Federal Aviation Administration

# REDAC / NAS Ops

## *Review of FY 2018 Proposed Portfolio*

***NextGen – Wake Turbulence R,E&D and Wake Re-Categorization***

***BLI Numbers: A12.a and 1A06B***

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# Wake R,E&D and Re-Categorization
## *A12.a and 1A06B BLI#'s for FY18*

**Wake turbulence research and development (Wake R&D) and Re-Categorization (RECAT) projects support the NextGen objective to accommodate increased demand (flights) during peak demand periods. They have increased access to airport runways and airspace while maintaining or enhancing the safety of the National Airspace System (NAS) .**

**Wake R&D and RECAT mature wake mitigation operational concepts to the point they can be directly implemented by FAA orders. If NAS infrastructure enhancements are required, the concepts are developed to the point that they can be operationally demonstrated and a repeatable process can be handed off to the ATO for implementation.**

# Wake Turbulence R,E&D/BLI #: A12.a Capability Overview

**People:**

- Wake Program Manager: Jeff Tittsworth (ATO)
- Wake Research Manager: Paul Strande (ANG)
- Subject Matter Experts: Edward Johnson (AIR), Wayne Gallo (AFS), Kevin Connelly (NATCA), RJ Eisemann (ALPA)
- Contract support SMEs: 4 world renowned wake experts, two previous AFS Chief Science and Technology Advisors for Wake, retired branch manager for AFS-450

**Organizations:**

- Volpe NTSC: data collection and analysis, safety case development
- MITRE/CAASD: concept development, benefits analysis
- MIT/LL: wind forecast algorithm development
- CSSI: en-route wake data analysis and concept development
- NEXTOR II: future concepts modelling and analysis

# Anticipated Research in CY16/17

## Planned Research Activities

- Wake Standards Developed for New Aircraft Designs:
- “Procedures Only” Wake Mitigations Developed for ATC Operations
- “Technology Aided” Wake Mitigations Developed for ATC Operations
- Wake Data Bases, Models and Data Extraction Tools Developed and Applied

## Expected Research Products

- A320-Neo series aircraft – wake separations added to FAA Orders – CY16
- CS100/300 series aircraft – wake separations added to FAA Orders – CY16
- SFO 19’s authorized for 7110.308 operations – CY16
- 1 NM diagonal operations authorized for 7110.308 (SFO key site) – CY16
- 737-Max series aircraft – wake separations added to FAA Orders – CY17
- Changes in FAA ATC Orders impacted by the use of RECAT Phase II/2.5 wake separation standards – series of Orders modified - CY16/17
- Series of NextGen and SESAR wake mitigation concept development/ definition coordination workshops/seminars

# Anticipated Research in CY16/17

## Expected Research Products (continued)

- Wake Turbulence Mitigation for Single Runway (WTMSR) concept expanded to address direct use by controllers of time based wake separation standards (based on NATS procedures at London Heathrow) – CY 2016
- Wind prediction algorithms for WTMSR arrival/departure corridors development completed – CY 2017
- Wake encounter mitigation technology aided concepts/procedures developed for piloted aircraft en-route trajectories – CY 2017
- Wake encounter mitigation technology aided concepts/procedures developed for Unmanned Aircraft Systems (UAS) operating in the NAS - CY 2017
- Complete cost/benefit assessment of shifting from static to dynamic wake separation standards and procedures – CY 2017
- Develop/acquire enhanced wake/wind tracking sensors for collection of wake transport and decay data – ongoing activity

# Anticipated Research in CY16/17

## Expected Research Products (continued)

- Standards developed for real time in-flight observed weather information transmitted by aircraft – information needed for dynamic wake mitigation tools and other users of aircraft observed weather data – ongoing activity through CY 2020
- Incorporate Canadian NRC en-route aircraft wake measurement data into the FAA wake transport and decay data base – ongoing activity
- Probabilistic wake encounter relative risk model validated for use in feasibility investigations, both for terminal area and en-route trajectories – CY2017
- Determine from light-aircraft simulator pilot runs and other data sources - what constitutes a minor or major wake encounter hazard for light aircraft – CY 2017

