

# FAA Office of NextGen (ANG)

**REDAC / NAS Ops** 

Review of FY2022 – 2025 Proposed Portfolio

Name of Program: Wake R,E&D BLI Number: A11.p Presenter Name: Jillian Cheng Date: 31 August 2022

## Wake R,E&D Overview

#### What are the benefits to the NAS User:

Wake R,E&D's assessment of aircraft wake encounter risk provides the information to develop ATC wake risk mitigations that will enable fewer flight delays/cancellations and reduced inflight operating costs.

- Assessments of wake characteristics for new aircraft types entering service in the NAS
- Wake risk mitigation solutions for specific airport/airspace ATC operations
- Aircraft wake generation/encounter databases, modeling, and analyses

#### What determines program success:

- No increase in the reported wake encounters per flights in the NAS
- Increased Airport Arrival Rates set by ATC when in Instrument Meteorological Conditions (IMC)
- ATC able to mitigate wake encounter risk when separating En route aircraft at distances less than 5 NM

## Wake R,E&D Program Support

### **People:**

- Program Manager: Jillian Cheng
- Subject Matter Experts: wake data collection & analysis experts, pulsed Light Detection and Ranging (LIDAR) application experts, statistical wake encounter Flight Operational Quality Assurance (FOQA) data extraction experts, wake modeling experts.

### Laboratories/R&D Centers:

- Volpe Center
- National Institute of Aerospace
- MITRE/CAASD Aviation Safety Information Analysis and Sharing (ASIAS) data center
- National Research Council Canada Flight Research Laboratory

## Current Wake R, E&D FY22 Accomplishments

- Developed wake generation and wake encounter response assessments for new aircraft types (piloted and large UAS) slated to receive ATC Separation Service when operating in the NAS (40 assessments through 3rd Qtr. FY22)
- In concert with EUROCONTROL reviewed and provided updated Wake Turbulence Separation Minima Group recommendations (152) for use in ICAO DO 8643
- Progressed in the development of candidate absolute wake encounter metrics (projected severity if aircraft encounters a wake from another aircraft) for use in developing safe, flight capacity efficient ATC applied separations between aircraft
- Continued the collection and assessment of aircraft generated wakes at SFO and JFK airports
- Successful application of the previously developed statistical wake encounter FOQA data screening utility (SU) on ASIAS's archived FOQA data sets



# Anticipated Wake R, E&D Research in FY23

#### **Planned Research Activities:**

- Develop wake risk assessments for aircraft types operating in the NAS
- When requested, assess airport/airspace ATC operations to develop wake risk mitigation solutions that will address specific operational constraints
- Continue development of absolute wake encounter metrics for use in determining ATC wake risk mitigation recommendations for new aircraft types that will be operating in the NAS
- Continue collection and assessment of aircraft generated wakes at SFO and JFK airports

#### **Expected Research Products:**

- Wake risk assessments for new aircraft types and for other aircraft types requested by ATC
- Absolute wake encounter metrics for use in assessing wake encounter risk for aircraft in terminal area operations
- Wake risk assessments of proposed changes to ATC procedures/systems used in ATC Separation Services



# Anticipated Wake R, E&D Research in FY24

#### **Planned Research Activities:**

- Develop wake risk assessments for new aircraft types operating in the NAS
- When requested, assess airport/airspace ATC operations to develop wake risk mitigation solutions that will address specific operational constraints
- Development of absolute wake encounter metrics for use in wake risk assessments of new aircraft types that will be operating in the NAS
- Continue collection and analysis of aircraft wake tracks at SFO and JFK airports

#### **Expected Research Products:**

- Wake risk assessments for new aircraft types and for other aircraft types requested by ATC
- Wake risk assessments of proposed changes to ATC procedures/systems used in ATC Separation Services
- Wake risk mitigation solutions for unique airport/airspace operational constraints

# Emerging Wake R, E&D FY25 Focal Areas

#### Application of Wake Generation and Encounter Data

- Provide wake risk assessments for aircraft types slated to begin operating in the NAS and receiving ATC Separation Services
- When requested, assess airport/airspace ATC operations to develop wake risk mitigation solutions that will address specific operational constraints
- Continue the development of absolute wake encounter risk metrics for use in determining an aircraft's wake encounter risk during en route flight

#### **Acquiring Additional Wake Generation/Transport Data**

 Continue collection and assessment of aircraft generated wakes with suites of sensors to characterize the aircraft generated wake and how its transport is affected by atmospheric conditions and airport location



