

# Liquid Water Equivalent A New Approach



# The Challenge

During winter weather conditions the Captain needs an accurate, reliable and straightforward way to answer one question:



Am I safe to take off?

# The Problem

- Current methods to answer that question use Holdover Tables
- Holdover Tables are based on estimates of snowfall intensity

# Snowfall Intensity Measurement

Visibility



# Snowfall Intensity Measurement

Accumulation  
Rates



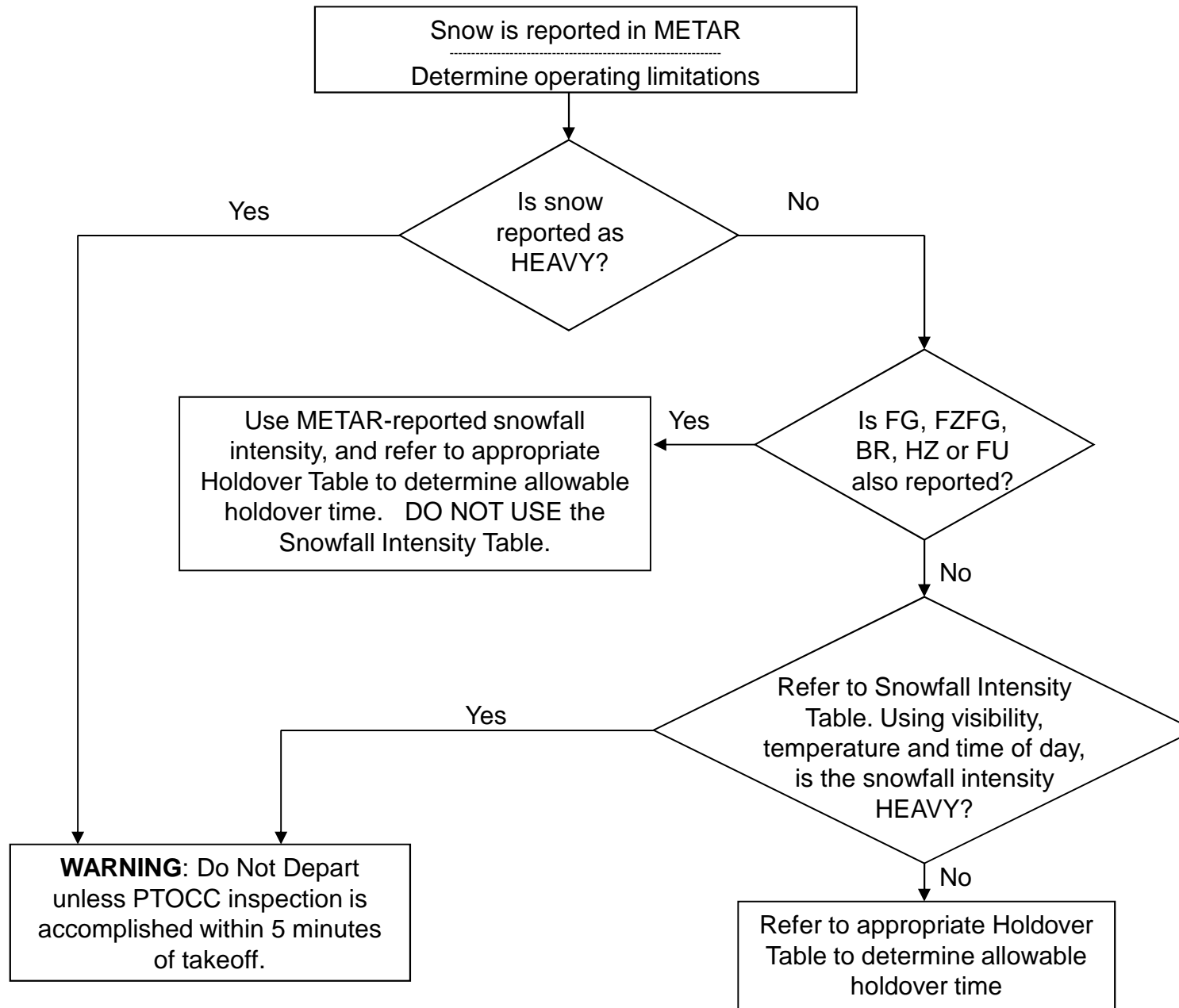
# The Problem

- Current methods to measure snowfall intensity are
  - Imprecise
    - *Operational restrictions*
  - Lead to operational complexities for the pilots
    - *Distractions at critical times*
    - *Safety risk*

# U.S. – Snowfall Intensity Table

Time of Day	Temp.		Visibility (Statute Mile)						
	Degrees Celsius	Degrees Fahrenheit	$\geq 2 \frac{1}{2}$	2	$1 \frac{1}{2}$	1	$\frac{3}{4}$	$\frac{1}{2}$	$\leq \frac{1}{4}$
Day	colder/equal -1	colder/equal 30	Very Light	Very Light	Light	Light	Moderate	Moderate	Heavy
	warmer than -1	warmer than 30	Very Light	Light	Light	Moderate	Moderate	Heavy	Heavy
Night	colder/equal -1	colder/equal 30	Very Light	Light	Moderate	Moderate	Heavy	Heavy	Heavy
	warmer than -1	warmer than 30	Very Light	Light	Moderate	Heavy	Heavy	Heavy	Heavy

## Snowfall Intensity Table – Decision Matrix (UPS Crew De-Ice Manual)





# Aircraft Operating Manual

- 1994 – 5 pages
  - 2 kinds of tables
  - 3 pages of explanatory notes
- 2013 – 77 pages
  - 8 kinds of tables
  - 35 pages of explanatory notes

# Simplify

- Our fluids are getting better
- Our operations are safer
- Our documentation and processes are getting more complex
- Complexity creates safety, operational and compliance risk