# Emerging A12.a FY18 Focal Areas

## In addition to on-going research:

- Continued analysis of Embraer E-2 series aircraft design and development of wake separation recommendations for use by ATC
- In depth analysis of Boeing 777-8/9 series aircraft engineering design data and in coordination with Boeing, determination if FAA will require flight test data to determine wake separations
- Evaluate a feasibility prototype of controller decision support tool information display for use in dynamically reducing the required wake separations between aircraft in instrument approaches to a single runway
- In collaboration with Flight Standards Service, continued small scale flight data recorder screenings of an aircraft series for potential medium to low level wake encounter events. (If this project receives requested increased funding or AFS incorporates this activity into its research portfolio, the originally planned large scale activity would be accomplished - $500K needed)
- Using probabilistic wake encounter models, develop relative wake encounter risk assessments for proposed specific trajectory based ATC procedures and associated airspace design

# Emerging A12.a FY18 Focal Areas

## In addition to on-going research:

- A portion of the wake turbulence data collection suite is refreshed with updated measuring and data processing technology. (If requested additional funding is provided in FY18, the third prototype LIDAR will be overhauled and refreshed with updated scanning and processing components - $500K needed)
- Refined prototype algorithms that use downlinked aircraft flight information to adjust required wake mitigation separations between aircraft

# Wake Turbulence R,E&D

## Research Requirement

- Work with controllers, air carriers, pilots, other air navigation service providers (ANSPs), government and industry research organizations, aircraft and avionics manufacturers, and airport operators to understand and perform research to address near-, mid- and far-term needs regarding wake mitigation separation standards and procedures
- Sponsors: Improved Multiple Runway Operations & Separation Management Portfolios (ANG-C7)
  POC: Jeffrey Tittsworth (AJV-82) & Paul Strande (ANG-C22)

## Outputs/Outcomes

FY15 Major Outputs:

- SRMD modification for FAA Order 7110.308A to allow use of RNAV approach to Boston 4L Runway – More BOS capacity
- SRMD for setting the ATC wake separations to be applied to the Airbus A350 aircraft when it operates in the NAS
- Wake separation recommendations for A320 Neo & CS100/300
- Wake data collected on heavy aircraft flying into JFK and SFO – for use in NextGen capacity/safety assessments
- Additional aircraft modules developed for flight data recorder wake encounter screening tool – needed to establish basis for relative risk assessments
- Initial validation of probabilistic wake encounter risk assessment tool for use in evaluating proposed en-route ATC procedures

## FY 2015 Accomplishment / Issues

- Assessment of the Airbus A320 Neo and determination of wake mitigations to be applied by ATC when the aircraft operates in the NAS
- Methodology developed and utilized in processing high altitude aircraft wake data collected by the Canadian National Research Council aircraft during flights behind cooperating commercial aircraft in Canadian airspace
- Analysis to modify Wind Forecast Algorithm (WFA) wind limit parameters to enhance WTMD system to support Paired Departures concept at SFO

## NARP Funding ($M)*

| FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 |
|---|---|---|---|---|---|---|
| 8.5 | 7.9 | 7.9 | 7.9 | 7.9 | 7.7 | 7.8 |

*Funding for the project's contracts

# Wake Re-categorization
## *1A06B*

**The RECAT project supports the NextGen objective to accommodate increased demand (flights) during peak demand periods by developing wake separation standards that are tailored to aircraft performance characteristics rather than the more general single aircraft weight parameter of the present standards.**

**Wake RECAT uses matures wake mitigation operational concepts to the point they can be directly implemented by FAA orders. If NAS infrastructure enhancements are required, the concepts are developed to the point that they can be operationally demonstrated and a repeatable process can be handed off to the ATO for implementation.**

# Wake Re-Categorization/BLI #:1A06B Capability Overview

## People:

- Wake Program Manager: Jeff Tittsworth (ATO)
- Wake Research Manager: Paul Strande (ANG)
- Subject Matter Experts: Edward Johnson (AIR), Wayne Gallo (AFS). Kevin Connelly (NATCA), RJ Eisemann (ALPA)
- Contract support SMEs: 4 world renowned wake experts, two previous AFS Chief Science and Technology Advisors for Wake, retired branch manager for AFS-450

## Organizations:

- Volpe NTSC: data collection and analysis, safety case development
- MITRE/CAASD: approach/departure speed analysis, benefits analysis

