Aircraft Technology and Modeling Improvements

Aircraft Noise

To: NYCAR
By: James I. Hileman
   Chief Scientific and Technical Advisor for Environment and Energy
   Federal Aviation Administration

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Outline

• Background
• Continuous Lower Energy, Emissions & Noise (CLEEN)
• Integrated Noise Model (INM) and Aviation Environmental Design Tool (AEDT)
• Closing Remarks
Community Noise from Aircraft

Aircraft Noise

All noise sources contribute to acoustic signature – both at takeoff and during landing

Landing Takeoff Cycle

Community exposure set by aircraft types and operational tempo over day and night
Commercial Aircraft Noise Evolution

Cumulative Noise Level Relative to Stage 3 (EPNdB)

-35 -25 -15 -5 5 15


Year of Certification

STAGE 2
B737-200
B-727-200
DC-9-10
DC8-55F
B707-300
B727-100

STAGE 3
B747-100
747-100F
DC9-14
MD10-10F
A300B2/B4F
B747-200
B767-200
B767-300
MD83
MD87
A310-300
MD-82
A320-200
B757-200
B747-300
B747-400
MD11
B737-800
B737-900
B777-200
MD90-30
A340-300
A300-300
MD717-200
B737-800
A340-600
B737-700

STAGE 4
B777-900
A320CFM
B787-9
A350-941

STAGE 5
B747-8
B787-9
A320PW

Aircraft Technology Requires Time to Enter the Fleet

Diffusion of first generation jet aircraft into the airline fleet: 15 year diffusion dynamic† (Data source: ATA Annual Reports 1958–1980)
Continuous Lower Energy, Emissions & Noise (CLEEN)

- FAA led public-private partnership with 50-50 cost share from industry
- Reducing fuel burn, emissions and noise via aircraft and engine technologies and alternative jet fuels
- Conducting ground and/or flight test demonstrations to accelerate maturation of certifiable aircraft and engine technologies

<table>
<thead>
<tr>
<th></th>
<th>Phase I</th>
<th>Phase II</th>
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<tbody>
<tr>
<td>Time Frame</td>
<td>2010-2015</td>
<td>2016-2020</td>
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<tr>
<td>FAA Budget</td>
<td>~$125M</td>
<td>~$100M</td>
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<tr>
<td>Noise Reduction Goal</td>
<td>25 dB cumulative noise reduction cumulative to Stage 5</td>
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<tr>
<td>NO$_X$ Emissions Reduction Goal</td>
<td>60% landing/take-off NO$_X$ emissions</td>
<td>75% landing/take-off NO$_X$ emissions</td>
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<td>Fuel Burn Goal</td>
<td>33% reduction</td>
<td>40% reduction</td>
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<tr>
<td>Entry into Service</td>
<td>2018</td>
<td>2026</td>
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For more information: http://www.faa.gov/go/cleen
CLEEN Details

Awardees:
- Aurora Flight Sciences (Phase II only)
- Boeing
- Delta Tech Ops, America’s Phenix, MDS Coating Technologies (Phase II only)
- General Electric (GE) Aviation
- Honeywell Aerospace
- Pratt & Whitney
- Rohr, Inc. / UTC Aerospace Systems (Phase II only)
- Rolls-Royce

Phase I Technologies:
- 9 Technologies focused on
  - Revolutionary Engine Design
  - Engine redesign
  - Wing technologies
  - Flight Management System Improvements
  - Improved Combustors
- 14 Technologies focused on
  - Fuselage redesign
  - Engine redesign
  - Wing technology
  - Flight Management System improvements
  - Improved combustion

For more information: http://www.faa.gov/go/cleen
CLEEN Technology and Benefits: Demonstrated technologies that reduce noise, emissions and fuel burn

**Boeing**

Adaptive Trailing Edge
~ 2% fuel burn reduction
~ 1.7 EPNdB cum reduction in some single and twin aisles

