Detroit
Deicing Decision Support Tool

Jonathan T. Lee
Suzanne Chen
Anastasios (Chris) Daskalakis

U.S. Department of Transportation
Volpe National Transportation Systems Center

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Acknowledgement

- **NASA Langley Research Center, under contract DTRS57-03-C-10014**
- **Northwest Airlines**
  - System Operations Control (at MSP)
  - DTW ramp tower

Outline

- Overview and Problem Statement
- Model Description
- Simulation Results
- Future Work

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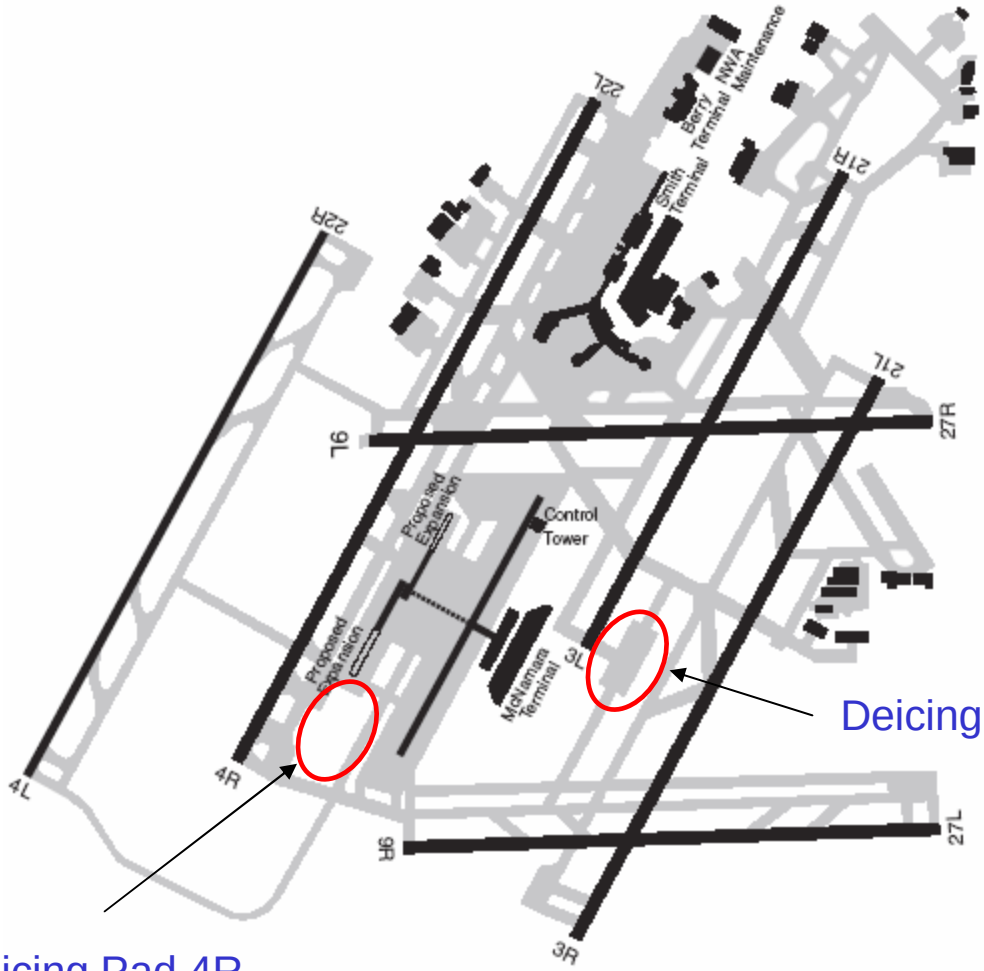
Deicing

- **Motivation**
  - Decrease impact of snow and ice on air carrier and airport operations
- **Issues**
  - Non-linear mapping between initial conditions and total system time (total time in queue and in deicing position)
    - Deicing pad configurations
    - Queue sequence
  - Bottleneck
- **Benefits**
  - Maximize predictability
  - Minimize operating cost
  - Reduce environmental impact

Detroit (DTW) Map

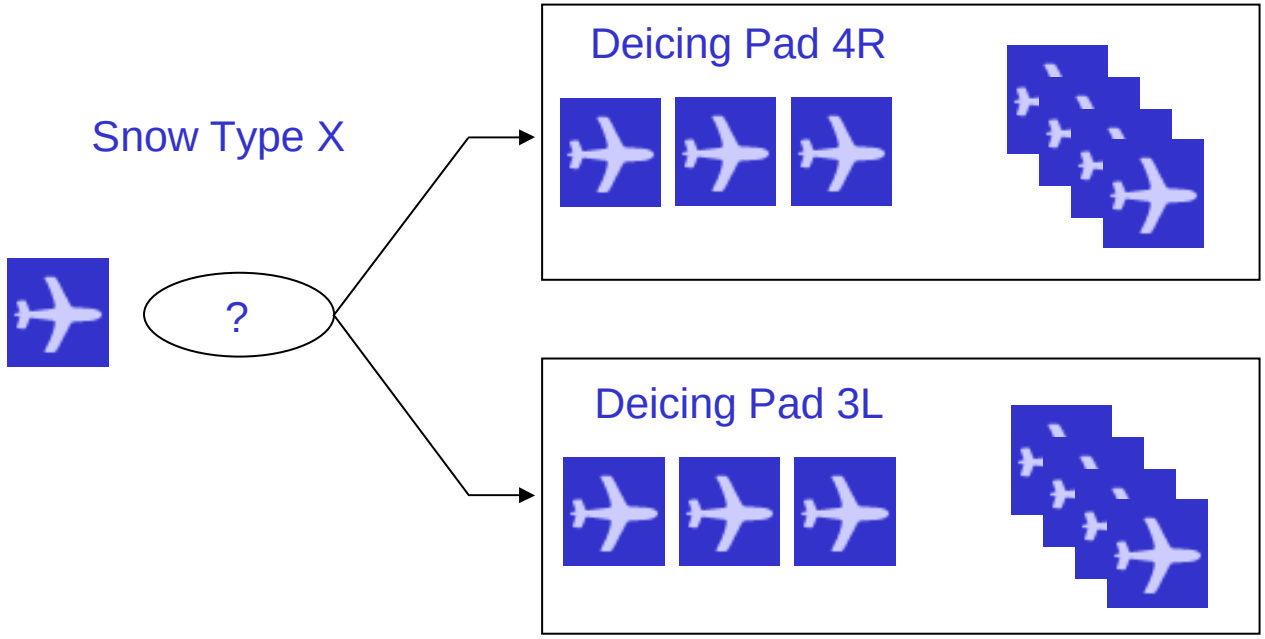


Deicing Pad 3L

Deicing Pad 4R

Objective

- **To assist in determining the deicing pad to send the outbound aircraft (AC) to minimize the total time in queue and at the deicing position, given the current conditions and type of aircraft at the respective deicing pads. (Think supermarket checkout lines.)**



