B solutions and their likely evolution, emerging technologies, and alternative means of surveillance to determine the feasibility of deploying on Class 1 and Class 2 UFBs.

B. Automatic Dependent Surveillance – Broadcast

As the preferred method of surveillance technology for the FAA, the ARC initially considered ADS-B technology to provide ATC surveillance. Current technology provides all the information required in the Act and the ARC Charter. To develop recommendations, the ARC reviewed the current regulations, equipment available, and relevant operator experience.

1. Regulatory Requirements

For operations above 18,000 ft, FAA regulations codified in § 91.225(a) require all aircraft to be equipped with a transponder that meets certain performance requirements (e.g., Minimum Operational Performance Standards, or "MOPS"), collaboratively developed and published by the Radio Technical Commission for Aeronautics (RTCA), and FAA Technical Standard Orders (TSO). These transponders, compliant with TSO-C166b or TSO-166c, are essentially Mode S Extended Squitter Transponders that operate on the 1090 MHz frequency and commonly referred to as "1090ES." Although the Universal Access

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[17] Federal Aviation Administration, *ADS-B Air Traffic Control (ATC) Applications* (Mar. 03, 2025).

Transceiver option exists for some operations below 18,000 ft, that type of transponder would not normally align with UFB operations.

Given the UFB requirements to operate above 18,000 ft, the ARC focused on TSO-C166b and TSO-C166c compliant transponders. These are referred to as Mode S/ADS-B transponders in this report.

Within part 91, § 91.225 specifies equipment requirements and usage. Section 91.227 specifies performance requirements. Many of these requirements are specific to conventional aircraft installation, including requirements on pitot static systems and concurrence with pilot instruments. As UFBs have neither, these requirements would not be appropriate for a UFB.

In addition to regulatory requirements, each aircraft must have a unique N-Number and 24-bit ICAO aircraft address for identification. These identifications are assigned to conventional aircraft with an airworthiness certificate by the FAA Aircraft Registry. As UFBs do not have airworthiness certificates, they cannot use the established process to obtain N-Numbers. As such, UFB operators must use an alternate method to reserve N-Numbers. Operators must also establish a process to manage and reuse identifications across balloon flights.

2. Platform Requirements

Equipping any aircraft, including a UFB, with a Mode S/ADS-B Out transponder places significant requirements on the platform. Beyond the transponder radio itself, bracketry, environmental controls, cabling, antennas, electromagnetic interference (EMI) shielding of all components, and additional power/batteries must be included. Today, the estimated per system cost is reportedly between $4,500 to $7,000 depending on the UFB system.[18]

There is also a non-recurring engineering cost to a UFB operator to test and qualify a transponder system. Current TSO certifications do not validate to the altitudes and environmental conditions encountered by high-altitude UFBs. Operators currently flying transponders at altitude have reported that several models had to be tested on the ground and in flight prior to selection as they are being operated beyond the vendor's test regime.

3. Transponder Summary

Although not currently required, a small number of UFB models have verified that Mode S/ADS-B transponders can work at the high-altitudes required by many UFBs. These early implementations have also validated the costs imposed if equipage were mandated in part 101. Per system costs range between $4,500 to $7,000. Non-recurring costs are more

[18] Cost estimates are based on ARC member subject matter expertise.

difficult to estimate, as they are operator specific. Looking forward, the ARC is not expecting these costs to significantly decrease over time.

C. Alternative Surveillance Technologies

The ARC reviewed alternative technologies that might have potential to serve as sources of surveillance of UFBs for use by ATC. There are current developments underway focused on UAS (Unmanned Aircraft Systems) operations. In addition, the ARC reviewed technologies currently in use by primarily Class 1 operators.

1. UAS Technologies

Technologies are being developed in support of the UAS market, focused on lower altitudes and high-density operations. To support higher densities, the technologies leverage the fact that the distance to the horizon of a UAS at 400 ft altitude is ~21 nmi (~ 39 km) versus up to 424 nmi (785 km) for UFBs. The shorter effective range also decreases the signal strength required and the potential for signal interference. These two considerations limit the applicability of technologies under development for UFBs.

Similar efforts are underway in the United Kingdom and other areas, but none were found to satisfy UFB requirements.

2. Radiosondes

Radiosondes are unique UFB payloads as they transmit on one of two Federal Communications Commission (FCC) frequencies allocated for Meteorological Aids (403 MHz or 1680 MHz). The typical transmit range is 150-200 nmi. Most radiosondes use the Binary Universal Form for Representation of meteorological data (BUFR) format standardized by the World Meteorological Organization. Some radiosondes use encryption, primarily for military applications.

It is possible for the FAA to deploy the infrastructure required to directly receive radiosonde transmissions. The BUFR format would provide the altitude, location, and identification required by the ARC charter. The benefit of deploying this infrastructure would be enabling the FAA to surveille approximately 95% of the UFB flights in the NAS. However, the cost of this effort would have to be evaluated against the relatively low risk of current radiosonde operations which carry payload weights of less than 3.5 ounces (100 grams).

Given the VSRP collision data balanced against the potential risk of collision between an aircraft and a radiosonde, the ARC is not recommending deployment of infrastructure that would enable radiosonde surveillance.

3. Automatic Packet Reporting System

Automatic Packet Reporting System (APRS) is a communication protocol in use by amateur radio operators to communicate position and other information from a range of platforms. APRS is widely used for a range of platforms beyond UFBs. As an example, the International Space Station operates an APRS node. For UFB operations, APRS trackers are used to provide the user with the position of the balloon while in flight.

APRS Packets are typically transmitted on the 2-meter amateur radio band (144.39 MHz in the U.S.) with participating nodes repeating the packets to extend range and/or transferring the packets via the Internet to publicly available servers. APRS is widely used by academic research, STEM, and recreational users.

APRS uses documented, standardized packet formats to ensure interoperability globally. Packets typically include altitude and location. Although there is no standard for platform identification, the amateur license call sign for the operator is included, which could be a proxy for identification. The rate at which the APRS sends packets varies and is dependent on the user settings.[19] For many UFB operations, the APRS trackers will send packets every minute while below an altitude of 15,000 ft and every ten minutes above that altitude. This is to ensure the user is still able to track the UFB but prevent an overflow of packets being received by independent ground stations.