Ceramic Matrix Composite (CMC) Acoustic Nozzle
~ 1% fuel burn reduction
~ 2.3 EPNdB cumulative noise reduction

**Pratt & Whitney**

Geared Turbofan Technologies
CLEEN techs expand design space for engine with ~ 20% fuel burn reduction,
> 20 EPNdB cumulative noise margin to Stage 4

For more information: http://www.faa.gov/go/cleen
CLEEN Technology and Benefits:
Demonstrated technologies that reduce noise, emissions and fuel burn

General Electric

Open Rotor
~26% reduction in fuel burn (re: 737-800)
~15-17EPNdB cumulative noise margin to Stage 4

Novel Acoustic Liner Technology
~2 EPNdB cumulative noise reduction

Fan Noise Source Strength Reduction
~1 ENLdB cumulative noise reduction

Aurora

D8 aircraft fuselage
~29% fuel burn reduction
~16 EPNdB cum noise margin to Stage 4

For more information: http://www.faa.gov/go/cleen
Assessment of CLEEN Technologies

Analytical Evaluation:
• Conducted by Georgia Tech
• Evaluating impact on fuel burn and noise out to 2050
• Modeled most, but not all, Phase I and II CLEEN Technologies
• Evaluation of Phase I captured in two technical reports

Key Results:
• 22 billion gallons of cumulative jet fuel saved
  – Equivalent to 1.7 million cars off road between 2025 and 2050
• Contribute to a 14% decrease in the land area exposed to DNL 65 dB and greater
Integrated Noise Model (INM)

• FAA’s legacy tool to model aircraft noise in the vicinity of an airport
  – Between 1978 and 2015, it was the regulatory model for the FAA
  – Also used by hundreds of international users

• Methodology based on internationally agreed upon standards

• Basis for AEDT noise and performance calculations

• Desire for an integrated capability of computing/identifying interrelationships between noise and emissions and amongst emissions drove AEE to replace INM
AEDT Replaces Legacy Tools

AEDT builds upon the methodologies in the legacy tools

AEDT replaces legacy tools for environmental compliance, research, and policy analysis.
Aviation Environmental Design Tool (AEDT)

Features

• Computes noise, fuel burn, emissions, and air quality
• Able to conduct analyses at airport, regional, national, and global scales

Applications

• Air space and airport design and planning (e.g., National Environmental Policy Act reviews)
• International Civil Aviation Organization (ICAO) Committee on Aviation Environmental Protection (CAEP) analyses
• Assessing benefits from introducing NextGen and new aircraft and engine technologies (e.g., from FAA CLEEN and NASA Programs)

For more information on AEDT or to download it, please visit: https://aedt.faa.gov/
AEDT Development Plan - Noise

• Current version of tool, AEDT2d, was designed to model DNL 65
  – Seeking to improve ability to model noise at lower DNL
• Adding noise and performance information for additional aircraft types
• Improving takeoff weight and thrust modeling
• Improving aircraft performance module
• Laying ground work to incorporate airframe noise more explicitly
Methodology Updates since INM

- NIRs legacy capabilities
  - Flexibility for larger study areas
  - Impact Report and table
  - Noise ranking and flight track reassignment for change analysis

- Addition of Number of Above calculation for some metrics (e.g., LAMax, LCMax, SEL)

- Addition of Environmental Justice Population Identification feature

- Updated algorithm regarding how sound dissipates between the aircraft and what is experienced on the ground
AEDT3a Functionality: Noise

• Aircraft performance modeling update
  - More accurate and unified modeling of aircraft performance for both terminal area and cruise operations
  - Improved aircraft takeoff weight and takeoff thrust modeling to better represent flight operations
  - Added speed control capability to procedure modeling

• Fleet database updates
  - 737-800 Arrival Profiles, G650, Boeing 737-8Max
Closing Observations

• Despite considerable reductions, noise remains a challenge
• Utilizing a comprehensive approach to address this challenge
• Technology advancements are needed to achieve additional aircraft noise reductions
• Modeling tools continue to advance as new methodologies and algorithms mature
Northeast Corridor Initiative (NEC)

