EGTS™ – Future Of Aircraft Taxiing

Aircraft Builders Conference, September 21-23, 2014
Basic Concept Of EGTS

• The **EGTS** will allow the aircraft to push-back and taxi under APU generated electrical power *without the main engines running*
  – APU generator powered motors allow aircraft to “taxi”
  – Motors housed in main landing gear wheels for maximized performance, traction and agility

• High value offering to Single Aisle Airline Customers with significant savings and “Green” Benefits, *reducing:*
  ▪ Fuel Use
  ▪ Airport Emissions
  ▪ Need for Ground Tug
  ▪ Other Direct Operation Costs

**Target Savings: ~4% Block Fuel Reduction Depending On Mission**
Paris Air Show 2013
Why EGTS?
Why Electric Taxiing System?

**Economic Challenges:**
- 6% of fuel is burnt on ground
- High FOD cost ~$1.1B
- Increased air traffic and airport congestion

EGTS offers up to 4% fuel savings

**Environment Expectations:**
- Carbon neutral growth from 2020
- 50% reduction in carbon emission by 2050
- Airport’s increased scrutiny on noise from aircraft

EGTS offers up to 60% reduction in CO₂

**Technology Solution Now Available – EGTS™**
Who is EGTS International?
EGTS International – A Joint Venture

... Combining The Strength Of Two Market Leaders

- Partnership includes joint system development, production, marketing and support
- Provides an accelerated time to market for electric taxiing system
- JV to provide a superior product and global customer support
The EGTS Footprint

**Toronto**
Electric power system integration, generator controls & power electronics design & manufacturing – EGTS electrical system, ATRU, PCU

**Torrance**
Electric drive development, motor design & development

**Phoenix/Deer Valley**
Honeywell EGTS management team, ATA 24/31/49 EGTS system design, EGTS control hardware and operating system, cockpit interface definition and panel development

**Tuscon**
Generator design & development and EGTS system controller concept design

**Tempe/Bangalore**
Wheel attachment design and advanced wheel actuator concept development

**Mexicali**
Cockpit interface definition

**Toulouse/Toulouse**
MSN234 aircraft testing, harness installation

**Colomba**
2-stage gear box design and manufacturing

**Gloucester/Bidos**
Landing gear integration activities and physical mock-up and landing gear manufacturing

**Vélizy/Paris**
Safran EGTS management team, ATA32 EGTS system design, EGTS control law development, wheel actuator, wheels and brakes and landing gear equipment design, integration and endurance lab testing, wheel attachment design and advanced wheel actuator concept development

**Molsheim**
Manufacturing management team, wheel actuator final assembly and pre-ATP, wheel & brake industrialization & manufacturing

**Réau**
Aircraft operational procedure definition, pilot resources, electric power design support, clutch control module design and manufacturing

**Villemur/Vichy**
Harness design, configuration management and harness manufacturing
Benefits To All Stakeholders
**EGTS Benefits To All Stakeholders**

- **Airline:**
  - Shorter push back time
  - Reduced cost (no tug)
  - Earlier start of taxi out phase
  - Autonomy

- **Airline:**
  - Improved gate availability
  - Improved ground personnel safety
  - No jet blast
  - Less vehicles on apron

- **Airline:**
  - Fuel savings
  - Reduced FOD

- **Airport/Community:**
  - Reduced ground emissions
  - Reduced noise

- **Airline:**
  - Fuel savings
  - Quicker servicing of aircraft

- **Airport/Community:**
  - Reduced ground emissions
  - Reduced noise
  - Improved ground personnel safety
  - No jet blast

- **Passengers:**
  - Faster exit and luggage availability
Reducing Fuel Use And Ground Operations Costs

Value model delivers over 50% savings compared to Dual Engine Taxi

Additional EGTS savings:
- Pushback costs
- Carbon credit
- Foreign Object Damage
- ...

As well as:
- Aircraft positioning
- On Time Performance
- ...

EGTS Fuel Benefit
EGTS Total Benefit
Dual Engine Taxi (Ref)
Single Engine Taxi
Ground ops savings
EGTS – Improving the Environment and Ground Safety

• Improved Airport Emissions
  – Main engine run time substantially reduced
  – Removal of Tug based emissions

• Improved health, safety and efficiency for airport ground personnel
  – No engines running in gate area...No jet blast
  – No tug’s running in gate area
  – Personnel can get to work sooner after aircraft arrival at gate

• Improved performance for airports....... and passengers
  – Reduced Turn Around Time at gate
  – Faster passenger disembarkation
  – Earlier luggage delivery

• Increased aircraft autonomy
  – Ability to “Pushback and Go”
  – No reliance on tug