Again, it is possible that the FAA could deploy the infrastructure to receive APRS signals directly. However, the wide use of APRS for non-UFB platforms would make it challenging to filter out relevant data. In addition, the slow update rate above 15,000 ft (10 minutes) could make position certainty unacceptable, especially during the critical ascent and descent through Class A airspace. Finally, APRS is used by less than 1.5% of flights in the NAS, predominantly Class 1 UFBs.

Given the VSRP collision data, low percentage of flights that use APRS, and position uncertainty, balanced against the potential risk of collision between an aircraft and a Class 1 UFB, the ARC is not recommending deployment of infrastructure that would enable APRS surveillance.

4. Weak Signal Propagation Reporter

The Weak Signal Propagation Reporter (WSPR) is a communication protocol and radio architecture targeting very small, low-power radios that can transmit over long distances. A WSPR radio for UFB operations typically weighs 0.2 ounces (~ 5 grams) with very low power requirements. WSPR radios can be designed to operate on a range of frequencies, typically

[19] *See* Jay Mottern, "*APRS Demystified: The Versatile Tool for Modern Amateur Radio*," The APRS Foundation: How APRS Works (Jan. 16, 2025).

operating on the 10-meter and 20-meter amateur bands. To minimize the power requirements on the UFB, packets are transmitted every 10 minutes.[20]

Small packet size and low bit rate limit the information that can be transmitted. The protocol provides altitude but only provides position using the Maidenhead Locater System (MLS), which gives a position without altitude with an accuracy between 0.25 statute miles and 3 statute miles, depending on configuration.

The very small size and low cost of the transmitter make it appealing to STEM and recreational operations which represent ~ 1% of flights in the NAS.

The ARC believes the WSPR does not meet the requirements for position and identification given the lack of standard packet formats for altitude and identification. The lack of standardized frequencies and low update rates further diminish its value.

Given these constraints, the ARC does not recommend the FAA pursue WSPR as an alternative surveillance technology for UFBs.

5. Alternative Technology Summary

Commercial and government development is currently focused on the UAS market, which has requirements that are not sufficient for the UFB market. The ARC does not believe it is reasonable to expect these technologies to be enhanced to support the long distances required by UFBs.

Several technologies are in use by the UFB community today, primarily in radiosonde and non-commercial applications.

Radiosondes utilize FCC-allocated frequencies and typically transmit with a standardized packet format that would provide altitude, location, and identification with acceptable update rates (typically 1 Hz). Although it is conceivable that the FAA could deploy infrastructure to directly receive these transmissions, the ARC does not believe the cost and effort required is warranted given the VSRP collision data for UFBs regardless of class.

APRS and WSPR technologies are currently used in research, STEM, and recreational operations. These technologies have significant constraints that led the ARC to determine them unsuitable for use as a source of FAA surveillance.

No other alternative technologies were identified by the ARC.

VIII. Surveillance Effects on UFB Platforms

As detailed above, the only technology identified by the ARC to meet the requirements of the charter for the surveillance of UFBs is a TSO-certified Mode S/ADS-B transponder.

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[20] *See e.g.* Zach Tec, *WSPR-TX Pico Transmitter*; Traquito *Jetpack WSPR Tracker*.

Equipment is currently commercially available to equip UFBs. However, the typical weight of a transponder subsystem is 5 to 8 pounds with a cost of $4,500 to $7,000 dollars.[21]

A. Class 1 UFB Platforms

1. Radiosondes

Radiosondes represent ~ 95% of all Class 1 UFB operations with the majority operated by the NWS. If equipped with transponders, current radiosonde payload weights would increase from less than 3.5 ounces to more than 5 pounds. The increase in weight would significantly increase the risk of consequence in the event of a MAC.

As radiosonde flights typically cost less than $500, the economic cost of a transponder, with an approximate cost $4,500 to $7,000 per transponder, is severe. Beyond system cost, environmental requirements must be considered. Current environmental impact assessments do not require the recovery of radiosonde system after flight. This environmental impact assessment would likely change with the addition of a transponder and much larger batteries, likely requiring the NWS to recover at least 73,000 payloads every year.

2. Other Class 1 Platforms

The remaining Class 1 operators would be similarly affected as radiosondes. The requirement to equip with transponders is a significant weight increase which has a corresponding increase in consequence in the event of a MAC.

The economic effect on operations would also be severe and would likely eliminate most Scientific/Academic, STEM, and Recreational flights due to increased cost, creating barriers of access for these programs. Commercial operators would incur much higher costs that could threaten existing business models.

3. Class 1 Recommendation

The ARC believes the overall increase to safety and situational awareness of the FAA requiring Class 1 UFBs to equip with Mode S/ADS-B transponders would likely not be counterbalanced by a potential decrease in overall safety given the significantly higher payload weights increasing the consequence of a MAC. The economic consequences for otherwise low-cost flights would also be significant. Given the review of safety data for Class 1 UFB operations in the NAS, the ARC does not recommend equipping Class 1 UFBs with transponders.

[21] Cost estimate based on ARC member subject matter expertise.

B. Class 2 UFB Platforms

Part 101 subpart D levies additional requirements for Class 2 UFBs as these systems are normally larger and heavier, which can increase the consequence of a MAC between a UFB and another aircraft. Many Class 2 operators acknowledge this higher consequence of a collision and voluntarily equip their Class 2 UFBs with Mode S/ADS-B transponders. These flights have demonstrated the viability of transponders at high altitude and ability to successfully participate in the ATC surveillance environment.

Class 2 UFBs are subject to the same weight (5 to 8 lbs) increase and equipage cost ($4,500 to $7,000) as a Class 1 UFB. However, these burdens are a lower percentage of the overall system weight and cost. Given the increased risk of consequence of a MAC with a Class 2 UFB, the ARC recommends that the FAA require Class 2 UFB operators to equip with a Mode S/ADS-B transponder.

