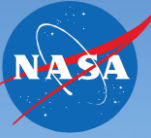


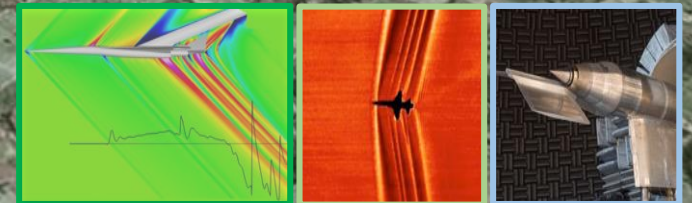
Commercial Supersonic Technology Project

Acoustics Technical Working Group Meeting

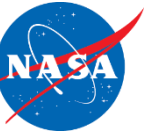
April 13, 2021



Lori Ozoroski, CST Project Manager



Outline



- **Introduction**
- **LBFD Mission Updates**
- **Phase II Acoustic Validation Planning**
- **Phase III Community Test Planning**
- **New Landing & Takeoff Noise Technical Challenge**
- **Summary**

The Vision for Commercial Supersonic Flight

An emerging potential market has generated renewed interest in civil supersonic aircraft

- Evidenced by the appearance of several commercial programs despite lack of standards for en route noise or landing and takeoff noise

Overland Flight Restrictions based on unacceptable sonic boom noise are viewed as the main barrier to this vision



National Research and Policy agencies play a central role in developing the data needed for the regulation change that is essential to enabling this new market

The vision of the Supersonics Community is a future where fast air travel is available for a broad spectrum of the traveling public

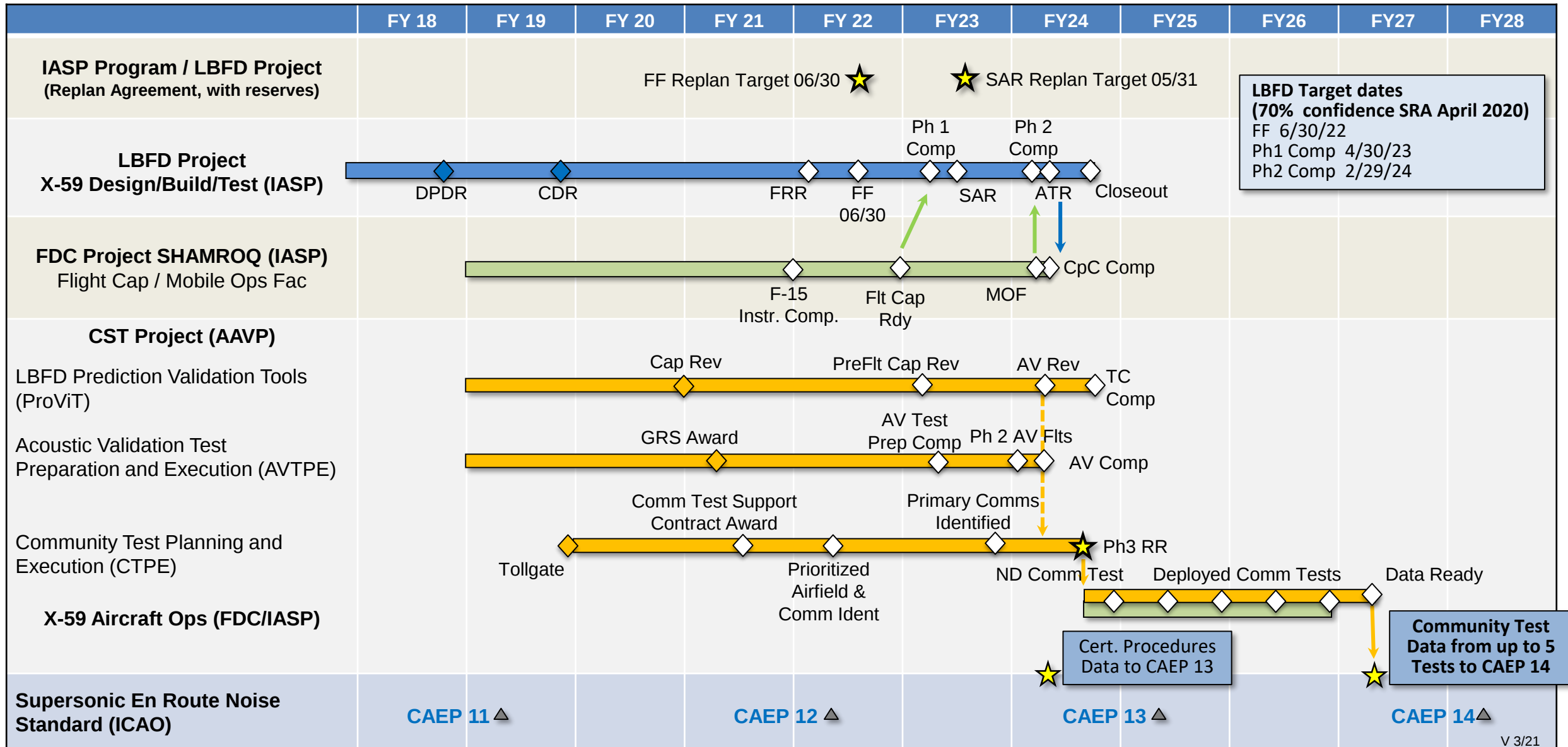
- Future supersonic aircraft will not only be able to fly overland without creating an “unacceptable situation” but compared to Concorde and SST will be efficient, affordable, and environmentally responsible