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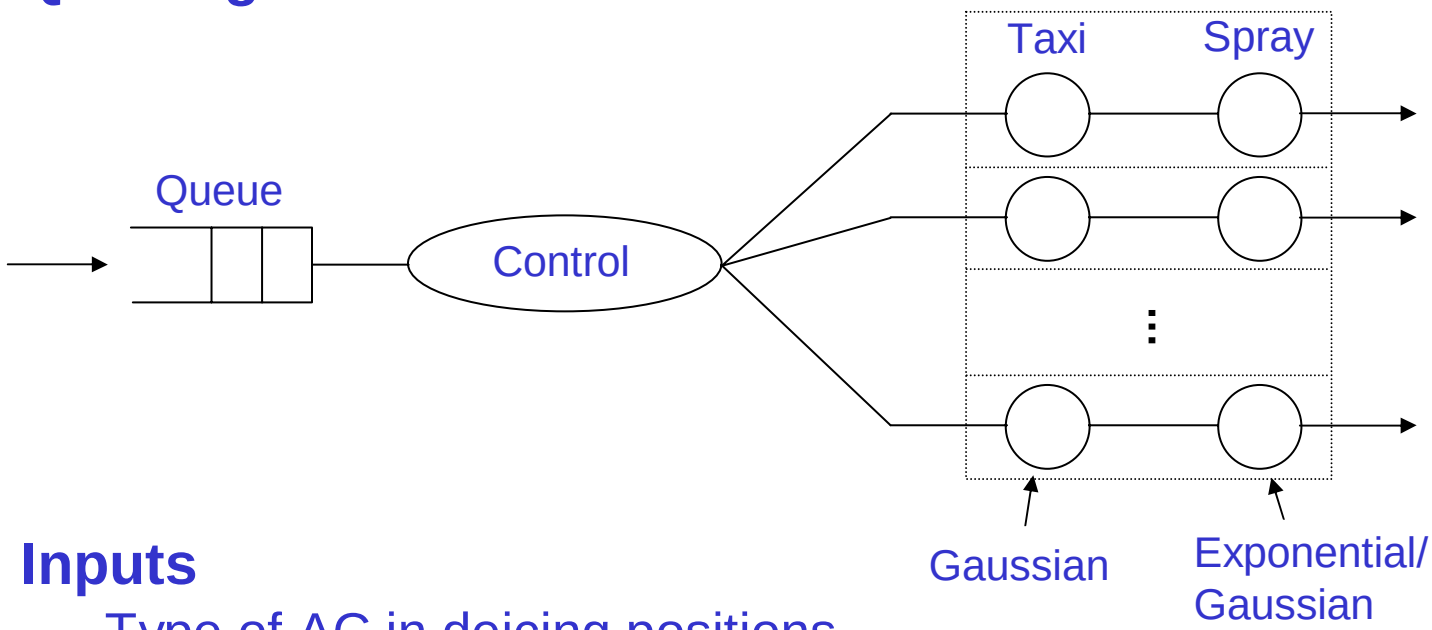
Modeling Overview

- **Mathematical Methods**
  - Deicing queuing model
  - Monte Carlo simulation
- **Metrics**
  - Average total system time (queue and deicing)
  - Confidence interval on total system time
- **Model Elements**
  - Deicing process
    - Spray time
    - Taxi time from queue to deicing position
  - Pad configuration

Deicing Queuing Model

- **Queuing Model**



- **Inputs**
  - Type of AC in deicing positions
  - Type of AC and order in queue
  - Type of snow event

Aircraft List

B747

A330/DC-10

B757

A319/A320

DC-9

RJs(RJ-85, CRJ, Saab-340)

Snow Types

A	frost, freezing fog or mist, light dry snow < = ¼”/HR, visibility => ½ mile
B	rime ice, light wet snow <= ¼”/HR, visibility => ½ mile, moderate dry snow ¼ to ¾”/HR visibility > ¼ mile
C	moderate wet snow > ¾”/HR visibility > ¼ mile, heavy dry snow > ¾”/HR, visibility <= ¼ mile
D	heavy wet snow > ¾”/HR, visibility < ¼ mile, light freezing drizzle, visibility < ½ mile
E	freezing rain – light, moderate, heavy

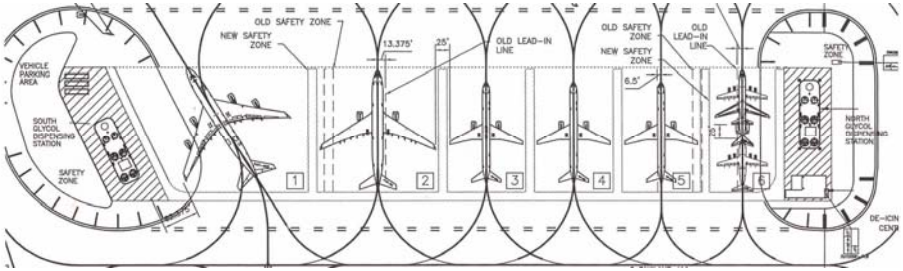
Model Parameters

	Mean Time						S.D.
	Snow	Type A	Type B	Type C	Type D	Type E	All Snow
Spray	B747	18	23	30	40	60	0.5*
	A330/DC10	13	18	23	34	45	
	B757	8	11	16	20	45	
	A319/A320	7	9	14	19	45	
	DC9	3	5	12	15	45	
	RJs	3	5	12	15	45	
Taxi	All AC	1					1/6

* S.D. is only valid for Gaussian distribution.