# Wake R, E&D

#### **Research Requirements**

- Assess wake risk in today's and future ATC operations to insure target level of safety is maintained
- Provide aircraft wake generation/transport analyses to developers of wake risk mitigation solutions that allow increased flight efficiency/capacity in the NAS
- Provide wake risk mitigation solutions for specific ATC airport/airspace operating constraints
- Develop metrics for use in determining safe/flight efficient ATC wake risk mitigation aircraft-to-aircraft separations

#### FY 2025 Planned Research

- Continue developing wake risk assessments for new aircraft types (piloted and large UAS) slated to receive ATC Separation Services
- Assess proposed changes to ATC procedures for wake risk
- Continue ground-based collection of wake generation/ transport data to enhance the statistical data used for wake risk assessments
- Continue development of en route absolute wake encounter risk metrics

#### **Outputs/Outcomes**

- Wake risk assessments for new aircraft types that are to begin operating in the NAS and will require ATC Separation Services and updates to assessments for current operating aircraft as more wake generation data is collected
- Wake risk assessments of proposed changes to ATC separation procedures
- Wake risk mitigation solutions for specific airports/airspace
- Initial absolute wake encounter risk metrics for en route operations

#### Out Year Funding (contract dollars)\*

| R,E&D | FY22    | FY23   | FY24    | FY25    | FY26    | FY27    |
|-------|---------|--------|---------|---------|---------|---------|
|       | \$ 2.6M | \$2.9M | \$ 3.7M | \$ 2.6M | \$ 2.6M | \$ 2.6M |

\* Additional funding is needed to resume wake risk mitigation concept development and wake data collection instrument replacement. (Current wake LIDARS are near the end of useful life.)



# Wake Turbulence Data Collection

- Wake turbulence data collection is an umbrella term that describes the suite of instrumentation\* and data types needed to support various wake related analyses
- Data types collected
  - Wake Vortices
  - Meteorology
  - Aircraft surveillance

\* Unless specified, the data are acquired via FAA WTR&DP sponsored data collection effort using dedicated research sensors

# **Ground Based Data Collection**

- Wake Vortices
  - Position and strength as a function of time
- Meteorology
  - Operational wind, ceiling and visibility (Automated Surface Observing System [ASOS], via NOAA)
  - Vertical wind profiles
  - Turbulence profiles
  - Temperature profiles
  - Aircraft based weather observations (via NOAA)
  - Numerical weather product (RAP via NOAA)
- Aircraft surveillance
  - For aircraft identification at the Make-Model-Series level (PDARS and ASDEX/ASSC)
  - Characterizing the aircraft dispersion at various weather and operational scenarios (PDARS and ASDEX/ASSC)

# **Current Measurement Sites**

- SFO and JFK
- The general SFO area hosts three of the four FAA WTR&DP's Pulsed LiDAR assets
- Both arrival and departure wake vortices are measured
- 24/7 unstaffed (at the measurement sites) data collection
  - Data transfer from test sites to Volpe Center
  - Post-processing, quality-control steps and database construction occurred at Volpe
- The aircraft types acquired in the accumulated wake database are annually checked against the list of "wake generator aircraft"\* that contributed to 99 percent of the aircraft movements in the NAS
  - SFO and JFK data covers the NAS needs well



<sup>\*</sup> Defined as the leading aircraft that have a separation requirement of MRS

## Current and Near-Future SFO Site Layout



## Current JFK Site Layout





# **Ground Based Data Collection**

- FAA NextGen WTR&DP is a very data driven program
- The overall data collection balances the near-term procedural based data needs, as well as longer term system-based dynamic separation
- A particular focus has been on wake data collection close to the ground/surface, which is an area where
  - The SMS process had identified it as a critical region
  - Fast-time wake models continued to be less mature to this day
- Data collection details and data types changed/updated as identified by research needs for the future



# Wake Turbulence Data Collection at Cruise Altitude

- Made possible by the Memorandum of Cooperation NAT-I-8417 (FAA & Institute of Aerospace Research -NRC Canada)
  - Wake turbulence data collected at cruise altitude by Anthony Brown in the NRC Canada instrumented T-33 "chase" aircraft





# Wake Turbulence Data Collection at Cruise Altitude

 The wake turbulence data collected during the T-33 encounters with the wake of the generating aircraft are then correlated with the ADS-B track of the generating aircraft and the atmospheric conditions occurring at the data collection location to yield the characteristics and transport of the generating aircraft's wake turbulence

The Future of the NAS **Starts Here** 