Low Boom Flight Demonstration Mission Timeline

FY21 Revision



Current as of March 1, 2021



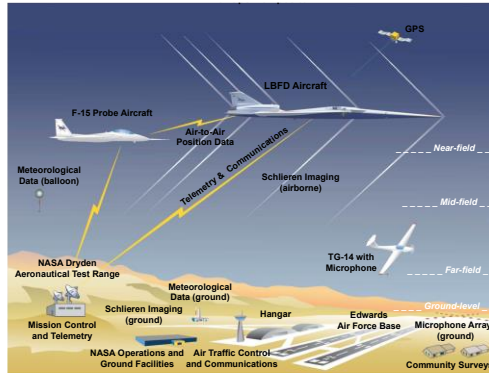
Low Boom Flight Demonstration Mission Overview



Phase 1 – Aircraft Development – *In progress 2018-22*

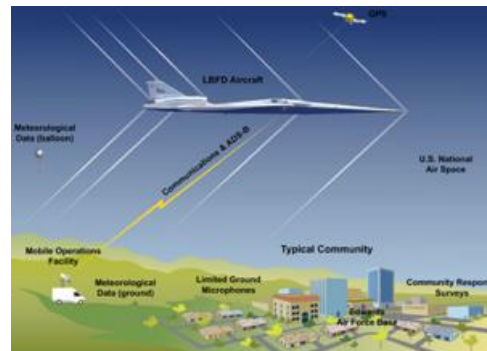
- Detailed design
- Fabrication, integration, ground test
- Checkout flights
- Subsonic envelope expansion
- Supersonic envelope expansion

Systematic Approach Leading
to Community Testing



Phase 2 – Acoustic Validation – *Preparation 2018-22, Execution 2022-23*

- Aircraft operations & support, range operations, support aircraft
- In-flight measurement capabilities
- Ground measurement capabilities
- Validation of X-59 boom signature and prediction tools
- Development of acoustic prediction tools for Phase 3



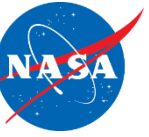
Phase 3 – Community Response Testing

Preparation 2020-24, Execution 2024-26

- Aircraft operations & support, deployment
- Ground measurement capabilities
- Ground crew operations
- Noise exposure design
- Community response surveys
- Data analysis and database delivery