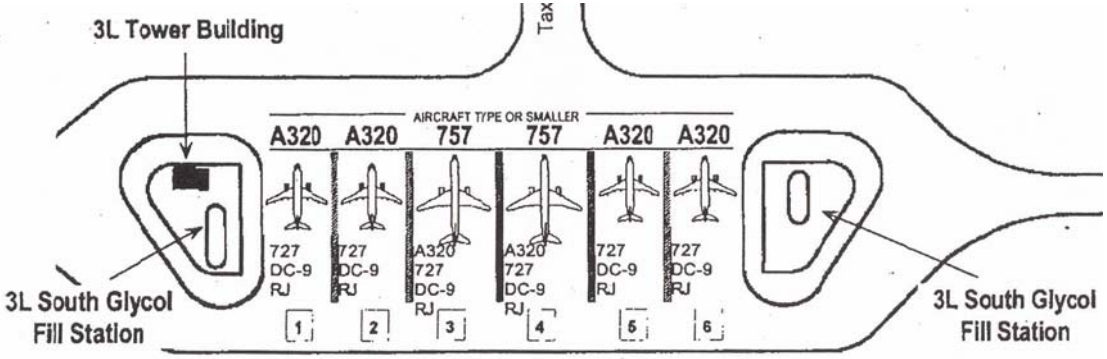
DTW Deicing Pads Configuration

- **Deicing Pad 4R**

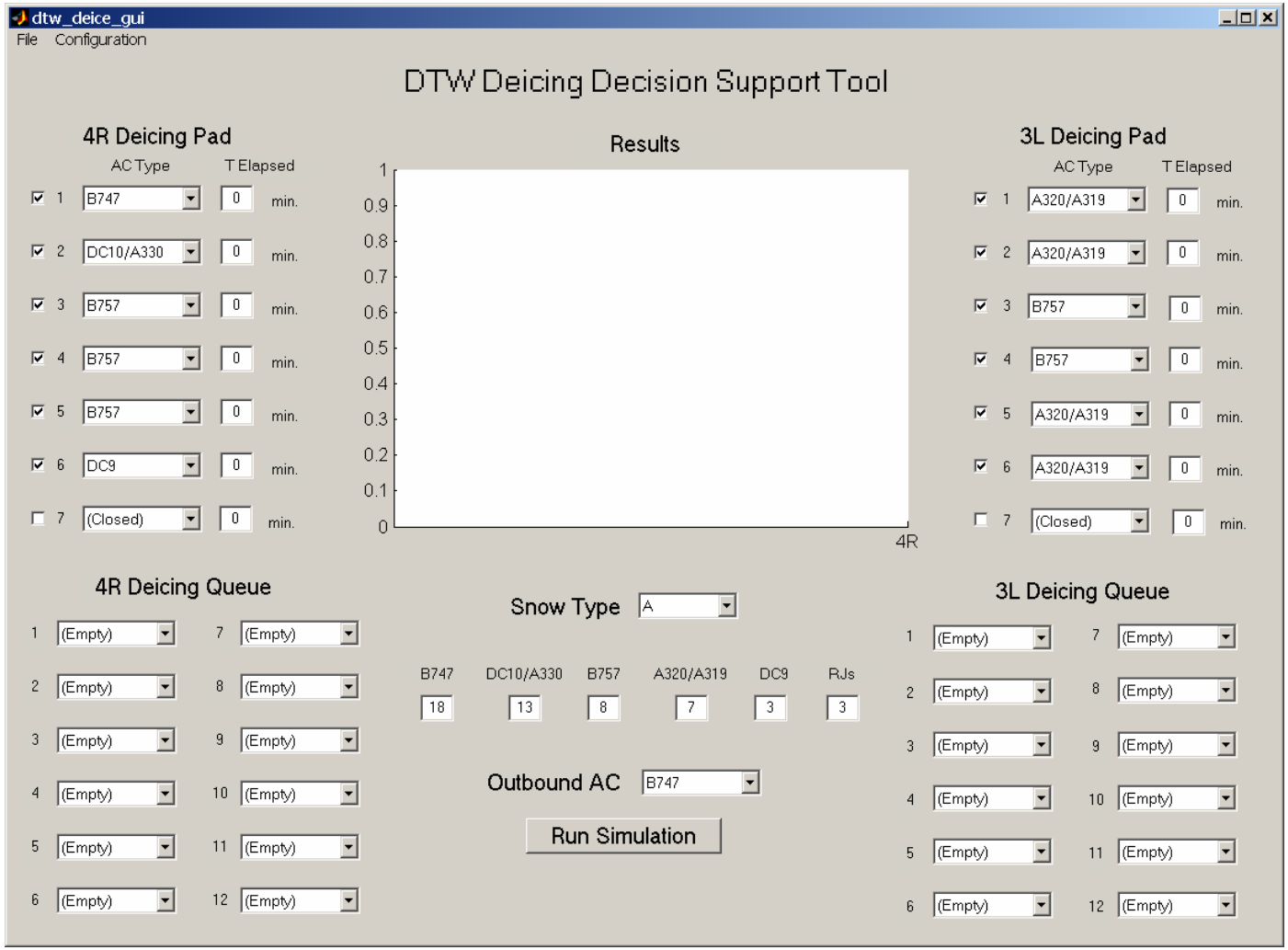


747 A330 757 757 757 DC9

- **Deicing Pad 3L**



DTW Deicing DST, Build 2



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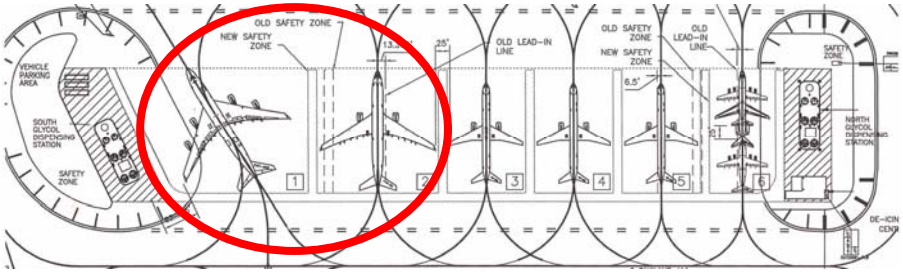
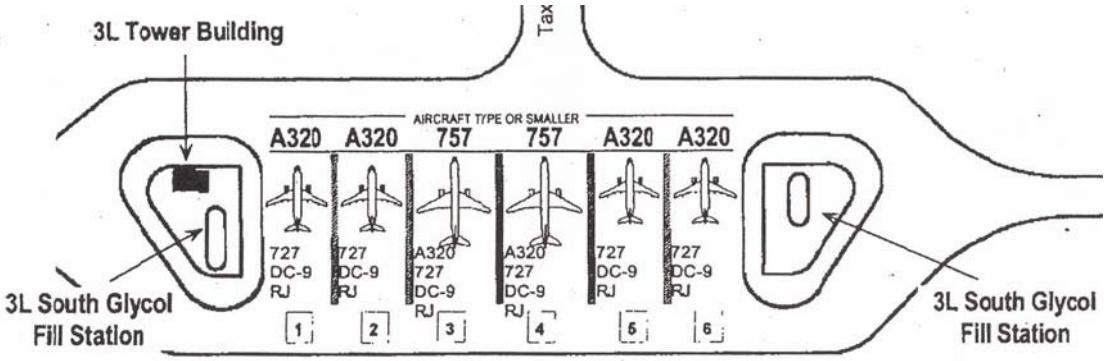
Widebody Capable Positions