The ARC acknowledges that a requirement to equip only Class 2 UFBs with a transponder creates a significant weight and cost increase for a platform when considering the lighter weight Class 2 UFBs as compared to the heavier Class 1 UFBs. The ARC acknowledges an FAA equipage requirement will always disadvantage platforms at the low-end of the Class 2 UFB market. However, until lower cost technologies are available to enable ATC surveillance of UFBs, the ARC believes this cost differential is necessary for increased safety in the NAS.

IX. Alternatives to Surveillance

As the ARC does not believe current transponder technologies are suitable for Class 1 UFBs and did not identify any other surveillance or conspicuity technologies that would be suitable for direct surveillance, the ARC reviewed options to increase ATC awareness of Class 1 operations. Consistent with the tasks as prescribed by the ARC's charter, the ARC discussed the following alternatives to surveillance.

A. Launch Notification

Under § 101.37, operators of Class 2 UFBs are currently required to notify the FAA 6 to 24 hours prior to launch. Required information includes:

- Balloon identification.
- Launch details.
- Forecasted altitude, trajectory, and duration.
- Balloon and payload details
- Forecasted time and location of impact to the surface

The FAA provides a HIBAL Worksheet and designated email address for the submission of this data. This worksheet is used by a service center to coordinate Class 2 UFB operations with ATC.

Currently, class 1 UFBs are not subject to the same reporting requirement.

To give ATC visibility to upcoming launches, Class 1 operators could be required to provide a similar notification. As Class 1 operators include less sophisticated users, such as STEM and recreational, the ARC recommends a web-based submission tool that provides an easy method to modify details such as launch time.

Given that current ATC procedures only apply to Class 2 UFBs (see section V.A), it is recommended that any notification process should clearly distinguish between Class 1 and Class 2 operations.

The ARC also recommends an additional change to § 101.37(b), which allows for a shorter notification time for specified exceptional cases. If Class 1 UFBs are required to notify prior to launch, more exceptions need to be allowed, especially for meteorological events. Many Class 1 operators perform unscheduled launches to monitor weather conditions.

B. Externally Available Data

Although the limitations of Class 1 UFB platforms preclude equipage with a transponder, all operators have a means to track and/or control their UFBs. Radiosondes and most non-commercial operators utilize established protocols over known frequencies. Section VII.C reviewed the technologies typically used. Commercial operators utilize proprietary communication methods between UFBs and operation centers.

To mitigate the lack of transponder surveillance, the FAA could collect data from external sources to provide location and tracking information to provide ATC situational awareness for Class 1 UFBs in the NAS. The level of integration of this external data into ATC workflows would have to be determined accordingly.

There are several publicly available websites that provide situational awareness for most of the radiosonde and non-commercial Class 1 UFB flights. These sites are much like the sites that track aircraft ADS-B information, such as ADS-B Exchange or FlightRadar24. They provide a map showing all tracked platforms with any additional information received, often with the ability to retrieve data via API’s or manual queries.

Although these sites may be either commercial or non-commercial, they commonly leverage data collected from a network of enthusiast-hosted receivers. These receivers collect radiosonde, APRS, and WSPR transmissions and forward the data to different website providers.[22]

Although ATC resources can currently use these sites to validate any pilot or other reports, these websites aggregate data for many different platforms other than UFBs. The FAA could engage an external aggregator to customize a website or service to provide UFB-specific information in an acceptable visual presentation or data interface. The level of integration into ATC operations would depend on the approach taken. Anecdotal data shows ATC has used these publicly available data sources in the past.

For commercial operators using proprietary communication methods, the FAA could develop a voluntary program for operators to supply tracking and identification in real-time for their platforms. This interface could be direct to FAA resources or through an external aggregator. The ARC believes that many operators would support a voluntary program to supply data if the data were only presented to the FAA.

A single aggregator could collect both the publicly available data and commercial operator data and present both to the FAA. Commercial participation would likely increase if the FAA funded the aggregator to provide tools and access to commercial operators at no cost.

Admittedly, externally available data is less optimal than surveillance via a certified source. Complete coverage is not guaranteed and update rates for some platforms are slower than desired. That said, Class 1 UFBs are disadvantaged platforms that cannot be equipped with transponder technology now or in the foreseeable future.

The ARC believes the situational awareness provided by this externally available data would provide ATC with an alternative, dynamic source of information compared to static launch notifications. Externally available data could provide more timely information, as opposed to estimated launch times and trajectories that could likely change immediately after a balloon launch, depending on wind conditions on the surface and aloft.

The ARC recommends that the FAA develop the capability to ingest externally available data to gain situational awareness to Class 1 UFB operations in the NAS. This data should be integrated into ATC workflows as able.

While this capability to ingest externally available data is being developed, or in the event the FAA does not pursue the recommendation, the ARC recommends that the FAA make the appropriate resources available for ATC to access existing public sources of data at all appropriate locations.

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[22] *See, e.g.*, Sondehub.org.

X. Other Part 101 Considerations

A. Radar Reflectivity

Section 101.35 requires that a Class 2 UFB be equipped with a radar reflective device that presents an echo to ground based radar. This requirement was instituted in the early 1960s[23] before broad use of aircraft transponders was mandated for civil aircraft in 1969. UFB tracking with a primary target alone has limited functionality in today's ATC radar environment. The recommended requirement of a Mode S/ADS-B Out transponder for Class 2 UFBs would replace the need for a radar reflective device and result in better UFB surveillance.

The ARC recommends removing the requirement for radar reflectivity from § 101.35 if the FAA were to require transponder equipage for Class 2 UFBs.

B. FAA Procedures

Following the 2017 ARC, the FAA made improvements in the process and operator interactions for part 101 operations.[24] For example, the FAA developed the HIBAL Worksheet for Class 2 UFB operators to submit standardized launch notifications. Internal guidance for processing waivers has been improved. However, operators still report inconsistencies in information requests and requirements when interacting with FAA personnel unfamiliar with UFB operations. Given the relatively small number of UFB operations overall, this may not be surprising. That said, it points to the continued need to improve internal resources available to the various functions that interact with UFB operations.

The ARC recommends that FAA continue to improve and disseminate training and guidance for UFB operations internal to the FAA.