Low Boom Flight Demonstration Project
Flight Demonstration & Capabilities Project
Commercial Supersonic Technology Project

X-59 Manufacturing Updates



Note: Video has been publicly released already



Phase 2 Acoustic Validation Status



Ground Recording System

- Contract to procure 175 State-of-the-Art Ground Recording Systems for sonic booms recently awarded to Crystal Instruments, Inc
- System Requirements include:
 - Research quality measurements
 - Single-person deployment
 - Long deployment and operational time
 - Remote health and functional checks
 - Remote data analysis and transmission



Unattended Trigger Concepts

- Prototyping & testing of down-selected concepts underway
 - ADS-B: Triggering Hardware and Observation Recorder (THOR)
 - Satellite: Boom Universal Recorder Satellite Trigger (BURST)

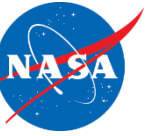
CarpetDIEM Phase II – November 2021

- Evaluate prototype GRS with real booms & evanescent waves
- Evaluate unattended trigger concepts

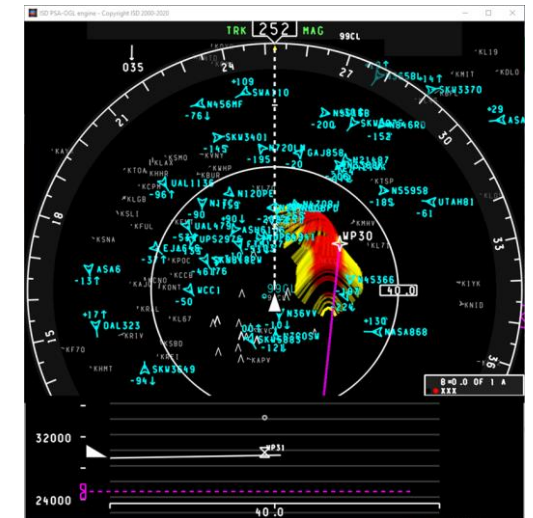
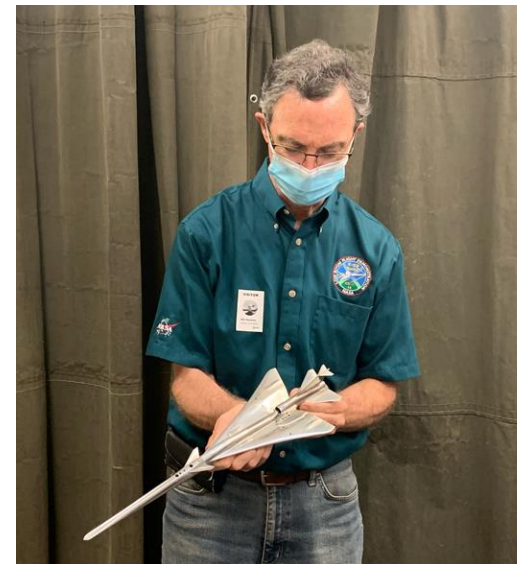
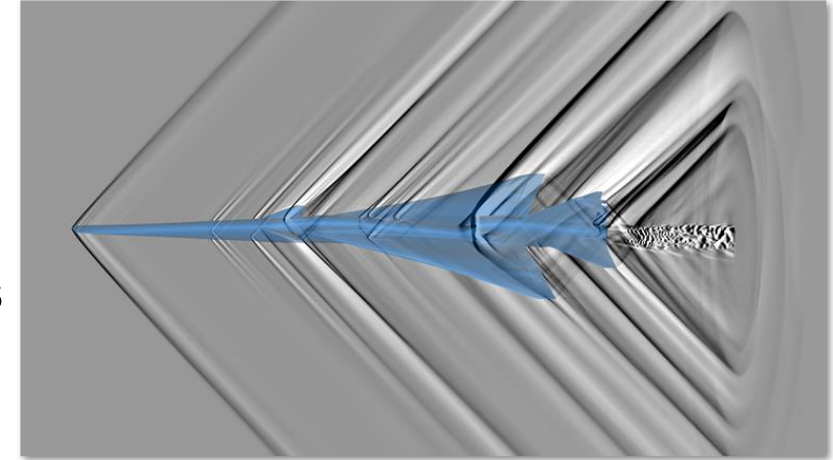
Phase 2 Planning – Concept of operation & flight test matrix



