Fuelling Aviation with Green Technology:
Overview and Environmental Benefits of EGTS electric taxiing

Sept 9 & 10, 2014
Confidential & Proprietary Notice

This document contains HONEYWELL and MESSIER-BUGATTI-DOWTY, SAFRAN confidential information.
This unpublished work is protected by the laws of the United States, France and other countries.

NOTICE - FREEDOM OF INFORMATION ACT (5 USC 552) AND DISCLOSURE OF CONFIDENTIAL INFORMATION GENERALLY (18 USC 1905)
This document is being furnished in confidence by HONEYWELL and MESSIER-BUGATTI-DOWTY, SAFRAN.

The information disclosed herein falls within exemption (b) (4) of 5 USC 552 and the prohibitions of 18 USC 1905.

These Commodities, Technology or Software Were Exported From the United States in Accordance with the Export Administration Regulations. Diversion Contrary to U.S. Law Prohibited.
EGTS™ – Meeting Agenda

- Why EGTS?
- General Introduction to EGTS System
- Benefits/Value
- Summary and Way Forward

Informing ICAO on EGTS Program and Related Benefits
Why An Electric Taxiing System?

- 30%-40% of Airline cost is fuel
- 6% of fuel is burnt on ground
- 60,000 FOD incidents cost $1.1B
- 50% on runway & stand

Aviation Industry produces 2% of worldwide CO₂ emission

Air traffic in Europe will nearly double by 2030
19 to 39 key airports at saturation

Neutral Carbon Growth from 2020
50% reduction in carbon emission by 2050

Noise reduction improves comfort of passengers and ground personnel

SAFRAN and HONEYWELL Have Formed a 50/50 JV to Develop EGTS™
Concept of EGTS

An innovative system allowing aircraft to pushback and taxi without main engines running

APU generator powered motors allow aircraft to “taxi”

A Step Towards The More Electric Aircraft
EGTS Schematic Architecture

- Interface Unit
- Wheel Actuator Control Unit
- Power Converter
- Wheel Actuator
- APU Generator

EGTS™ - Technology Under Development
# Ground Operations Process – Pushback & Taxi Out

## Up to 2 Min. Time Savings with EGTS vs. Dual Engine Taxi

<table>
<thead>
<tr>
<th>EGTS Pushback and Taxi Out</th>
<th>Single engine Pushback and Taxi Out</th>
<th>Dual engine Pushback and Taxi Out</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Engine Warm-Up Time</strong></td>
<td><strong>1 min</strong></td>
<td><strong>2 min</strong></td>
</tr>
<tr>
<td><strong>Eng 1 IDLE</strong></td>
<td><strong>Eng 1 Single Eng taxi</strong></td>
<td><strong>Eng 1 Dual Eng taxi</strong></td>
</tr>
<tr>
<td><strong>Eng 1 Dual Eng taxi</strong></td>
<td><strong>Eng 1 Dual Eng taxi</strong></td>
<td><strong>Eng 2 Dual Eng taxi</strong></td>
</tr>
<tr>
<td><strong>Eng 2 IDLE</strong></td>
<td></td>
<td><strong>Eng 2 IDLE</strong></td>
</tr>
<tr>
<td><strong>Eng 2 Dual Eng taxi</strong></td>
<td></td>
<td><strong>Eng 2 Dual Eng taxi</strong></td>
</tr>
</tbody>
</table>

**Total Time**

- **EGTS Pushback and Taxi Out:** 10 min
- **Single engine Pushback and Taxi Out:** 11 min
- **Dual engine Pushback and Taxi Out:** 12 min

**Fuel Burn**

- **EGTS Pushback and Taxi Out:** 56 kg
- **Single engine Pushback and Taxi Out:** 102 kg
- **Dual engine Pushback and Taxi Out:** 133 kg

**Savings**

- 2 min saved on pushback
Ground Operations Process – Taxi In

-1 min  0 min  5 min  7 min
LDG IDLE REV  TAXI IN  GATE
ENGINES MIN COOL DOWN TIME
Eng 1 Dual Eng taxi  GATE
Eng 2 Dual Eng taxi  GATE
APU ON  GATE

Dual engine Taxi In: 85 kg fuel burn

-1 min  0 min  1 min  2 min  5 min  7 min
LDG IDLE REV  TAXI IN  GATE
ENGINES MIN COOL DOWN TIME
Eng 1 Dual Eng taxi  GATE
Eng 2 Dual Eng taxi  GATE
Eng 1 Single Eng taxi  GATE
APU ON  GATE
GROUND PERSONNEL ON A/C

Single engine Taxi In: 71 kg fuel burn

-1 min  0 min  1 min  2 min  5 min  7 min
LDG IDLE REV  TAXI IN  GATE
ENGINES MIN COOL DOWN TIME
Eng 1 Dual Eng taxi  GATE
Eng 2 Dual Eng taxi  GATE
APU ON  GATE
GROUND PERSONNEL ON A/C
No jet blast at gate area

EGTS Taxi In: 36 kg fuel burn

Safer Environment for Ground Handling Personnel
EGTS Value Proposition

- High value offering to Single Aisle Airline Customers with significant savings and “Green” benefits,

**designed to:**
- meet Airlines & Airports operational requirements

**reducing:**
- Fuel burn
- Airport Emissions / Noise
- Need for Ground Tug
- Other Direct Operation Costs

**Target Savings:** ~3% Block Fuel Reduction Depending on Mission
EGTS Environmental Benefits

- Slashing fuel burn and emissions on ground

Example: 17 min taxi out

The Best Opportunity to Drastically Reduce Emissions on Ground
EGTS Benefits Airlines, Airports, Community and Passengers

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

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

Airport/Community:
- Reduced ground emissions
- Reduced noise

Passengers:
- Reduced noise

Airline:
- Fuel savings
- Reduced FOD

Airport/Community:
- Reduced ground emissions
- Reduced noise
- Improved ground personnel safety (no jet blast)

Passengers:
- Reduced noise
- Faster exit and luggage availability

Delivers Benefits to All Stakeholders
Summary And Way Forward

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

• **Next steps**
  – Technology maturing through simulation and test program in labs and on aircraft
  – Work on benefits for all stakeholders – Airlines, Airports, Community
www.greentaxiing.com

Follow us on Twitter @green_taxiing