- **Deicing Pad 4R**

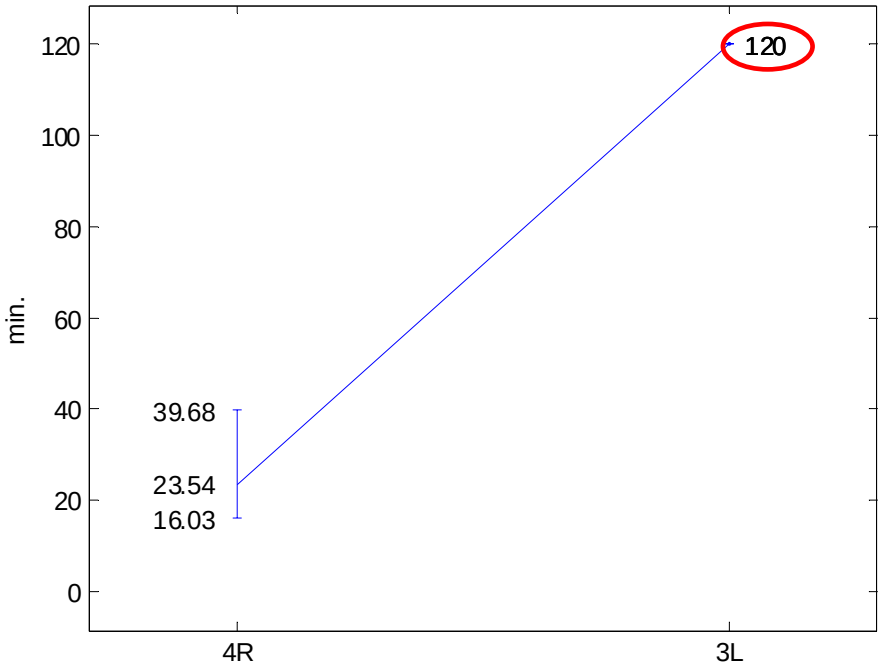


747 A330 757 757 757 DC9

- **Deicing Pad 3L**



Oversized Outbound AC



4R Deicing Pad

B747 A330 B757 B757 B757 DC9

3L Deicing Pad

A320 A320 B757 B757 A320 A320

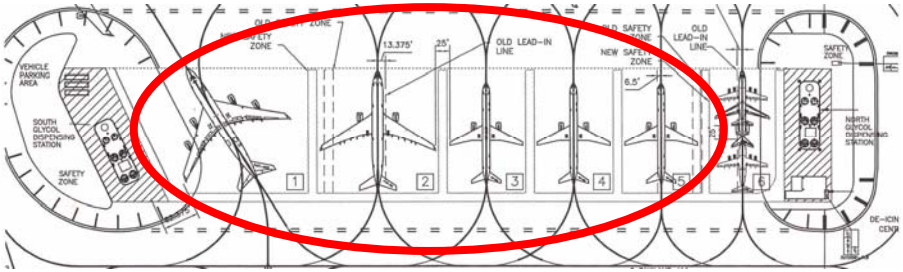
No Queue

Snow Type A

Outbound AC: A330/DC-10

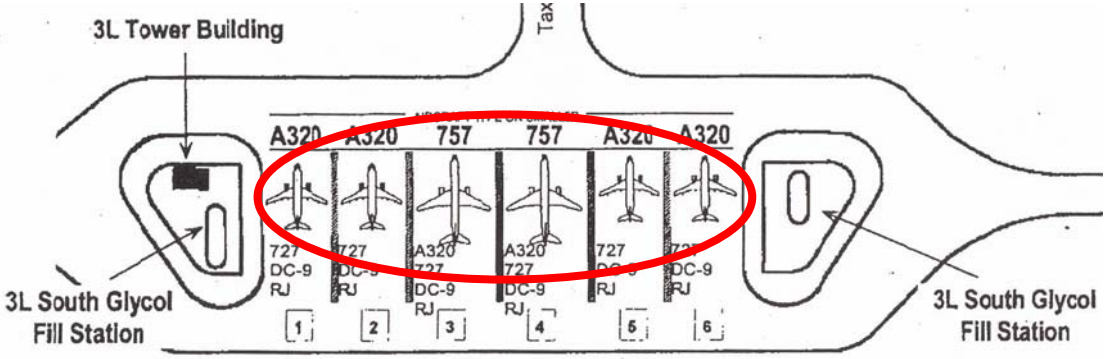
A320 Capable Positions

- **Deicing Pad 4R**

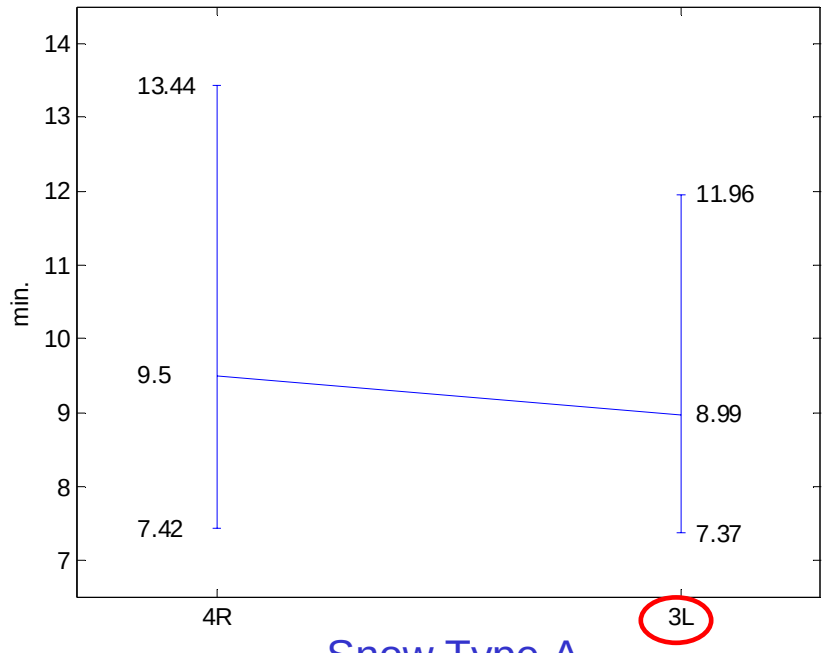


747 A330 757 757 757 DC9

- **Deicing Pad 3L**



Outbound AC: A320



Snow Type A

4R Deicing Pad

B747 A330 B757 B757 B757 DC9

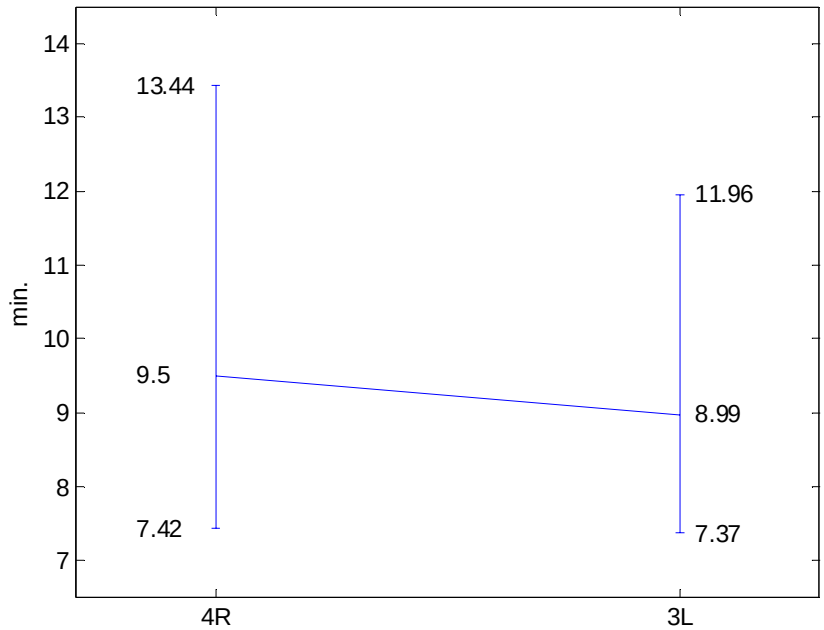
3L Deicing Pad

A320 A320 B757 B757 A320 A320

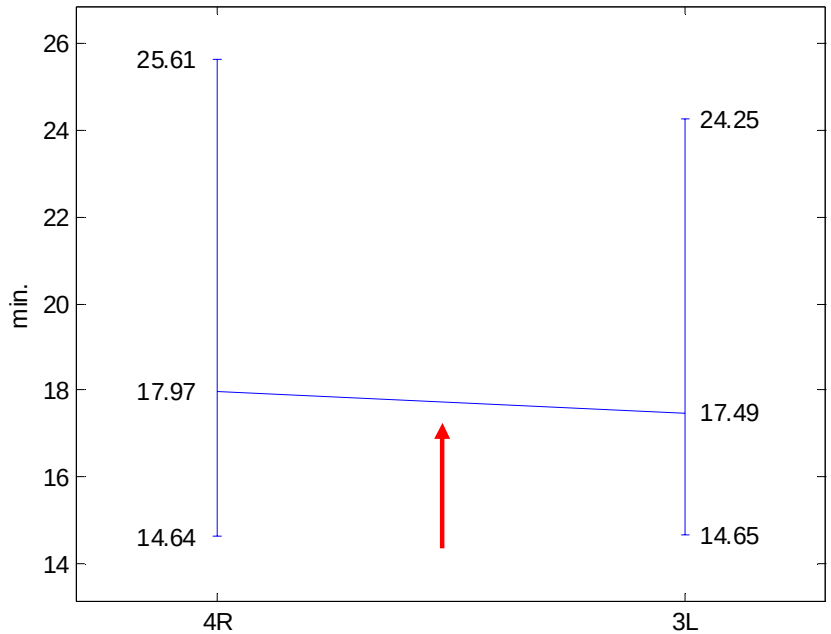
No Queue

Outbound AC: A320

Snow Type: A vs. C



Snow Type A



Snow Type C