C. FAA Education and Outreach

UFB operators range from highly trained operators to recreational operators that may only perform one launch. Publicly available components and kits rarely mention FAA regulations or list any specific requirements for flights. As such, many operators unwittingly violate part 101 through simple lack of knowledge.

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[23] Part 101 – Moored Balloons, Kites, Unmanned Rockets and Unmanned Free Balloons. Miscellaneous Updates Final Rule, 29 FR 47 (Jan. 03, 1964).

[24] The ARC reviewed several internal FAA materials, including: Federal Aviation Administration, AJV-1, *Guidelines for Processing Requests to 14 CFR part 101, Subpart D Unmanned Free Balloons* (July 24, 2014); Federal Aviation Association Central Service Center, *HIBAL Worksheet*.

The ARC believes the FAA is in the best position to launch an education outreach program for UFB operators, similar the program developed for small, unmanned aircraft systems (UAS), such as a public-facing, informational FAA website. The FAA's goal should be to provide regulatory compliance guidance, standardized notification procedures, including specific methods to submit launch notices, and/or best practices. This would likely increase part 101 compliance and safety for UFB operations in the NAS. Additionally, the FAA could also conduct internal education to enhance FAA understanding of part 101 requirements, UFB operations, and how UFBs affect NAS operations.

D. Weather Limitations

Per 14 CFR 101.33, Class 2 UFBs are prohibited from operating at any altitude in an area with less than five-tenths cloud cover and, when below 60,000 ft areas, where visibility is less than 5 miles.

Outside of the launch environment, there are few, if any, weather products providing visibility and cloud coverage at altitude. Therefore, there is no method for an operator to evaluate compliance with these limitations.

Equipping Class 2 UFB with transponders will provide awareness to ATC as well as Traffic alert and Collision Avoidance System Traffic Alerts and Resolution Advisories to properly equipped aircraft. This will enhance both safety and conspicuity for proximal operators.

To increase Industry compliance with updated regulations, the ARC recommends amending § 101.33 to only apply weather limitations to the launch and landing environments and while operating below 10,000 ft MSL or 2,500 ft above ground level (AGL), whichever is higher.

XI. Manned Moored Balloons and Kites

In Task 4(e) of the ARC charter, the FAA specifically tasked the ARC to address the applicability of part 101, specifically 14 CFR 101.11, to Manned Moored Balloons and Kites.

Part 101 specifically deals with Moored Balloons, Kites, Amateur Rockets, and Unmanned Free Balloons. By definition, UFBs are unmanned. Furthermore, amateur rockets are specifically limited to unmanned rockets in 14 CFR 101.21. There is no specific language in part 101 to either exclude or include manned operations for either moored balloons or kites. The ARC found prior opinions that helped direct the ARC's recommendations.[25]

[25] FAA Legal Memorandum, *Applicability of 14 C.F.R. part 101 (Moored Balloons, Kites, Unmanned Rockets and Unmanned Free Balloons) to parasails and parasail operations* (Nov. 09, 2009); FAA Legal Interpretation to Martin Palmaz, *Applicability of Part 101 to Ultralight Vehicles During Tethered Takeoff* (Jan. 02, 2015); FAA Legal Interpretation to Mark McCulloch (Aug. 25, 2011).

A. Manned Moored Balloons

In a Legal Interpretation to Mr. Bramble dated March 11, 1994, the FAA has stated a moored balloon regulated under part 101 is "a balloon that is secured to the earth by several mooring lines and does not carry a person."[26] The ARC found no change or exception to this interpretation.

To avoid continued confusion, the ARC recommends updating § 101.1 and part 101 subpart B to explicitly regulate unmanned moored balloons per prior FAA interpretations.

B. Manned Moored Kites

In response to recommendations resulting from a 2004 collision involving a parasail operation and an aircraft banner-towing operation, the FAA issued a memorandum dated November 9, 2009.[27] The memorandum established the applicability of part 101 to parasail operations, specifically as Moored Kites regulated under subpart B.

Further guidance is found in FAA Order JO 7400.2R – Procedures for Handling Airspace Matters, chapter 33.[28] This reaffirms that parasailing operations are subject to the requirements for kites under part 101.

To avoid continued confusion, the ARC recommends updating § 101.1 and part 101 subpart B to explicitly regulate both manned and unmanned kite operations explicit per prior FAA interpretations.

XII. ARC Recommendations

The following section outlines the ARC's recommendations, including intent, rationale, and suggested approach to implementation. These recommendations are based on the background and analysis provided in prior sections of the report, and they are summarized here to provide a succinct list of recommendations to the FAA.

A. Classes of UFBs

1. Recommendation

The ARC recommends that the FAA should amend part 101 to establish two classes of UFBs based on § 101.1(a)(4) limitations.

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[26] FAA Legal Interpretation to Mark McCulloch (Aug. 25, 2011).

[27] FAA Legal Memorandum, *Applicability of 14 C.F.R. part 101 (Moored Balloons, Kites, Unmanned Rockets and Unmanned Free Balloons) to parasails and parasail operations* (Nov. 09, 2009).

[28] FAA Order No. 7400.2R, Procedures for Handling Airspace Matters, 33-1-1 (Feb. 20, 2025).

2. Intent

Establish a framework that clearly distinguishes between Class 2 UFBs (balloons that have historically subject to part 101 subpart D) and Class 1 UFBs (balloons that have historically only subject to only § 101.7). This will facilitate adding additional regulations to Class 1 UFBs as recommended by this ARC. This will also help alleviate confusion as to which regulations apply to each class.

3. Rationale

The ARC recommends that Class 1 UFBs be required to provide launch notices consistent with current § 101.37 contained in part 101 subpart D. Establishing these classes will allow current part 101 subpart D to apply to all UFBs with distinction made as to what specific items apply to each class.

4. Approach

The ARC recommends the following approach:

- Amend § 101.1(a)(4) to limit applicability to UFBs that carry a payload, or some other attribute to exclude party and other similar balloons.
- Within subpart D, create definitions for Class 1 and Class 2 UFBs based on current § 101.1(a)(4) limitations.
- Amend §§ 101.33, 101.35, and 101.39 to only apply to Class 2 UFBs.
- Section § 101.37 should apply to both Class 1 and Class 2 UFBs per separate ARC recommendation.

