ICN Deicing Operations Analysis

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Motivations

• Understand and characterize deicing operations and impacts in Incheon International Airport
• Develop a deicing modeling capability (in SOSS fast time simulation environment)
Outline

• ICN deicing operations concept
• Deicing operation data analysis
• Summary and next steps
Definitions

• Deicing -- A procedure to remove frost, ice, slush, or snow from aircraft

• Anti-icing -- A procedure to provide protection against the formation of frost or ice and accumulation of snow or slush on aircraft surface

References: FAA (AC120-60B), Association of European Airlines (Recommendations for De-Icing/Anti-Icing of Aircraft on the Ground, 23rd Edition)
Deicing Zones & Pads
Deicing Zones & Pads

North Zones

South Zones

Cargo 1

Cargo 2

Terminal

Concourse
Deicing Zones & Pads

North Zones

South Zones
Deicing Zones & Pads

Number of Pads:

A South: 5
A North: 5
M South: 4
M North: 3
D South: 2
D North: 2
3. Sharp Aviation Korea
4. Swissport Korea
5. Bang-bo

1. Korean Airport Service (KAS)
2. Asiana Airport (AA)
## Stakeholders

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Responsibilities &amp; Concerns</th>
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<tr>
<td>IIAC (airport)</td>
<td>Prepare deicing zones and pads, acknowledge Ice Phase by ATIS</td>
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<tr>
<td>Flight operator</td>
<td>Inspect aircraft at gate for advise deicing operation to pilot</td>
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<tr>
<td>Deicing position (Incheon De-icing)</td>
<td>Assign deicing zone, control aircraft taxi in and out of deicing facility</td>
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<td>Ramp control (Incheon Ramp)</td>
<td>Issue push back clearance</td>
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<tr>
<td>Pilot</td>
<td>Call Deicing Position with deicing request, taxi to deicing facility</td>
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<tr>
<td>Airline</td>
<td>Manage boarding, inform passengers of delay</td>
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<tr>
<td>Deicing operator (ground handler)</td>
<td>Provide deicing services (remove frost, ice or snow and apply anti-icing fluid)</td>
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<tr>
<td>Incheon Delivery (ATC)</td>
<td>Departure clearance after deicing</td>
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<td>Ground and local control</td>
<td>Departure clearance and taxiway and runway crossing control</td>
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Preparation & Decision Makings

- **Prepare** for deicing requests & operations
- **Decide** deicing need
- **Assign** deicing facility
Preparation & Decision Makings

• **Prepare** for deicing requests & operations
  – Check deicing facility condition and readiness
  – Check deicing operators readiness and capacity
  – Prepare to add Deicing Position at ramp control
  – Prepare deicing delay information sharing

• **Decide** deicing need

• **Assign** deicing facility
Preparation & Decision Makings

• **Prepare** for deicing requests & operations

• **Decide** deicing need
  – Inspect aircraft for deicing request
  – Notify pilot of the request

• **Assign** deicing facility
Preparation & Decision Makings

- **Prepare** for deicing requests & operations
- **Decide** deicing need
- **Assign** deicing facility
  - Service contract between airline and service operator
  - Deicing facility load
  - Taxi distance to deicing zone and to departure runway
Operation Concept, Cont’d

- Incheon Delivery
- Incheon Ramp
- Incheon De-icing
- Pilot
- Flight Operator
- Deicing Operator

ATC departure clearance

Clear to enter deicing zone

Call to enter deicing zone

Clear to exit deicing zone

Call to exit deicing zone

Taxi to next TCP for departure

Deice

Call for ATC departure clearance
Deicing Data Analysis

• Data source
  – Reports
  – Tracks

• Metrics
  – Deicing days
  – Zone distribution
  – Queue length
  – Deicing stage times
Data Source

• Three-month surface operation data from Dec 2015 to Feb 2016
• Total 40,792 departures and 40,833 arrivals
  – 65,841/15,784 North/South Flow departures
  – Average daily flights ~450 (departure or arrival)
• Each flight record consists of
  – Reported data from FIMS (Flight Information Management System)
  – Track positions from ASDE-X
Deicing Days

Monthly Deicing Days

- Dec 2015: 21 days
- Jan 2016: 22 days
- Feb 2016: 20 days

Minimum 25 deicing operations
Top Ten Daily Deicing Operations

190/433 (40%)
Airport Departure Throughputs

Comparison of departure throughput rate shows reduced departure rate between 0900 to 1800.
Long taxi out times of deicing flights impact throughput.
Top Ten Deicing Days

Top Ten Daily Deicing Operations

A North, A South, M South are heavily used in heavy deicing days.
South flow departures

Cargo flights cross runways

Map data: Google, SK telecom
Zone Use – Ramp Area Distribution

Deicing Zone - Ramp Area Distributions

- Terminal
- Concourse
- Cargo 1
- Cargo 2

Deicing Ops

Zones:
- A South
- M South
- D South
- A North
- M North
Zone – Flow Distribution

Zones - Flows Distributions

- **South Zones - North Flow 56%**
- **North Zones - North Flow 12%**
- **South Zones - South Flow 18%**
- **North Zones - South Flow 14%**

**Unfavorable Configuration**
- 30% deicing and takeoff lineup at opposite runway

**Favorable Configuration**
Deicing Stage Times

- Push back
- Enter zone
- At pad
- deicing
- Pad time
- Deicing time
- Zone time
- Leave pad
- At runway
- Exit zone
- Taxi out time

Time line
Deicing Stage Times

North zones taxi out longer by ~10 min
Zone Queue Size

Definition: number of aircraft taxiing to or staying inside a deicing zone when an aircraft starts to taxi to the zone.
Zone Queue Size

![Box plot showing Zone Queue Size for A_North, A_South, M_North, and M_South.](image)
Zone Queue

Zone Queue Size Histogram

Light deicing condition, or favorable zone-flow config

Heavy deicing condition, or unfavorable zone-flow config
Taxi Out Times (Zone to Runway)

Taxi Out Times From Zone to Runway

After deicing, aircraft must take off within the holdover time.
Summary

• Deicing service at dedicated deicing facilities under the ramp control
• ~20 monthly deicing days in 2016-2016 winter months
• Deicing requests up to 40% departure flights at a single day
• Two thirds of deicing at A South and M South
• Deicing impacts
  – Extra controller workload
  – Longer taxi time → departure delays
• Decision making constraints
  – Service contracts between airlines and operators
  – Equipment setups
Next Steps

• Finalize analysis
  – SME verification
  – Constraints and impact analysis
  – Weather data correlation
  – Compare CLT deicing operation

• Develop model concept
  – Benefit analysis
  – Model concept development and validation
CLT Deicing Facilities

South Cargo Ramp
Total 6 pads

Rwy 5/23, three zones
West, Center and East
Total 8 pads

Single Service Provider: Integrated Deicing Service (IDS)

South Cargo Ramp
Total 6 pads
CLT Deicing

- Single deicing service provider
- Runway 5/23 used as deicing pads
- Three deicing ‘zones’ – West, Center and East on Rwy 5/23, total 5 pads in series configuration
- Ramp assigns (in coordination with IDS) first 5 deicing flights to Rwy 5/23
- When all Rwy 5/23 pads in use, FAA assigns pads for flight at spot
- Aerobahn is used in deicing operation