4R Deicing Pad

B747 A330 B757 B757 B757 DC9

3L Deicing Pad

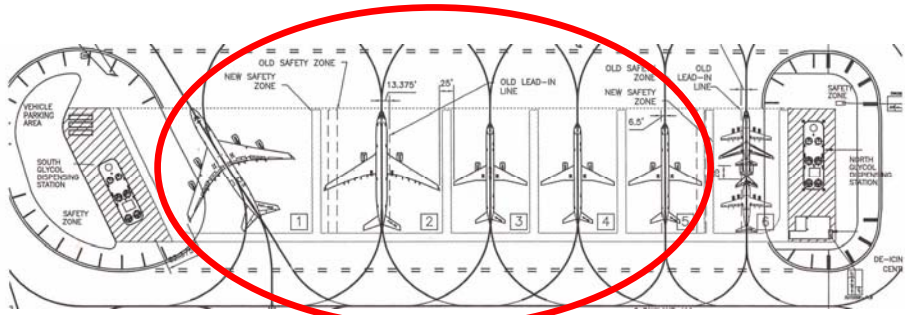
A320 A320 B757 B757 A320 A320

No Queue

Outbound AC: A320

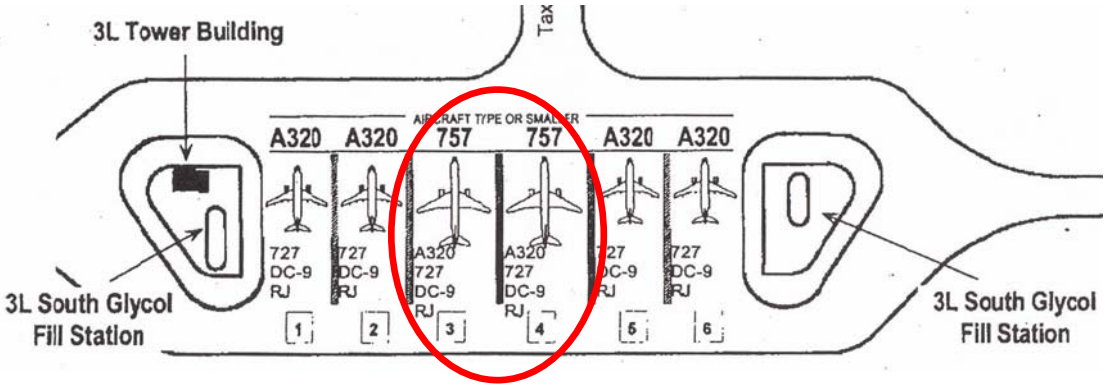
B757 Capable Positions

- **Deicing Pad 4R**

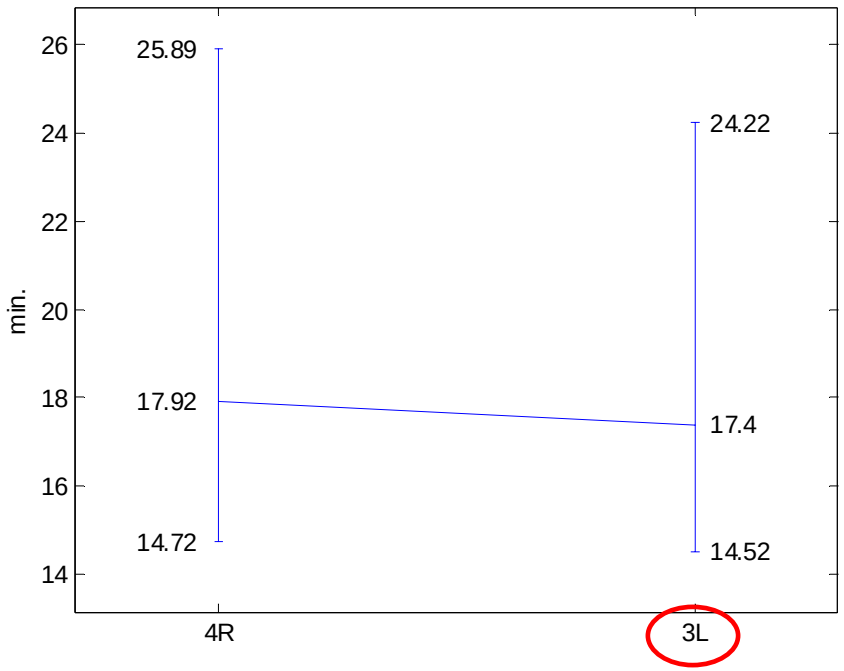


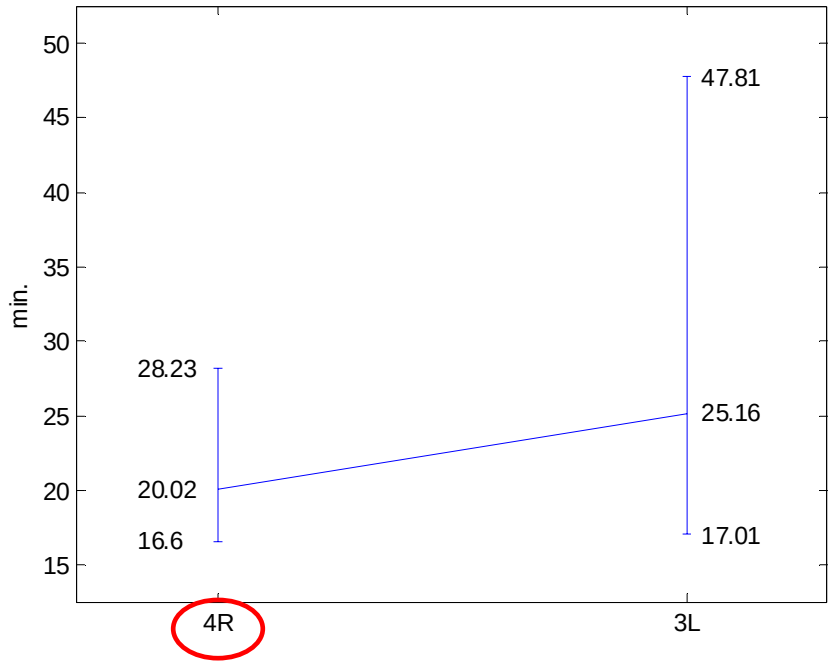
747 A330 757 757 757 DC9

- **Deicing Pad 3L**



Outbound AC: A320 vs. B757





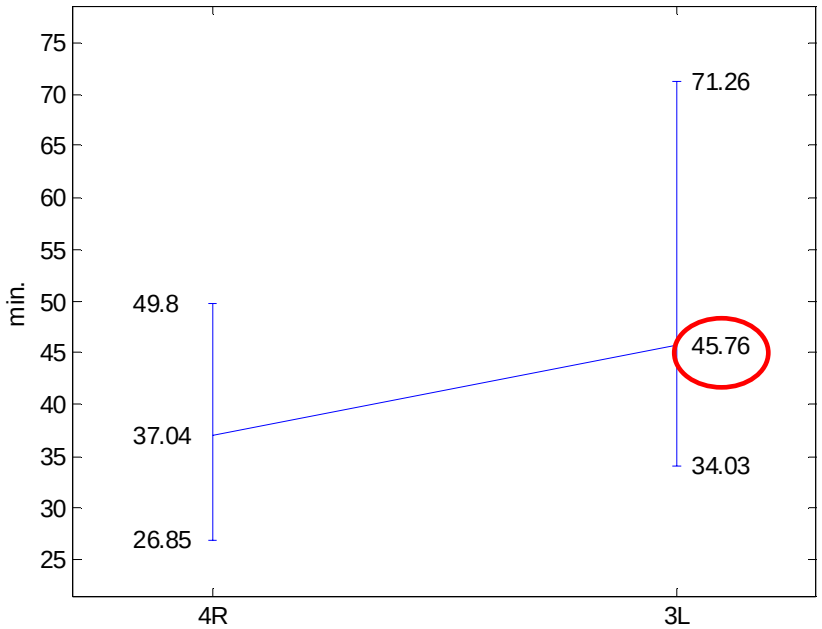
AC in Pads A320 A320 B757 B757 A320 DC9

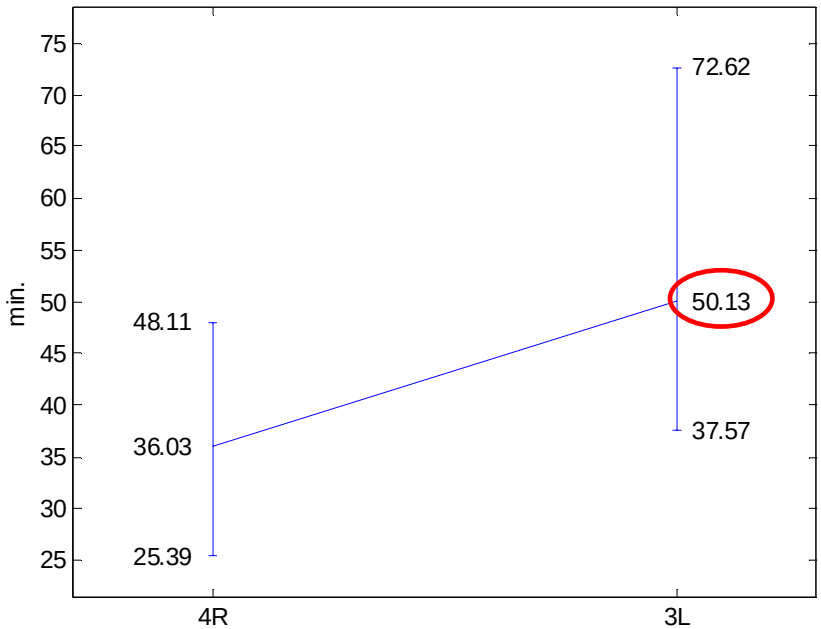
No Queue

Snow Type C

Outbound AC: A320 B757

Order of Queue





AC in Pads

A320 A320 B757 B757 A320 DC9

Snow Type C

Queue 1

B757
B757
A320
A320

A320
A320
B757
B757

Queue 2

Outbound AC:
B757

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Work In Progress