Phase 2 Prediction Tools Validation Status



- Continued speed, accuracy, robustness and usability advancements for near-field prediction CFD codes in preparation for acoustic validation testing
- New releases of both PCBoom and sBOOM propagation tools
 - Continued developments related to focus booms, turbulence modeling, secondary booms
- Cockpit Interactive Sonic Boom Display Avionics (CisBoomDA) enhancement including the use of live ADS-B data
- Sonic boom wind tunnel tests planned for GRC 8x6 (fall 2021) & at JAXA (spring 2022)
 - 1.62% scale model, multiple configurations, mounts
- Developing CLEOPATRA tool for X-59 flight planning in Phase 3
 - Surrogate models based on X-59 sonic boom database
 - Turbulence filters
 - PCBoom



LBFD Mission Phase 3 Overall Timeline



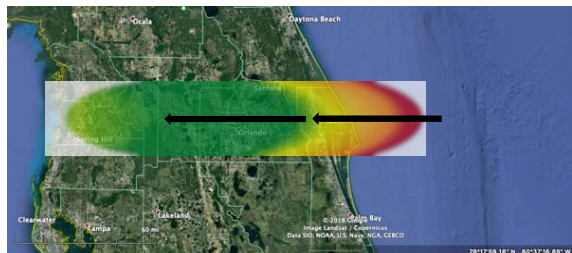
2020	2021	2022	2023	2024	2025	2026	2027
<i>Planning Stage</i>				<i>Execution Stage</i>			
- Develop overall LBFD Phase 3 plans - Survey design - Exposure estimation - Operations - Public outreach and communication - Risk reduction activities - Survey test - Acoustic monitor and infrastructure checkout - Automated data processing validation - Obtain feedback on survey methods and exposure estimation approaches - ICAO WG1 participation - Virtual and in-person international workshops - Independent review panel				- Community Test 1 at AFRC - Additional community tests (across the US, different regions) - Dose-response data analysis - Aggregation of analysis and extension to nationally-representative database			Database delivery for CAEP14
				Community Test Support Team contract solicitation in progress			

Phase 3: Community Test Planning Status

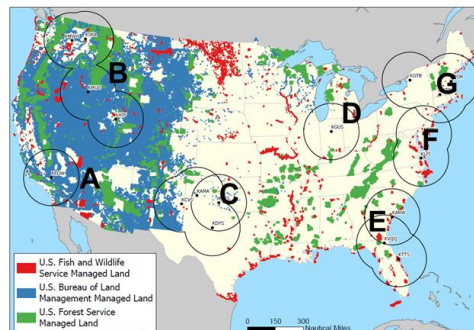


Initial airfield and community identification

- Key criteria
 - X-59 operational criteria (runway length, airfield logistics, etc)
 - Community test data criteria (location, population level/density/distribution, etc.)
- Identified ~20 candidate airfields, 7 potential regions
 - Application of key criteria
 - Placement of transition focus or off-design boom
 - Consideration of noise-sensitive regions
- Other considerations
 - Supersonic flyover region
 - Inland vs coastal
 - Census zone demographics
- Prioritization vs selection approach within regions