# Anticipated R&D in FY16 and FY17

## Planned Research Activities

- RECAT Phase 2.5 safety analysis – FY16
- Development of categorical optimization tool for RECAT 2.5 – FY16
- Operational demonstration of RECAT 2.5 initiated at 2 sites – FY17
- Evaluation of dynamic wake separation concepts for incorporation into RECAT Phase 3 planning – FY17

## Expected research Products

- Approved RECAT Phase 2.5 SRMD – FY17
- Authorized RECAT Phase 2.5 order – FY17
- Operational demonstration of RECAT 2.5 at 2 sites – FY17

# Emerging RECAT FY18 Focal Areas

- **Initiate RECAT Phase 2.5 operational demonstration at the 3rd selected TRACON and associated ATCTs**
- **Completion of the RECAT Phase 2.5 wake separation standards operational demonstrations at the 3 selected TRACONs and associated ATCTs**
- **Refinement and handoff of RECAT Phase 2.5 Operational Demonstration products to ATO for follow-on NAS wide implementation of Phase 2.5**
- **Definition of the RECAT Phase III products that will be developed by the RECAT project**

# Wake Re-Categorization (RECAT)

## Research Requirement

- Refine pair-wise wake separation standards for in-trail, directly behind, and intersection departures (RECAT 2.5)
- Define and develop concept for dynamic pair-wise wake separation (RECAT Phase 3)
- Sponsor: Separation Management Portfolio (ANG-C7) & Jeffrey Tittsworth (AJV-82)
- POC: Paul Strande (ANG-C22)

## Outputs/Outcomes

- RECAT Phase 1.5 continues to deliver benefits across the NAS (MEM, SDF, CVG, ATL, IAH/HOU, CLT, JFK/EWR/LGA, ORD/MDW, and DEN
- Approved SRMD for RECAT Phase 2 pairwise wake separation standards
- NAS wide implementation of separation reduction behind B757 is a direct outcome of RECAT 1.5

## FY 2015 Accomplishment / Issues

- Accomplishments: AOV approval of RECAT Phase 2 SRMD and pairwise wake separation standards; initial analysis for RECAT Phase 2.5
- Issues: Questions regarding implementation of RECAT Phase 2 operational concept. Analysis is underway to complete assessment of RECAT Phase 2 concept, operational impacts, and benefits prior to Phase 2 key site implementation.

## CIP Funding ($M)

| FY15 | FY16 | FY17 | FY18 | FY19 | FY20 |
|---|---|---|---|---|---|
| 0.0 | 0.95 * | 1.8 | 2.5 | 2.5 | 0.0 |

* $575K for RECAT 1.5 implementation

# NAS Wide Separation Reduction

RECAT I reduced separation for Heavy and Large behind B757 from 4 NM to 3 NM (MRS)

RECAT Phase 1.5

- B757s are categorized with other upper Large aircraft (Cat D)
- Separation was reduced for Smalls (Cat F) behind B757 (Cat D) from 5 to 4 NM

Separation changes behind B757

- Authorized FAA Order 7110.65w effective Dec 10, 2015 and
- Applies to all non-RECAT sites

**RECAT 1.5 Changes Relative to RECAT 1.0**

| | | | Follower | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | A | B | C | D | E | F |
| | | | Super | Upper H | Lower H | Upper L | Lower L | Small |
| Leader | A | Super | MRS | 5.0 | 6.0 | 7.0 | 7.0 | 8.0 |
| | B | Upper H | MRS | 3.0 | 4.0 | 5.0 | 5.0 | 7.0 |
| | C | Lower H | MRS | MRS | MRS | 3.5 | 3.5 | 6.0 |
| | D | Upper L | MRS | MRS | MRS | MRS | MRS | 4.0 |
| | E | Lower L | MRS | MRS | MRS | MRS | MRS | MRS |
| | F | Small | MRS | MRS | MRS | MRS | MRS | MRS |

Reduction for all aircraft

| Traditional Classes | Trailing Aircraft | | | | |
|---|---|---|---|---|---|
| | Super | Heavy | B757 | Large | Small |
| Super | MRS | 6.0 | 7.0 | 7.0 | 8.0 |
| Heavy | MRS | 4.0 | 5.0 | 5.0 | 6.0 |
| B757 | MRS | MRS | MRS | MRS | 4.0 |
| Large | MRS | MRS | MRS | MRS | 4.0 |
| Small | MRS | MRS | MRS | MRS | MRS |

Reduction for all aircraft