- **Deicing Pad Re-Configuration**
  - Customize max AC size
  - Additional deicing positions
  - Widebody AC deicing (any two adjacent and open deicing positions at 4R deicing pad)
- **Spray Time Re-Configuration**
- **Deicing Position Shutdown**
- **Model Validation**

Deice DST: Future Directions

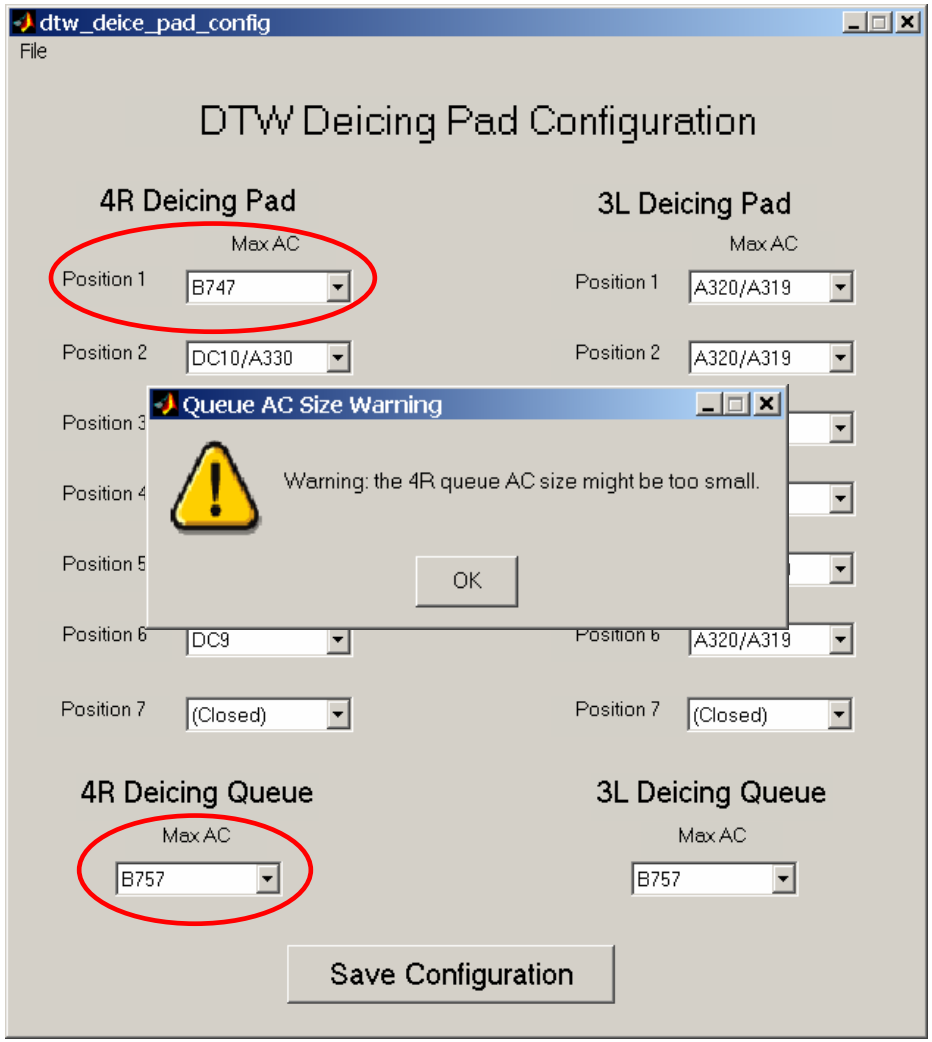
- **Real-Time Surveillance Input**
  - Type of AC in position
  - Elapsed time in position
  - Type of AC in queue
  - Type of AC departing from gate and runway assignment
  - Holdover time for deiced AC
  - Runway queue
- **Real-Time Prediction of System Time**
- **Real-Time Performance Monitor**
- **Multiple Departing AC and Optimal Ordering and Dispatch**
- **Other Locations**

Questions?

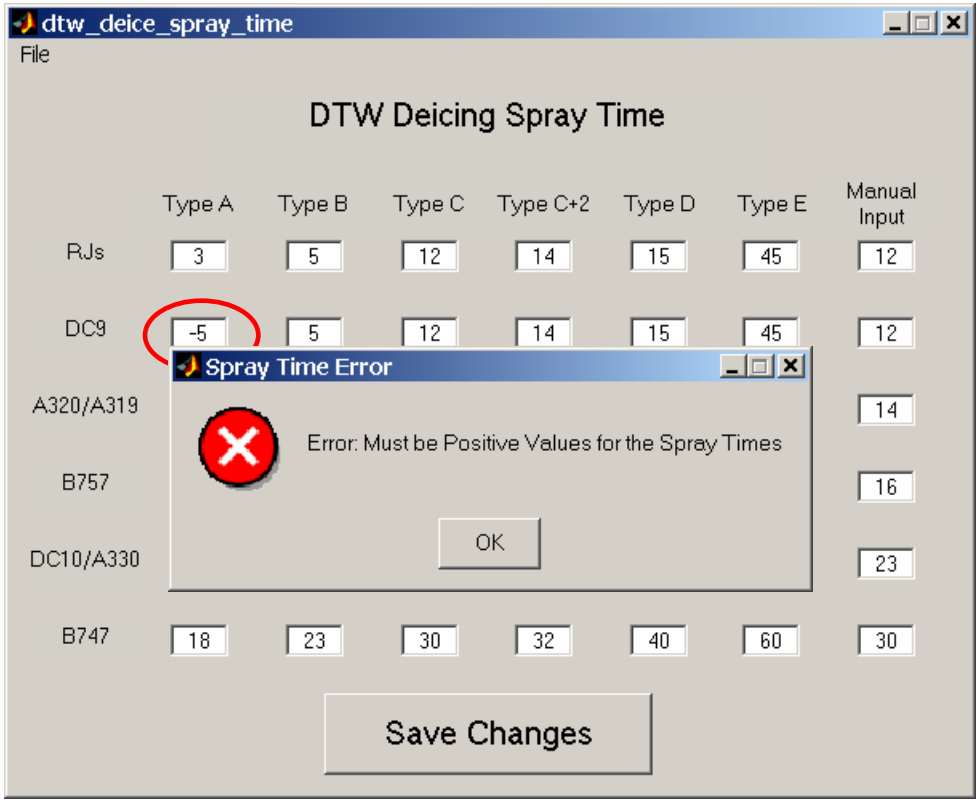
Thank you!

