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AVIATION OPERATIONAL MEASURES FOR FUEL AND EMISSIONS REDUCTION WORKSHOP

Aircraft Operating Procedures to Reduce Airport Ground Emissions

Captain Richard Sowden

Project Pilot Air Canada Flight Operations Technical Group

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Objectives

- Describe aircraft operating techniques to reduce aircraft noise and engine emissions for phases of flight below 3,000 ft. AGL
- Review strategies to ensure success
- Outline means to measure success
- Discuss conflicting environmental objectives
- Discuss the collective industry effort required to achieve the greatest enhancements in efficiency

Efficiency Assumptions

- A320 aircraft
- 100 aircraft in fleet
- 15,000 sectors/month or 180,000 sectors/year
- Every 100 litres of fuel burned releases the following combustion by-products
  - CO_2 – 233 kg
  - CH_4 – 219 g
  - NO_x – 23 g

Pre-departure

- Minimize APU use
  - Start APU 10 minutes before scheduled departure time
    - Reducing APU use by 2 minutes per sector saves 780,000 litres of fuel annually
  - APU vs. Ground Support equipment
    - APU burns 6 times as much fuel per hour as mobile ground support equipment (B744 – 20X)
  - Requires precise procedures & dedicated effort by ground handling teams

Engine Start & Taxi

- Single engine taxi should be the normal departure procedure unless conditions preclude it
  - 1 minute of single engine taxi-out per sector saves 430,000 litres of fuel annually
- Five key areas to focus on in Standard Operating Procedures (SOP's)
  - Limiting weight
  - Limiting thrust
  - Checklists
  - Engine start sequence
  - Stabilization times

Takeoff

- "Flex Thrust" normal operating procedure
  - Reduces noise
  - Reduces overall sector fuel consumption
  - Reduces gas path wear & maintenance costs
  - Currently 85% of A320 family departures are "Flex Thrust"
- Depart in direction of flight
  - Airborne fuel flow is 6 times higher than ground idle - 18 min. taxi = 3 minutes airborne

Initial Climb

- Climb profile tailored to direction of flight for turns limited by altitude due to noise abatement requirements
  - Use V_2 + 10 to 3,000 ft AGL for altitude restricted SID's when departure runway is more than 90° from direction of flight
  - Used on 1/3 of departures saves 3.2 million litres of fuel annually

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Approach

- RNAV arrivals
  - Enhanced traffic & energy management
  - Reducing IFR arrival distance by 4 miles saves 50 litres of fuel
- Decelerated approaches as normal SOP
  - Flap/gear selection defined by altitudes
  - Used on 1/3 of arrivals saves 4.5 million litres of fuel per year

Landing

- Reduced flap landings as normal SOP
  - Quieter approaches
  - Used on 1/3 of landings saves 3 million litres per year of fuel
- Idle reverse as normal SOP
  - Quieter & can improve carbon brake wear
  - Reduced gas path wear & maintenance costs
  - Used on 1/3 of landings saves 1.2 million litres of fuel per year

Taxi-in

- Single engine taxi should be the normal arrival procedure unless conditions preclude it
  - 1 minute of single engine taxi-in per sector saves 430,000 litres of fuel annually

Gate Arrival

- Minimize APU use with full ground support on arrival at gate
  - Start APU 10 minutes before scheduled departure time
    - Reducing APU use by 2 minutes per sector saves 780,000 litres of fuel annually
  - APU vs. Ground Support equipment
    - APU burns 6 times as much fuel per hour as mobile ground support equipment (B744 – 20X)
  - Requires precise procedures & dedicated effort by ground handling teams

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Achievable Fuel Savings

» A fleet of 100 A320 aircraft flying 15,000 sectors a month can save:

Pre-departure	780,000 litres
Taxi-out	430,000 litres
Initial climb	3,200,000 litres
Approach	4,500,000 litres
Landing	3,000,000 litres
Taxi-in	430,000 litres
Gate arrival	780,000 litres
Total	**13,120,000 litres (1.25%)**

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Fuel Savings Impact

- Operating cost reduction through reduced fuel consumption
  - $3.25 million US
- Emission reductions through reduced fuel consumption
  - CO_2 –12.2 million kg
  - CH_4 – 11,500 kg
  - NO_x – 1200 kg

Strategies for Success

- Build an efficient operating culture
  - Top down management support
  - Policy to define fuel efficiency as a corporate objective, but not at the expense of safety
  - Procedures that:
    - Establish fuel efficient procedures as the norm
    - Recognize conservative, safety oriented pilot culture
  - Education & awareness material to explain “why”
  - Training to teach the SOP
  - Checking to reinforce the SOP

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Measuring Success

- Fuel Management Information Database
  - Capture flight plan and actual aircraft operating fuel values
  - Validate policy & systems
- Flight Operations Quality Assurance (FOQA)
  - Capture aircraft flight profiles
  - Validate procedures and compliance rates
- Maintenance QAR & ACARS data
  - Trending information pending introduction of FOQA
- Clear employee non-judgmental clauses required

Conflicting Environmental Objectives

- Centralized de-icing facilities
  - Reduce glycol contamination
  - Incur significant taxi-out delays thereby increasing engine emissions
  - 30 minute deicing taxi event burns
    - A320 400 litres
    - B747-400 3300 litres

Conflicting Environmental Objectives…2

- Noise abatement procedures (N. Am):
  - Preferential runways and arrival/departure procedures are:
    - Based on track/altitude monitoring
    - Do not reflect actual aircraft noise or promote noise and fuel efficiency
    - Have not been revisited for years
    - Are not based on reasoned scientific and engineering analysis or evolution of aircraft technology

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An Industry Integrated Approach to Fuel Efficiency

- Airlines
  - Develop and implement fuel efficient SOP's
- ANS Providers
  - Develop and implement fuel efficient arrival and departure paths
- Airports
  - Maximize on-gate de-icing & minimize CDF delays
  - Facilitate departures in direction of flight
  - Ensure noise abatement procedures minimize adverse affect on fuel burns

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An Integrated Approach to Fuel Efficiency (cont'd)

- Aircraft Manufacturers
  - Introduce fuel efficiency improvements to aircraft in a timely manner to support the industry
  - Examples of needed aircraft modifications:
    1. A320 family aircraft approach idle change to Flap 3 or gear down from Flap 1 would save 12 litres of fuel per approach
    2. Bombardier Regional Jet Flap 30 landing instead of Flap 45 would save 18 litres of fuel per approach

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Thank you !

Contact: richard.sowden@aircanada.ca

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