B. UFB Transponder Equipage

1. Recommendation

The ARC recommends that the FAA amend part 101 to require Class 2 UFBs to equip with TSO-certified Mode S/ADS-B transponders.

2. Intent

Integrate Class 2 UFBs into the NAS using the FAA's preferred technology for continuous tracking of aircraft. This requirement will accomplish two important safety goals. First, tracking of UFBs will be integrated into the ATC environment using the same system as conventional aircraft. Second, the UFB's transponder will provide Traffic Alerts and Resolution Advisories to aircraft equipped with Traffic alert and Collision Avoidance Systems.

3. Rationale

The cost of a TSO-certified Mode S/ADS-B Transponder subsystem currently ranges from $4,500 to $7,000. The installation also adds 5-8lbs of equipment, including the necessary radio, antenna, cabling, bracketry, and power subsystem. Both the cost and weight of these systems are significant for most UFB operators.

As Class 2 UFBs are typically larger systems with higher mission costs, they can more readily accommodate the additional cost and weight of a transponder system. Given the higher risk of consequence of the larger system, the ARC believes a transponder subsystem should be required to reduce the risk of occurrence of an incident with another aircraft.

Class 1 UFBs present a challenge given the limited Size, Weight, and Power capabilities of the platform combined with the low total mission cost. After reviewing current products and expected products in the foreseeable future, the ARC could find no surveillance technologies that were deemed acceptable for Class 1 UFBs. Technologies under development do not support the altitude and range requirements of UFBs. Future technologies may emerge that could become appropriate for Class 1 UFBs.

4. Approach

Amend § 101.35 to specify that no person will operate a Class 2 UFB unless it is equipped with a TSO Certified Mode S/ADS-B transponder. If the FAA does not adopt the recommended Class 1 / Class 2 distinction, § 101.1(a)(4) and § 101.35 must be amended accordingly.

C. UFB Launch Notification

1. Recommendation

The ARC recommends that the FAA amend part 101 to require notification of Class 1 UFB launches while also expanding the exceptions for shorter notification time in § 101.37(b).

2. Intent

The ARC recommends that the FAA require notification of launches to provide ATC with awareness of Class 1 UFB launch operations, including launch location, launch window timing, and expected trajectory. The ARC recommends that the FAA provide Class 1 UFB operators with an accessible means to file such notifications, such as a website, that is appropriate for the range of users spanning from recreational to commercial operators.

3. Rationale

Given that the ARC believes equipage of Class 1 UFBs that would enable ATC surveillance is not currently feasible, launch notifications could provide information to a controller during the ascent of the balloon from launch through Class A airspace.

4. Approach

Assuming the establishment of UFB classes in part 101 subpart D (see recommendation XII.A), the ARC recommends that the FAA amend § 101.37 as needed to apply to both Class 1 and Class 2 UFBs.

Furthermore, the ARC recommends that the FAA amend § 101.37(b) to allow for unscheduled Class 1 UFB launches in support of exceptional weather observations that could not be scheduled normally.

D. Access to Externally Available UFB Information

1. Recommendation

The ARC recommends the FAA develop a program to leverage externally available data for Class 1 UFBs to provide situational awareness to ATC.

Also, the ARC recommends that the FAA enable consistent access and procedures for ATC to leverage publicly available UFB surveillance data.

2. Intent

Given it is too burdensome to equip Class 1 UFBs with transponder or other conspicuity technologies, an alternative means to surveil these systems is needed. Class 1 operators use a variety of methods to track their UFBs. The FAA should leverage either publicly available data and/or voluntarily supplied data to provide situational awareness to ATC.

At a minimum, ATC should have the means to access data available from public websites to verify UFBs that have been reported by pilots or other sources to help determine what, if any, actions may be necessary.

3. Rationale

No current technology has been identified that would allow ATC surveillance of Class 1 UFBs, but an estimated 97% of Class 1 UFBs can be located and identified on publicly available websites. Although not integrated into the ATC surveillance environment, these websites or other sources could provide situational awareness of Class 1 UFBs when needed to cross check pilot or other reports.

In reviewing MOR data, examples of air traffic controllers using publicly available data to correlate pilot reports have been found. A standard method and process should be developed to make this data available to ATC in all facilities.

4. Approach

A procedure for accessing selected public websites should be established to both drive awareness and simplify the process of obtaining UFB information when needed. Resources with appropriate IT access should be made available to ATC to provide efficient access to this data.

E. Radar Reflectivity Requirement

1. Recommendation

The ARC recommends that the FAA amend § 101.35 to remove the requirement for radar reflective devices on Class 2 UFBs.

2. Intent

If part 101 is amended to require a Mode S/ADS-B transponder to be equipped on Class 2 UFBs, the need for a radar reflector is eliminated.

3. Rationale

Even today, radar reflectors have minimal value for surveillance in the NAS. It is difficult for an operator to measure the effectiveness of any device or material used. Often any primary return for a balloon is removed by automated processing prior to display at an ATC workstation.

If a Class 2 UFB is equipped with a transponder, the burden of a radar reflector should be removed from the platform.

4. Approach

Amend § 101.35(a)(3) to remove the requirement to equip a Class 2 UFB with a radar reflective device or material.

F. UFB Weather Limitations

1. Recommendation

The ARC recommends that the FAA amend § 101.33 to only specify weather limitations for Class 2 UFBs to the launch and landing environments and while operating below 10,000 ft MSL or 2,500 ft AGL, whichever is higher.

2. Intent

Weather limitations should only be specified in environments where UFB operators have weather products available to determine compliance. Otherwise, an operator is subject to regulations that have no means of compliance.

3. Rationale

The current regulations prohibit operation of a Class 2 UFB at any altitude where obscuring phenomena of more than five-tenths coverage or below 60,000 feet where the horizontal visibility is less than five miles. Terminal Area Forecasts and Meteorological Aerodrome Reports do not provide sufficient data to evaluate cloud cover or visibility. No other current weather products provide necessary data.

4. Approach

Modify § 101.33 per the recommendation.

G. UFB Procedure Refinement and Dissemination

1. Recommendation

The ARC recommends that the FAA continue refining and disseminating standardized procedures throughout the FAA.