Backup

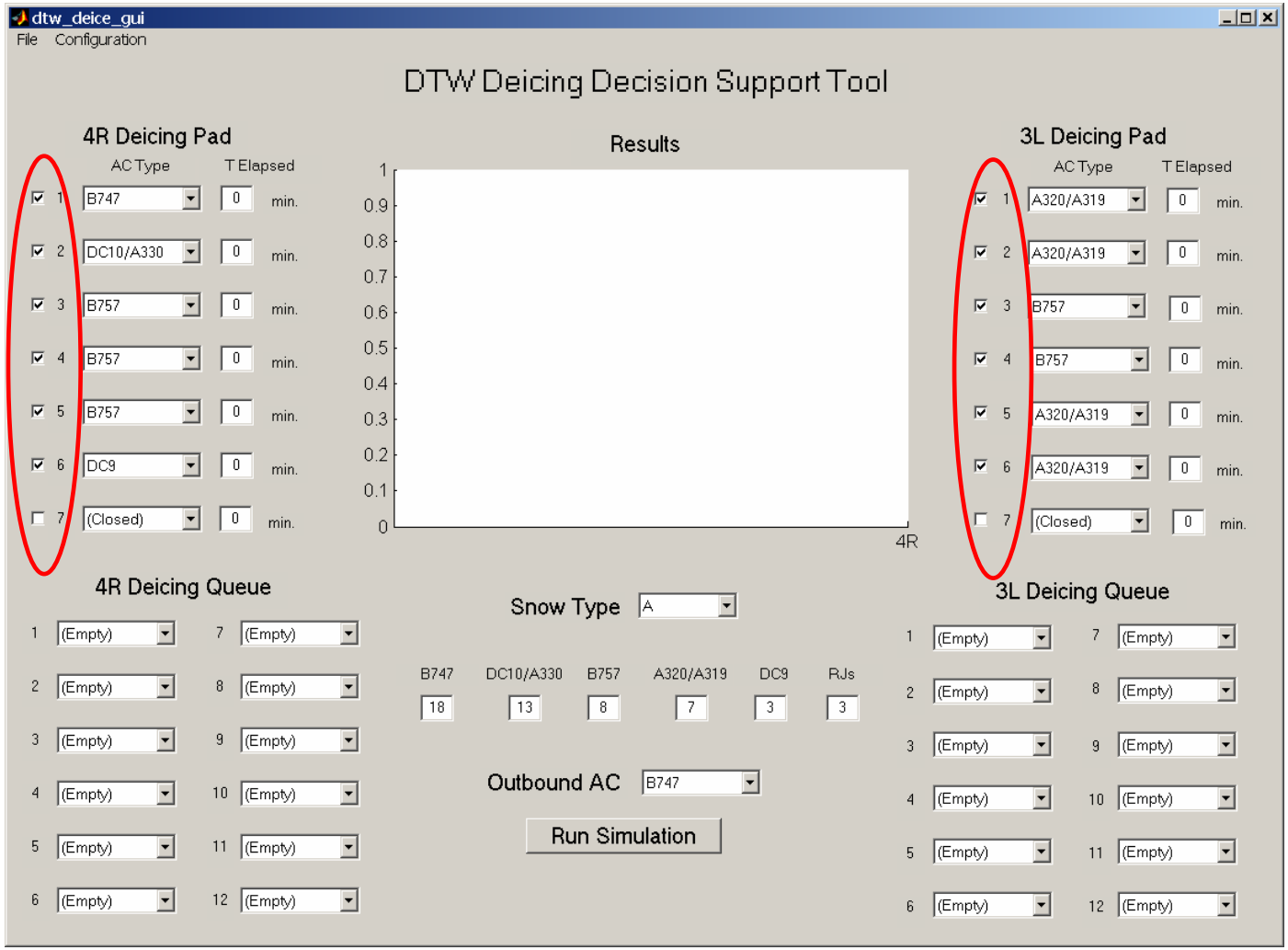
Configurable Deicing Pad



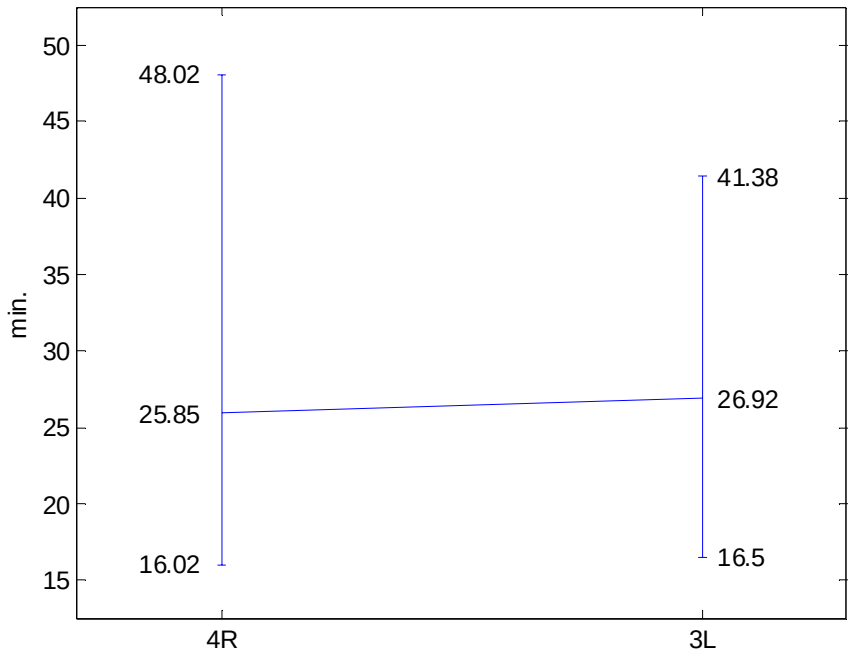
Configurable Spray Time



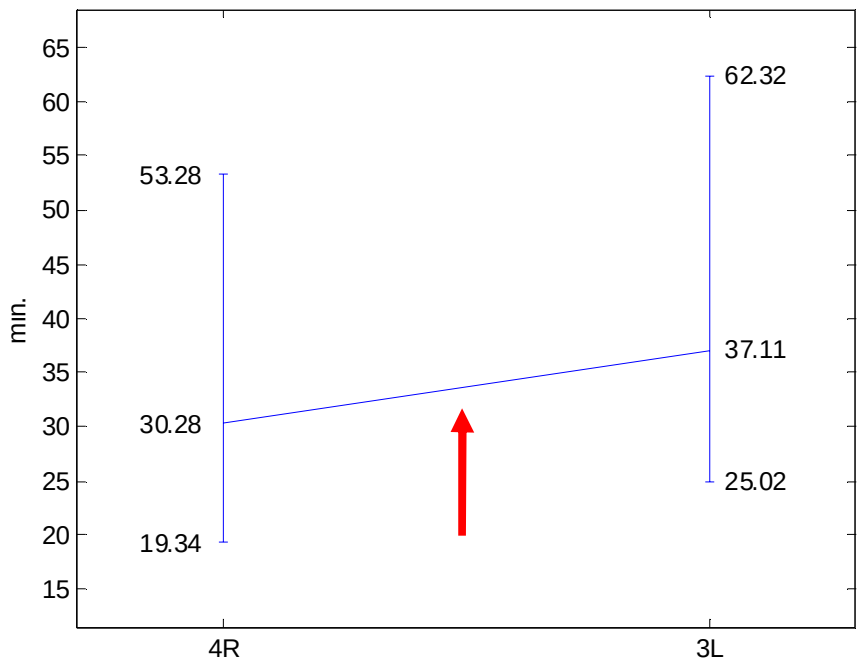
Position Shutdowns



Position Shutdown: 6 vs. 4

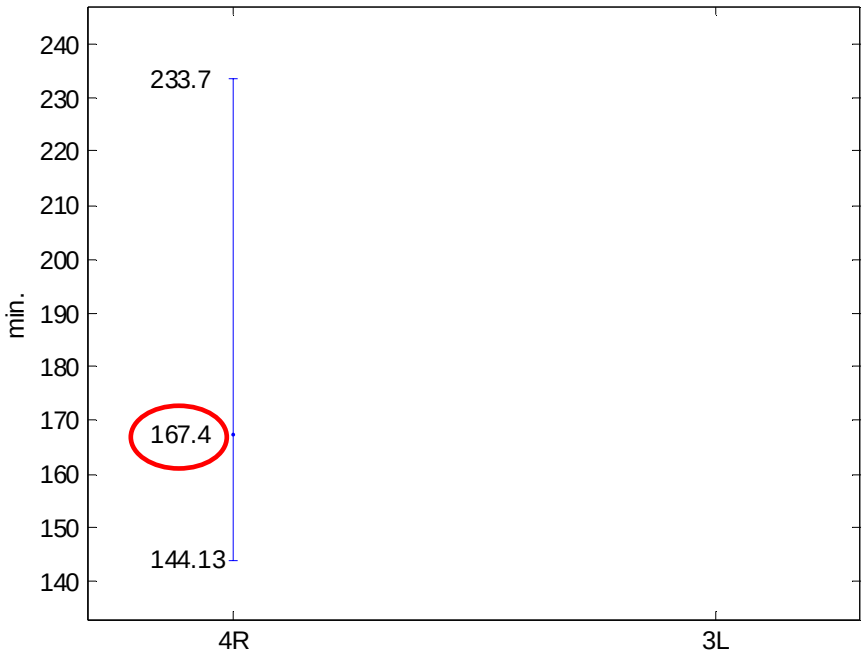


6 Open Positions/Pad

