March 19, 2023

The Honorable Rep. Frank Lucas
Chairman
House Science, Space, and Technology Committee

SUBJECT: Official Congressional Testimony for the Hearing:
"Advanced Air Mobility: The Future of Unmanned Aircraft Systems and Beyond"

Honorable Chairman Lucas, Honorable Ranking Member Lofgren, and the Esteemed Members of the U.S. House Science, Space and Technology Committee:

*Without undue exaggeration, this is truly a Sputnik Moment.*

The Chinese High-Altitude Balloon (HAB) or Uncrewed High-Altitude Systems (UHS, this term chosen because these Chinese systems are by definition a next-gen form of drone) or UHS incursions directly over U.S. continental "motherland" home-space this late January to early February of 2023, are historically only rivaled in audacity or encroachment by the USSR Soviet Sputnik program(s) of 1957 and beyond. The wake of such early "Cold War" events and "Sputnik Era" technology being flown directly over continental U.S. airspace in 1957 led to an exasperated U.S. public, which in-turn led to establishment of the Select Committee on Astronautics and Space Exploration in 1958, which today is this very Committee, the U.S. Science, Space and Technology Committee I am honored to speak before.

It is important to note, we are no longer in a "Cold War" to establish the most elite forms of the best technology in the world against the USSR; but rather a "Cool War" to establish the most scalable forms of "good to great" technology against the Peoples Republic of China and the ever-domineering Chinese Communist Party (CCP). The CCP has published Beijing policy such as the Shāshǒujiàn Strategy or "Assassin's Mace" or "Death by a Million Cuts", which seeks to use an array of affordable ballistic missiles; cyber-attacks; and commercially produced or copied aerial UAS/AAM technologies to overwhelm U.S. Air Superiority by basis of a cost-to-defeat scenario. Much like, forcing the U.S. to spend Millions of dollars to scramble multiple 5$^{th}$ Gen F-22 Fighters, deploy several U-2 Dragon Lady high-altitude resonances plans, deploy additional E-3 Sentry AWACS, and supporting RC-135 resonances aircraft. Then to spend potentially several million more in ground-based radar support and advanced real-time Satellite imagery, to ultimately fire a $399,500.00 Aim-9X Sidewinder missile to "pop" a UHS or "Balloon" system.

> *Excluded from Spoken Testimony Due to Time Constraints:*
> Without Congressional Authority to lead a formal investigation into the U.S. response or necessary clearances to understand all assets deployed in the UHS Chinese Incursions, I can only leverage my background instructing "System Safety and Reliability Analysis" at Tinker Air Force Base (headquarters of the Air Force Materiel Command – AFMC) for a Preliminary Cost Analysis. This total would be (by my own estimates) roughly $2.26M to $31.67M per Chinese UHS event, which is significant. Consider if the UHS had a total $100,000 (high-side est.) cost to the CCP, this would reflect a 22:1 to even 316:1 cost disadvantage to the United States. Hopefully, this Committee can clear see this Shāshǒujiàn Strategy, is not only clever but works efficiently in terms of cost-to-defeat vs traditional technology in the American Air Superiority Strategy. Furthermore, what I have

been tasked to testify in-front of this Committee specifically in terms of Uncrewed Aerial Systems (UAS) or Advanced Air Mobility (AAM) platforms; is at the front lines of this "Cool War" and faces immense U.S. scalability issues to counter near-peer aggression such as Shāshǒujiàn Strategy.

Today I testify representing AirWise Solutions a mid-scale UAS start-up. AirWise Solutions, Inc. is uniquely a U.S. based Uncrewed Aerial System (UAS) hardware & software manufacturer with academia background(s) that exists in the Jurisdictions of Oklahoma, Tribal Nation and HUBZone allocated lands. We believe that our American small business fully encapsulates the need for U.S. manufacturer development and the entrepreneurial spirit of the proposed bill. It is unquestionable this bill would be transformative for the U.S. based UAS manufacturing industrial base and as such we are honored to offer Congressional Testimony in Support for the concept of the "National Drone and Advanced Air Mobility Initiative Act".

I previously had the privilege of serving in Department of Defense (DoD) Counter sUAS capacities as active participant in a multi-year "Tri-Service advanced autonomous platform Activity" when the original concerns of covered foreign nation data security breaches in-turn triggered the sanctions of Section 848 of the NDAA for Fiscal Year 2020. Since January of 2021, I have served as the Chief Research & Development Engineer for the largest Oklahoma origin UAS manufacturer. Now on the opposite side of Counter UAS development, in the world of U.S. based UAS industry development, I have the firsthand knowledge of the incredible strain U.S. industry has gone through to meet NDAA Section 848 compliance and/or Defense Innovation Unit (DIU) "Blue List" or "Blue UAS" compliance.