2. Intent

The goal is to optimize and improve communication between UFB operators and the FAA. This is even more important If Class 1 operators are mandated to interact directly with the FAA.

3. Rationale

Although the frequency has decreased, operators still experience interactions with ATC personnel in which lack of knowledge of part 101 operations have complicated the situation. Having more ready internal resources available to ATC could alleviate the problems.

4. Approach

The FAA should continue to improve internal resources appropriate to part 101 operations.

H. UFB Outreach and Education

1. Recommendation

The ARC recommends that the FAA develop an outreach program for part 101 operations like the FAA's UAS web presence.

2. Intent

There is a wide range of expertise in UFB operators, ranging from trained commercial operators to operators that may only fly one balloon as part of a K-12 STEM program or simple recreational activity. A resource is needed to educate UFB operators on regulations, methods to comply, notification mechanisms, and general guidance for UFB operations.

3. Rationale

Class 1 UFBs are a popular STEM activity for K-12 programs and other recreational users that want to experiment with high-altitude flights. The ARC's review of operational and other safety reports (Section VI.A) confirms that Class 1 UFB operations pose a low risk to other aircraft in the NAS. That said, it's important for less experienced operators to understand the requirements and comply with limitations for safe operations. A review of commercially available Class 1 UFB kits found few, if any, mentions of part 101 compliance. Even with knowledge of part 101, a resource to provide practical guidance to the novice user is required.

4. Approach

The FAA should deploy a publicly available resource for UFB operators similar to efforts to educate UAS operators (e.g. a website like the FAA's "DroneZone").

I. Moored Balloon and Kite Applicability

1. Recommendation

The ARC recommends that the FAA amend part 101 to limit applicability as appropriate to manned or unmanned operations for moored balloons and kites.

2. Intent

Although the FAA has established guidance specifically addressing this issue, part 101 makes no distinction between manned or unmanned operations for moored balloons and kites. Part 101 should be amended to reflect this established guidance.

3. Rationale

Prior FAA opinions have established that part 101 applies to only unmanned moored balloons but does apply to both manned and unmanned kite operations (section XI). However, § 101.1 and part 101 subpart B regulates both operations identically, with no distinction as to manned or unmanned operations. This leads to confusion, especially to commercial operators. Examples include parasailing, a type of manned kite operation, that is regulated by part 101. However, manned tethered (moored) flight operators are not regulated by part 101.

4. Approach

Amend § 101.1(a)(1) and part 101 subpart B as appropriate to explicitly limit unmanned moored balloons and manned or unmanned moored kites. To avoid any confusion, the ARC recommends a specific reference to parasailing given the prevalence of the sport.

J. Prior ARC Recommendations

Given the ARC recommendations above, as directed in the ARC Charter, the recommendations in section 4.1.2. of the 2017 ARC Report were reviewed to either confirm or revise those recommendations.

The following 12 points are the recommendations from the prior ARC report. A response from the current ARC is provided.

1. General Recommendations: As the UFB industry does not have an association to work collaboratively with the FAA to improve safety and reduce risk, the FAA should host a recurring Part 101 Industry Forum to facilitate routine collaboration between the FAA and Part 101 operators, completely independent of rulemaking activities.

ARC Response: The consensus is that an FAA hosted industry forum would not be sufficient to reach the breadth of operators in the NAS. Most likely attendees at such an event would be from the established operators and larger research or education operators. As described in the current ARC recommendation, education is needed at all levels, including the recreational operator. Therefore, this ARC is recommending an education program that would supersede this prior recommendation to be a more effective effort.

General Recommendations: The FAA should undertake a safety risk assessment on the current status of UFB operations in accordance with FAA Safety Risk Management policy to assess potential benefits resulting from voluntary mitigations already in place.

ARC Response: The ARC's understanding is that a safety risk assessment is typically done prior implementing rule changes to evaluate both positive and negative effects on safety. This level of effort should be reserved to evaluate the changes the FAA is planning to propose, not the current practices of the industry. Therefore, the ARC does not support this recommendation as written. The need for a safety risk assessment should be considered as part of any rulemaking process.

As noted in the executive summary, an incident occurred resulting in damage to an airliner that might be attributed to a Class 1 UFB. If this incident is attributed to a UFB, the FAA should consider this incident with the ARC recommendations.

Notice Requirements: The FAA should organize a very near-term collaborative activity with UFB operators to standardize information needed for FAA notice requirements.

Notice Requirements: The FAA should develop and promulgate standardized ATC procedures for handling UFB operations throughout the NAS.

Notice Requirements: The FAA should develop a methodology to uniquely identify UFB operations.

ARC Response: As noted in Section X.B, progress was made following the prior ARC in standardizing procedures and notification requirements, including a standard HIBAL form distributed to operators. FAA internal operating procedures now include more detailed UFB procedures and policies. The ARC believes these three recommendations have been reasonably met.

Size and Weight: In accordance with the FAA policy, the FAA should conduct further study to reconsider the maximum potential payload weight, balloon size, and materials density that meet acceptable level of safety without proposed mitigations/ rules.

ARC Response: The ARC found no evidence that the Size and Weight categorization between Class 1 and Class 2 UFB have created any reasonable safety concerns. In the ARC's review, no VSRD indicated a change would affect operations in the NAS. As such, this ARC is not recommending this study to be conducted.

General Recommendations: The FAA should adopt new UFB operator certification requirements tailored to the UFB community analogous to the 14 CFR Part 107 remote pilot in control requirements

Notice Requirements: The FAA should adopt a new requirement that UFB operators should notify NAS users of planned operations prior to launch.

ARC Response: The current ARC also recommends notification for all UFB operations in the NAS (Section IX.A).

Equipage Requirements: The FAA should create a new rule that requires FAA- accepted surveillance for UFB and air traffic services, appropriate for the airspace, and provide some type of assistance to educational institution programs to comply with equipage requirements.

ARC Response: The current ARC is recommending **ADS-B/Mode S** transponders be required on all Class 2 UFB. As documented in Section VIII.B, current surveillance technologies are too burdensome for Class 1 UFB. The ARC cannot recommend transponder equipage requirements for Class 1 UFB until such time as available technologies are compatible.