Ultimately Improving Gate Capacity Via Improved On Time Performance
Environmental Benefit

EGTS drastically reducing emissions and noise on ground

Example for 17 min taxi out

Up to 50% ground noise reduction to residents

Based on preliminary study
Technical Overview
EGTS Schematic Architecture

Interface Unit
Wheel Actuator Control Unit
Power Converter

EGTS Controller
Wheel Actuator

APU Generator
Maturity Plan
Comprehensive Maturity Plan

Initial Development Phase

JAN 2010
Design Trade-Off

JAN 2011

Initial Development Phase

JAN 2012

Trade-offs and Technology maturing

JAN 2013

Breakaway testing on A320 and 737 to define high level specification

JAN 2014

Extensive lab testing

Trade-offs and Technology maturing

JAN 2015

Aircraft Ground Demonstration Successfully Completed in 2013

Fully integrated system demonstration on A/C

Pilot Days

MESSIER-BUGATTI-DOWTY and HONEYWELL – This document and data referred within shall not be disclosed without the prior written authorization of MESSIER-BUGATTI-DOWTY, SAFRAN and HONEYWELL.
Extensive Testing For System Demonstration

Wheel Actuator full performance testing

Dynamometer bench test

Power Electronics system bench test

Equipped Main Landing Gear

EGTS Program Recent Achievements

- **January 2013**:  
  - Start of EGTS prototype actuator testing in labs  
  - Second technical Joint Concept Phase with Airbus

- **March 2013**:  
  - Start of EGTS complete system testing on A320 MSN 234

- **April 2013**:  
  - Workshop with the Boeing company on technical feasibility and value model

- **June 2013**:  
  - EGTS demonstrations during Paris Air Show  
  - MOU signed with Air France on EGTS evaluation

- **September 2013**:  
  - Pursuit of technical trade off for system definition refinement after result of the test campaigns

- **December 2013**:  
  - MOU signed with Airbus for the evaluation of the EGTS for the A320 family on forward fit and retrofit

- **January 2014**: Start of the second EGTS test campaign on A320 MSN 234

- **March 2014**:  
  - EGTS Pilot Days: an opportunity given to airline pilots to test the EGTS on A320 MSN 234  
  - MOU signed with GoAir

- **April 2014**: MOU signed with Interjet

- **May 2014**: MOU signed with China Aviation Energy & Emission Solutions (CAEES)
Value
Substantial Benefits Depending On Operational Profile

Target Segment Based on Value Drivers

- Short flight range <1000 nm
- High flight cycles >1500
- Long Taxi Time >20 min

EGTS Target Segment
Benefits To Airlines And Environment

• **Benefits quantified:**
  - Reduced fuel burn
  - Reduced ground tug operation
  - Taxi to hangar / gate and stand positioning
  - Reduced Foreign Object Debris damage
  - Elimination of taxi out fuel contingency
  - Reduced emissions / carbon taxes

• **Benefits recognized but not quantified:**
  - Reduced *noise* in airport environment
  - Improved *safety* at apron: No engines running/no jet blast
  - Increased gate *autonomy* / Improved OTP
  - Reduced ground operations damage
  - Engine maintenance cost savings
  - Higher *precision* manoeuvring
  - Lower pilot workload vs. Single Engine Taxi

• **Additional costs quantified:**
  - Increased APU fuel burn
  - EGTS and additional APU Maintenance
  - Additional aircraft fuel burn due to EGTS Weight
EGTS™ Value Model – Average Single Aisle Operation

Annual airline savings using EGTS per aircraft

Robust Value Model Based on Airlines Operations
Worldwide Attendance

• More than 20 pilots and 18 airlines coming from all over the world!
Aircraft Demonstration

• First impressions Impressive
  – Intuitive
  – Fun
  – Nice and smooth
  – Great system
  – Easy to operate
  – Better initial acceleration than with main engines
  – Impressed by autonomous pushback capability

• Outcome
  – Acceleration sufficient for expedited taxiing/ runway crossing
  – EGTS much safer on slow speed compared to conventional taxiing
  – Performance has no impact to airport traffic normal operation
  – Able to perform at 1.5% slope
Summary And Way Forward

• Main benefits
  – Fuel burn and pushback costs savings
  – Ground operations improvements
  – Environmental footprint reduction

• Honeywell and Safran: A powerful partnership bringing a mature EGTS to market

• Next steps
  – Technology maturing
  – Work with airports and authorities to ensure smooth transition
  – Work on technology availability for forward fit and retrofit installations

EGTS™ - An Innovation Supporting Airline Sustainability
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