With the passage of the original NDAA Section 848 sanctions, over an estimated ~80% of the commercial UAS market in the U.S. (with DJI, a single China origin UAS vendor accounting for 76.1% of the market), was immediately no longer eligible for supporting Federal acquisition of UAS. The effects of the NDAA Section 848 sanctions were largely twofold:

a) The United States Government no longer maintained a strong industrial base to rapidly acquire even basic small UAS and thus a critical supply chain issue exists.

b) U.S. industry largely did not compete with covered foreign nations (namely the People's Republic of China) for small UAS advanced technology development and was/is largely unprepared to match United States Government more advanced technology needs.

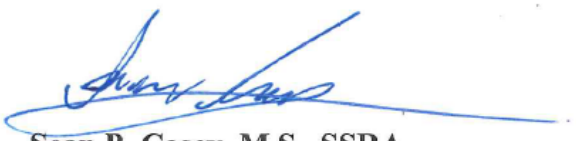
Moreover, with the critical developments in the ongoing Ukraine Invasion, we have seen the emergence of small UAS technology becoming a force multiplier with a critical supply chain that few analyst(s) could have ever predicted in the 21st century battlefield. It is important to note, the same small UAS technology emergence in recent military events, is the same technology that is driving a profound scientific/commercial UAS "renaissance" for new use cases in almost every single U.S. based industry. From multi-spectral cameras in agriculture, to methane detection in oil and natural gas safety, to photogrammetry technology in survey grade construction for infrastructure, to ozone-air detection in environmental protection and to even last-mile emergency medical delivery. To direct Science & Technology (S&T) applications ranging from collecting "whale-snot" marine data via UAS, monitoring global Greenhouse Gases (GHG) via UAS, and even to flying into active Category 4 Hurricanes for atmospheric monitoring data via UAS.

*Excluded from Spoken Testimony Due to Time Constraints:*
However, currently only ~15x total UASs are even NDAA Section 848 compliant or on the DIU "Blue UAS 2.0" list due to the challenges of even developing a U.S. UAS basic airframe or UAS platform. Even fewer U.S. based companies have either the time nor adequate funding to develop

the more advanced NDAA compliant payloads/technologies listed above. If the UAS payloads (ie a chemical Methane sensor or advanced photogrammetry camera) are not NDAA section 848 compliant, the U.S. government can not purchase these more advanced commercial capabilities except for very rare exceptions for exclusive scientific research or for Counter UAS. This means that currently, without further targeted U.S. industry development or funding like this "National Drone and Advanced Air Mobility Initiative Act", the United States government can simply not compete in (or even purchase) new domestic or international UAS technologies or developments.

The U.S. UAS industry has a strong history of "hobbyist", "tinkerers", "garage shops" and even innovative or efficient (but often underfunded) startups. This means even with nominal targeted funding or development, the U.S. based UAS industry will both use the tax-payers funding support hyper-efficiently and will enable breakthrough technologies. These use cases or challenges outlined are of direct importance to the role, purpose and functions of the esteemed House Science, Space, and Technology Committee. It is up to this Committee and the direction of this very bill, to decide if the U.S. UAS industry can not only "catch up" globally but further be a UAS technological global leader as is the American way.

Thank you.



**Sean P. Casey, M.S., SSRA**
Chief R&D Engineer, AirWise Solutions, LLC,
System Safety and Reliability Analysis- Adjunct Professor,
Oklahoma State University-Tinker Air Force Base

**Biography:**

Sean Casey has been a Principal Investigator and Program Manger on several Department of Defense (DoD) unclassified UAS/AAM programs which have led to several publications and patents awarded. He has managed efforts such as the United States Air Force (USAF) "Micro Computer Integrated Rifle (MCIR) with UAS Control" UAS program and the USAF "Rapid Target Acquisition with Command Livestream Capabilities" APNT program. Currently, Sean leads the AirWise Solutions research and development team for developing next-gen UAS enterprise technologies designed to an elite Department of Defense (DOD) standard. He is an Adjunct Professor for System Safety and Reliability Analysis (SSRA) for the Oklahoma State University Institute for Technology at Tinker Air Force Base. Sean has technically advised the Missile Defense Agency (MDA) Executive Science Counsel, the Army Space and Missile Defense Command Center of Excellence (SMDCoE) SES Executive Leadership, and the United States Space Force (USSF) F.O.R.G.E. Product Owner on AAM National Security issues ranging from hypersonic(s) to UAS(s).