Equipment Requirements: The FAA should remove the current requirement for radar reflective device(s) under § 101.35 (3), subject to the new FAA required surveillance rule proposed by the ARC.

ARC Response: The current ARC concurs.

Operating Limitations: The FAA should evaluate current operating limitations based on weather conditions as listed in § 101.33 (b) and (c).

ARC Response: The current ARC has provided two recommendations, one for launch weather and a second for enroute weather. These recommendations expand on the more general recommendation from the prior ARC.

Termination Requirements: The FAA should update current payload cut-down and termination requirements outlined in § 101.35 to be performance based, driven by safety considerations, and aligned with international regulations to the extent possible.

ARC Response: The current ARC does not support this recommendation. International regulations allow for a single termination method for super pressure balloons. [29] The industry feels this is not sufficient to guarantee redundancy in termination in all cases.

[29] ICAO Annex II Tenth Edition, Appendix 5-1 (July 2005).

Appendix A: Acronyms

Acronym	Definition
ADS-B	Automatic Dependent Surveillance – Broadcast
AGL	Above Ground Level
APRS	Automatic Packet Reporting System
ARC	Aviation Rulemaking Committee
ASRS	Aviation Safety Reporting System
ATC	Air Traffic Control
CFR	Code of Federal Regulations
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
HAB	High-Altitude Balloon
ICAO	International Civil Aviation Organization
KM	Kilometer(s)
LBS	Pounds
M	Meter(s)
MAC	Mid-Air Collision
MOR	Mandatory Occurrence Report
MSL	Mean Sea Level
NAS	National Airspace System
NMI	Nautical Mile(s)
NWS	National Weather Service
STEM	Science, technology, engineering, and mathematics
TSO	Technical Standard Orders
UAS	Unmanned aircraft systems
UFB	Unmanned Free Balloon
VSRP	Voluntary Safety Reporting Program
WSPR	Weak Signal Propagation Reporter

Appendix B: ARC Membership

Industry Member	Organization
Kurt Sehnert (Industry Co-Chair)	Aerostar International
Mark Ketcham	Aerostar International
Darrell Pennington	ALPA (Air Line Pilots Association, International)
Murray Huling	AOPA (Aircraft Owners and Pilots Association)
Steve Goodgame	ARRL (The National Association for Amateur Radio)
Jeff Rehaluk	A4A (Airlines for America)
William (Bill) McDonald	A4A (Airlines for America)
Margaret Colwell	EAA (Experimental Aircraft Association)
Sean Elliot	EAA (Experimental Aircraft Association)
Gregory Shoemaker	NATCA (National Air Traffic Controller Association)
Steve Wood	NATCA (National Air Traffic Controller Association)
Heidi Williams	NBAA (National Business Aviation Association)
Kate Spillman	Oklahoma State University
Rebecca Morrison	RTCA (Radio Technical Commission for Aeronautics)
Gene Bradley	WindBorne Systems
Sebastian Padilla	WorldView Enterprises
Jonathan Regouby	WorldView Enterprises
Government Member	**Organization**
Anthony Militello	Department of Defense
Alan Shafer	Department of Defense
Brian Konie (FAA Co-Chair)	Federal Aviation Administration
Timothy Harris	Federal Aviation Administration
Stephen Vantrees	Federal Aviation Administration
Matthew Haskin	Federal Aviation Administration
Jamal Wilson	Federal Aviation Administration
Mario O Verrett	Federal Aviation Administration
Charles Lewis	Federal Aviation Administration
Garland (Derak) Perkins	Federal Aviation Administration
Ramon (Bert) Alberto	Federal Aviation Administration
Robert Sweet	Federal Aviation Administration
Kevin Dillon	National Aeronautics and Space Administration
Andrew Hamilton	National Aeronautics and Space Administration
Debora Fairbrother	National Aeronautics and Space Administration
Gabriel (Gabe) Garde	National Aeronautics and Space Administration
Kevin Stone	National Oceanic and Atmospheric Administration
Curtis Marshall	National Oceanic and Atmospheric Administration
Daniel (Danny) Bowman	Pacific Northwest National Laboratories

Appendix C: ARC Member Voting Responses and Ballots

Voting Member	Organization	Ballot
Kurt Sehnert	Aerostar International	Concur, as written.
Darrell Pennington	ALPA	Concur, as written.
Murray Huling	AOPA	Concur, as written.
Steve Goodgame	ARRL	Concur, as written.
Jeff Rehaluk	A4A	Concur with comment.
Margaret Colwell	EAA	Concur, as written.
Greg Shoemaker	NATCA	Concur, as written.
Heidi Wiliams	NBAA	Concur, as written.
Kate Spillman	Oklahoma State University	Concur, as written.
Rebecca Morrison	RTCA	Concur, as written,
Gene Bradley	WindBorne Systems	Concur, as written.
Sebastian Padilla	World View Enterprises	Concur, as written.

Part 101 Modernization Aviation Rulemaking Committee (ARC) Voting Ballot

Voting Member Information

Voting Member Name: *

Kurt Sehnert

Voting Member Organization: *

Aerostar International

Voting Member Email: *

Statement of Concurrence/ Non-Concurrence:

Please place your vote. If you select either Concur with Comment, or Non-Concur, the form will prompt you to provide either your Comment/Exception or a Statement of Non-Concurrence.

As a voting member and full participant of the Part 101 Modernization Aviation Rulemaking Committee (ARC), I hereby acknowledge that I have reviewed the Final Report and recommendations and make the following statement: *

- (selected) I concur with the Final Report as written.
- I concur with comment or exception.
- I non-concur.

Electronic Signature

As a voting member and full participant of the 101 Modernization ARC, I hereby acknowledge that I have reviewed the Final Report and recommendations. My response is recorded on this ballot. Below is my virtual signature. (Please type your full name.) *

Kurt Sehnert

Part 101 Modernization Aviation Rulemaking Committee (ARC) Voting Ballot

Voting Member Information

Voting Member Name: *

Concur

Voting Member Organization: *

ALPA

Voting Member Email: *

Statement of Concurrence/ Non-Concurrence:

Please place your vote. If you select either Concur with Comment, or Non-Concur, the form will prompt you to provide either your Comment/Exception or a Statement of Non-Concurrence.