Presented to: NY Community Aviation Roundtable

Date: September 26, 2018
NextGen Advisory Committee (NAC) Recommended Goals for Northeast Corridor (NEC)

Near-term goals:

- Improve execution of today’s operation
  - Complete all scheduled Operations
  - Operate on time
  - Operate with predictability
- Critical to improve operations during adverse weather

Timeframe: October 2017 – December 2021
Northeast Corridor Update

Oct 2017: Interim phase 2 report approved by NAC
  • Includes milestones and commitments thru March 2019.

June 2018: Final phase 2 report received by NAC
  • Includes milestones and commitments thru Dec 2021
NEC Scope – What is included?

- **Airports**: build airport infrastructure on the airport surface, airport terminal buildings and air traffic towers that enable improved surface operations and airport throughput

- **Airspace and Procedures**: design and evaluate operational procedures that improve efficiency of today’s airspace/airport operation; and explore opportunities to deconflict traffic between close-in airports

- **Tactical Initiatives**: maximize and evolve the utilization of already deployed tools, routes and processes to improve movement of air traffic into, out of and within the NEC during periods of exceptionally high demand and severe weather

- **Tools / Technology**: deploy new automation capabilities, decision support tools, and processes that enhance controller information and decision making such that operational performance is improved in all operating conditions
Update on key procedure items in NY Metro area
NEC Initiative: ZNY Offshore Airspace Redesign

Benefit Considerations

Improve airspace efficiency in constrained offshore airspace

Status:
Design completed Mar 2018
Implementation NLT Dec 2019
NEC Initiative: East Coast High Altitude Routes

Initiative Objective
Design high altitude (Above 18000 ft) PBN Route structure to segregate flows and better manage traffic to/from major airports on east coast

Northeast Corridor
Mid Atlantic States to New England
• Design Completed June 2018
• Implementation September 2020

Florida Metroplex
Southern States to Puerto Rico
• Implementation November 2018
NEC Initiative: East Coast High Altitude Routes

Operational Objectives:
• Establish segregated routes in constricted east coast airspace to achieve higher throughput, optimal altitudes and increased routing options.
• Alleviate east coast airspace constraints

Expected Outcomes:
• Improve airspace throughput for high altitude traffic to/from NEC airports
• Reduce traffic management restrictions due to east coast airspace constraints for NEC airports
• Reduce airspace complexity
• Reduce radar vectors and reroutes
• Improved accommodation of requested altitudes
NEC Initiative: Vertical Climb Escape Route
High performance escape route during SWAP/other constraints for TEB/HPN departures that can perform climb

- **Objective:** When severe weather or other system constraints exist, leverage high performance business jet capabilities and release to climb above constrained airspace on predefined escape route

- **Status:** One flight test conducted. Additional study of routing and flight testing required.
NEC Initiative: Use of dispersal headings for LGA13 departures using TNNIS, GLDMN, & NTHNS (Q2-4 CY18)

“Complete”

Use of this initiative is limited to certain operational configurations

Benefits considerations

• Supports dispersion of Runway 13 departures

• Uses already published procedures

• Reduces average departure delay, reducing emissions and providing benefit to the traveling public
NEC Initiative: Modify LGA22 Missed Approach to Deconflict with EWR29 RNAV GPS Approach

Milestone: Complete feasibility study for the modified missed approach for LGA22. Due Q4 2018

Benefit: Developing an alternate missed approach for LGA RY 22 that deconflicts with EWR RNAV GPS X RY29 approach would enable EWR to land two runways

Status: Design options operationally not viable
Thank you!
We will continue to keep you and your communities updated

Please click the link below to view the latest Phase 2 Addendum to Priorities for Improving Operational Performance in the Northeast Corridor (NEC) through CY2021

Approved by the NextGen Advisory Committee June 2018

[AJV-12\NEC Phase II Addendum Report June 2018 (Through CY2021).pdf]