*Sean holds 8+ Publications, 3+ U.S. Provisional Patents, 1+ Full U.S. Utility Patent, 2+ Conference Proceeding Awards, 3+ United States Air Force (USAF) SBIR awarded research contracts, 5+ other general research grants, 8+ Department of Defense (DoD) Consortium Memberships and 5+ Commercial UAS Committee Membership(s).*

Sean has a Master of Science (MS), *Summa Cum Laude*, in "Space and Aviation" from Oklahoma State University and a Bachelor of Science (BS) in "Mechanical Engineering Technology" from Oklahoma State University. Sean is pursuant a secondary dual- Master of Science in Engineering (MSE), in "Space Systems Engineering" from the John Hopkins University.

**Special Thanks Provided:**

**Capt. Joshua Daviscourt, Plans & Programs Researcher and Plans & Programs Officer, National Security Space Institute, USSF:**
For supporting material on Shāshǒujiàn Policy implemented by the Chinese Communist Party (CCP) and associated National Security concerns for AAM.

**Dr. Bryan Cole, Director, The Uncrewed Systems Research Transition Office (UxSRTO), NOAA:**
For supporting material on various emerging UxS applications for the Science & Technology (S&T) community and leading the way on advanced S&T applications for Uncrewed Systems (UxS).

**The Association for Uncrewed Vehicle Systems International, AUVSI:**
For continued inclusion on the Air Advocacy Committee (AAC), the Sub-Committee on Defense, the Sub-Committee on C-UAS, Sub-Committee on AAM and the collection of UAS Industry-related issues.

## Appendix A): The 2023 China UHS Incursions Preliminary Cost Analysis (Per Event):

This Appendix A) section serves to outline the simple known costs of the systems reported to be deployed by the U.S. Government in response to the "2023 China Uncrewed High-Altitude Systems (UHS) Incursions" from late January 2023 to early February 2023. This section is a rudimentary, simple cost analysis based on the reported systems used and the available Department of Defense "Fiscal Year (FY) 2022 Department of Defense (DoD) Fixed Wing and Helicopter Reimbursement Rates" (https://comptroller.defense.gov/Portals/45/documents/rates/fy2022/2022_b_c.pdf) Cost Per Flight Hour (CPFH). All CPFH chosen are that of the 2022 DoD O&M User Rates and do not reflect total repairability cost to the U.S. Government, rather the reimbursement rates used to reflect simple operational costs for inter-agency requests. Actual CPFH costs to the U.S. Government are significantly higher in operational reality.

**2x F-22 Raptor Cost Per Flight-Hour:** $50,334/hour x 2 = $100,668/combined-hour
**2x U-2 Dragon Lady Cost Per Flight Hour**: $18,944/hour x 2 = $37,888/combined-hour
**Boeing E-3B Sentry (AWACS) Cost Per Flight-Hour:** $22,412/hour
**Boeing RC-135S Aircraft:** $15,949/hour
**KC-46A Pegasus (ABATE) Refuelers Cost Per Flight-Hour:** $9,201/hour

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**Min Flight Hours:** 10 hours
**Max Flight Hours:** 168 hours*
*Note: January 28th Detection to February 4th Downing or 7-day perpetual max flight hours.

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**Aim-9X Sidewinder Missile Munition Cost:** $395,000.00

**The 2023 China UHS Incursions Preliminary Cost Analysis (Per Event) Table**

| System Deployed | Cost Per Flight Hour (CPFH) ($/hour) | # of Aircraft for CPFH Purposes | Combined CPFH ($/hour) | Min Flight Hours | Max Flight Hours | Min Cost Per System Deployed ($) | Max Cost Per System Deployed ($) |
|---|---|---|---|---|---|---|---|
| **F-22 Raptor** | $50,334/hour | 2x | $100,668/ combined-hour | 10 | 168 | $1,006,680 | $16,916,224 |
| **U-2 Dragon Lady** | $18,944/hour | 2x | $37,888/ combined-hour | 10 | 168 | $378,880 | $6,365,184 |
| **E-3B Sentry** | $22,412/hour | 1x | $22,412/ hour | 10 | 168 | $224,120 | $3,765,216 |
| **RC-135S** | $15,949/hour | 1x | $15,949/ hour | 10 | 168 | $159,490 | $2,679,432 |
| **KC-46A Pegasus** | $9,201/hour | 1x | $9,201/ hour | 10 | 168 | $92,010 | $1,545,768 |
| **AIM-9X Sidewinder** | / | / | / | / | / | $395,000 | $395,000 |
| | | | | | | | |
| **Total System Response Cost to 2023 China UHS Incursion** | | | | | | **$2,256,180.00** | **$31,666,824.00** |