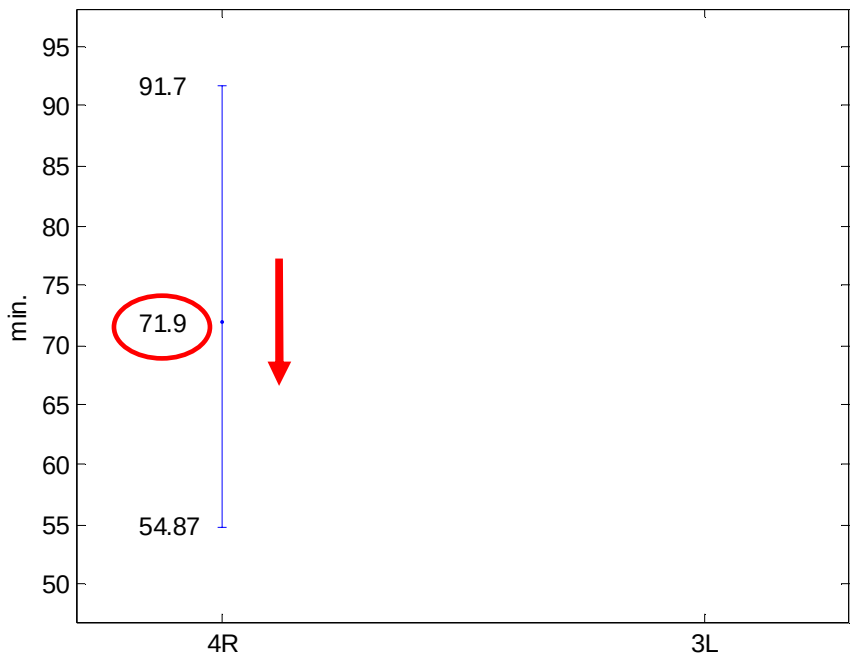


4 Open Positions/Pad

Wide-Body Deicing



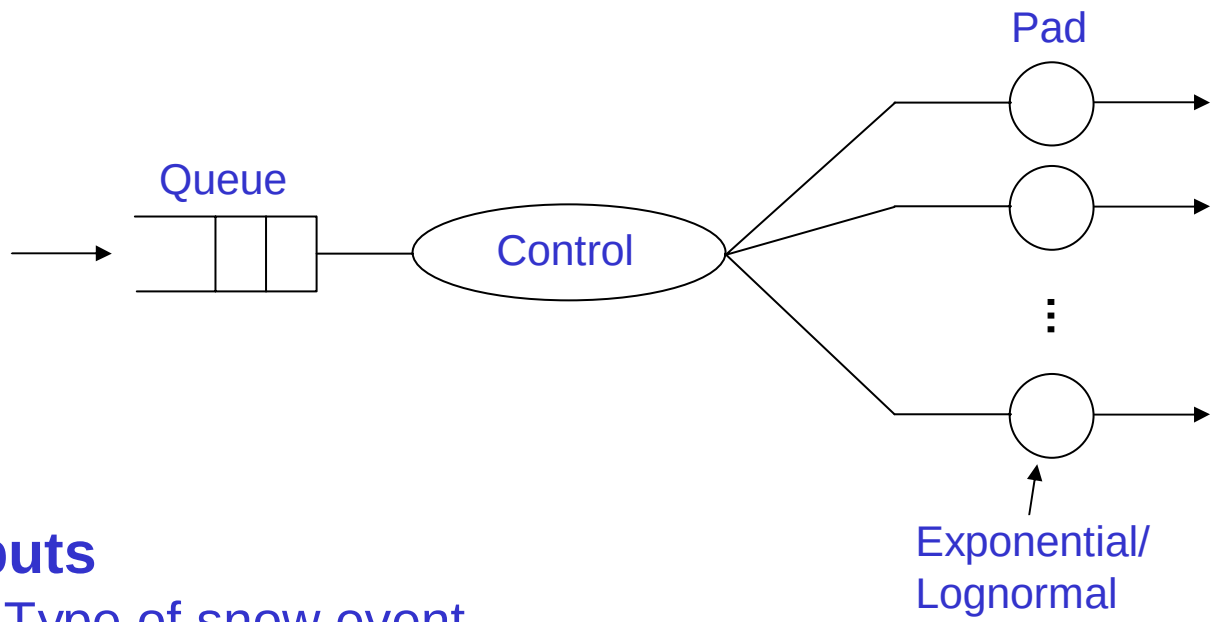
No Widebody



Widebody in 2 Positions

New Deicing Queuing Model

- **Queuing Model**



- **Inputs**
  - Type of snow event
  - Type of AC in deicing positions
  - Type of AC and order in queue