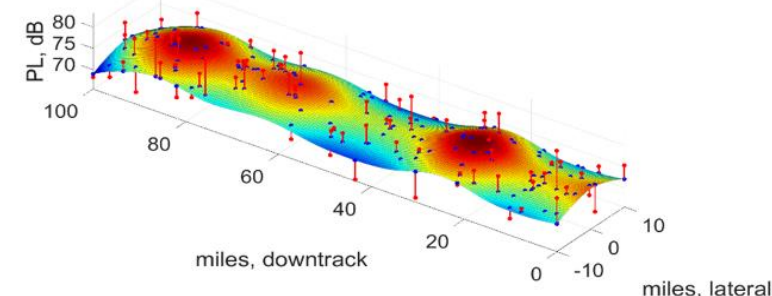


Credit: Volpe



Assessing data quality requirements

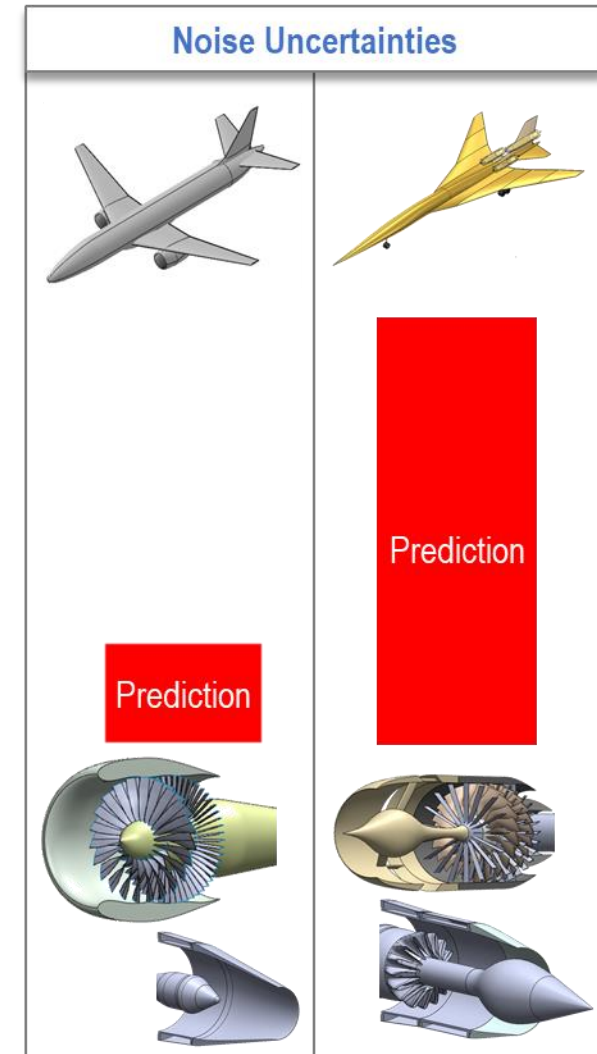
- Addressing noise dose uncertainty
 - Inadequate accounting can lead to artificial flattening of dose-response curves
 - Experimental design to mitigate effects of dose uncertainty
- Estimation of ambient PL across the USA
 - Estimated signal to noise ratio (SNR) of X-59 booms in ambient noise across the country
 - Recommendations for noise monitor use to estimate noise exposure
- Acoustic recorder requirements
 - Number of measurement sites, grouping and spacing of noise monitors
 - Survey area size vs. recommended number of sites
 - Mitigations for ambient noise and turbulence effects



Thrust 2 Barrier—Landing and TakeOff (LTO) Noise

Problem: There is currently no certification noise rule for commercial supersonic aircraft.

- Regulatory Catch-22:
 - OEMs have no international noise rule for product requirements.
 - Regulators have no existing product for technical feasibility assessment.
- FAA has led with issuance of with ‘Notice of Proposed Rule-Making’ (NPRM)
 - Technical assessment influenced by NASA system studies.
 - Further progress requires international collaboration.
- Newly approved Tech Challenge to reduce uncertainty in prediction of noise for supersonic aircraft.
 - Based on physics-based simulations of supersonic-relevant inlet, fan, and nozzle designs from OEM input.
 - Data releasable for impact on international regulators.



Thank You