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Electronic Signature

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Darrell Pennington

Part 101 Modernization Aviation Rulemaking Committee (ARC) Voting Ballot

Voting Member Information

Voting Member Name: *

Murray Huling

Voting Member Organization: *

Aircraft Owners and Pilots Association (AOPA)

Voting Member Email: *

Statement of Concurrence/ Non-Concurrence:

Please place your vote. If you select either Concur with Comment, or Non-Concur, the form will prompt you to provide either your Comment/Exception or a Statement of Non-Concurrence.

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- I non-concur.

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Murray Huling

Part 101 Modernization Aviation Rulemaking Committee (ARC) Voting Ballot

Voting Member Information

Voting Member Name: *

Steven Goodgame

Voting Member Organization: *

ARRL

Voting Member Email: *

Statement of Concurrence/ Non-Concurrence:

Please place your vote. If you select either Concur with Comment, or Non-Concur, the form will prompt you to provide either your Comment/Exception or a Statement of Non-Concurrence.

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Steven Eric Goodgame

Part 101 Modernization Aviation Rulemaking Committee (ARC) Voting Ballot

Voting Member Information

Voting Member Name: *

Jeff Rehaluk

Voting Member Organization: *

Airlines for America

Voting Member Email: *

Statement of Concurrence/ Non-Concurrence:

Please place your vote. If you select either Concur with Comment, or Non-Concur, the form will prompt you to provide either your Comment/Exception or a Statement of Non-Concurrence.

As a voting member and full participant of the Part 101 Modernization Aviation Rulemaking Committee (ARC), I hereby acknowledge that I have reviewed the Final Report and recommendations and make the following statement: *

- ○ I concur with the Final Report as written.
- ◉ I concur with comment or exception.
- ○ I non-concur.

Concurrence with Comment or Exception

We strongly support the work and the recommendations of the part 101 Modernization ARC. As stated in the ARC's Final Report in the recommendation on UFB Outreach and Education "it's important for less experienced operators to understand the requirements and comply with limitations for safe operations. A review of commercially available Class 1 UFB kits found few, if any, mentions of part 101 compliance. Even with knowledge of part 101, a resource to provide practical guidance to the novice user is required". We feel that providing the recreational user with the regulatory requirements and means to comply with the kit they purchase would be of value as well as utilizing available technologies to provide a link to a practical resource guide as identified in the recommendation.

Electronic Signature

As a voting member and full participant of the 101 Modernization ARC, I hereby acknowledge that I have reviewed the Final Report and recommendations. My response is recorded on this ballot. Below is my virtual signature. (Please type your full name.) *

Jeff Rehaluk

Part 101 Modernization Aviation Rulemaking Committee (ARC) Voting Ballot

Voting Member Information

Voting Member Name: *

Margaret Colwell

Voting Member Organization: *

Experimental Aircraft Association

Voting Member Email: *

Statement of Concurrence/ Non-Concurrence:

Please place your vote. If you select either Concur with Comment, or Non-Concur, the form will prompt you to provide either your Comment/Exception or a Statement of Non-Concurrence.

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- I concur with comment or exception.
- I non-concur.

Electronic Signature

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Margaret Colwell

Part 101 Modernization Aviation Rulemaking Committee (ARC) Voting Ballot

Voting Member Information

Voting Member Name: *

Gregory Shoemaker

Voting Member Organization: *

National Air Traffic Controllers Association

Voting Member Email: *

Statement of Concurrence/ Non-Concurrence:

Please place your vote. If you select either Concur with Comment, or Non-Concur, the form will prompt you to provide either your Comment/Exception or a Statement of Non-Concurrence.

As a voting member and full participant of the Part 101 Modernization Aviation Rulemaking Committee (ARC), I hereby acknowledge that I have reviewed the Final Report and recommendations and make the following statement: *

- [x] I concur with the Final Report as written.
- [ ] I concur with comment or exception.
- [ ] I non-concur.

Electronic Signature

As a voting member and full participant of the 101 Modernization ARC, I hereby acknowledge that I have reviewed the Final Report and recommendations. My response is recorded on this ballot. Below is my virtual signature. (Please type your full name.) *

Gregory R. Shoemaker

Part 101 Modernization Aviation Rulemaking Committee (ARC) Voting Ballot

Voting Member Information

Voting Member Name: *

Heidi Williams

Voting Member Organization: *

NBAA

Voting Member Email: *

Statement of Concurrence/ Non-Concurrence:

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Heidi J Williams

Part 101 Modernization Aviation Rulemaking Committee (ARC) Voting Ballot

Voting Member Information

Voting Member Name: *

Kate Spillman

Voting Member Organization: *

Oklahoma State University

Voting Member Email: *

Statement of Concurrence/ Non-Concurrence:

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Kate Spillman

Part 101 Modernization Aviation Rulemaking Committee (ARC) Voting Ballot

Voting Member Information

Voting Member Name: *

Rebecca Morrison

Voting Member Organization: *

RTCA, Inc.

Voting Member Email: *

Statement of Concurrence/ Non-Concurrence:

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- ( ) I non-concur.

Electronic Signature

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Rebecca Frances Morrison

Part 101 Modernization Aviation Rulemaking Committee (ARC) Voting Ballot

Voting Member Information

Voting Member Name: *

Gene Bradley

Voting Member Organization: *

WindBorne Systems

Voting Member Email: *

Statement of Concurrence/ Non-Concurrence:

Please place your vote. If you select either Concur with Comment, or Non-Concur, the form will prompt you to provide either your Comment/Exception or a Statement of Non-Concurrence.

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- I non-concur.

Electronic Signature

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Bobby Gene Bradley III

Part 101 Modernization Aviation Rulemaking Committee (ARC) Voting Ballot

Voting Member Information

Voting Member Name: *

Sebastian Padilla

Voting Member Organization: *

Works View

Voting Member Email: *

Statement of Concurrence/ Non-Concurrence:

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Electronic Signature

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Sebastian A. Padilla