# How Do We Simplify?

- Provide the Captain with a way to know the effectiveness of the anti-ice fluid that is more precise.

Liquid Water  
Equivalent

LWE



# Liquid Water Equivalent (LWE)

- The measurement of moisture affecting an aircraft's anti-ice fluid during a defined period of time



# Anti-Ice Fluids

- Water absorption capabilities are precisely known
- Measure accumulated water since application of anti-ice fluid

# Am I Safe to Depart?

Compare the accumulated water to the absorption capability of the fluid

Is the fluid saturated?

No – take off

Yes – don't take off

# Two Approaches

- Modified Holdover Time
  - SureWx (now in use in Canada)
- CheckTime
  - Vaisala

Operational testing by the FAA  
in the U.S this winter

# SureWx – Modified Holdover Time

- After de-icing the Captain requests a Holdover Time via ACARS
- System measures the LWE of the past 10 minutes
- Replies to Captain with the fluid effective time in a Holdover time
- Holdover time is used to calculate a “takeoff no later than” time



# ACARS Message to Crew

DIIS CYUL  
0801211755Z  
SN M1  
HLD OVR TYPE I 14 MIN  
HLD OVR TYPE IV 78 MIN

DIIS CYUL  
0801211640Z  
FZRA M1  
HLD OVR TYPE I 4MIN  
HLD OVR TYPE IV 31MIN

# If Weather Changes

- If conditions worsen, the Captain must request a new Holdover Time
- Captain must adhere to most restrictive Holdover Time, even if conditions improve

# Vaisala - CheckTime

- Captain requests CheckTime through ACARS just before takeoff
- System looks back to find the time when enough LWE is accumulated to reach fluid absorption limit
- Returns message with the CheckTime, which is compared to Anti-Ice time

# ACARS Message to Crew

MESSAGE RECEIVED

KDEN

N308

CHECK TIME

1233Z/0633L CPGA

1245Z/0645L KFS+

1257Z/0657L GTYPEIV

1412Z/0912L AGTYPE1

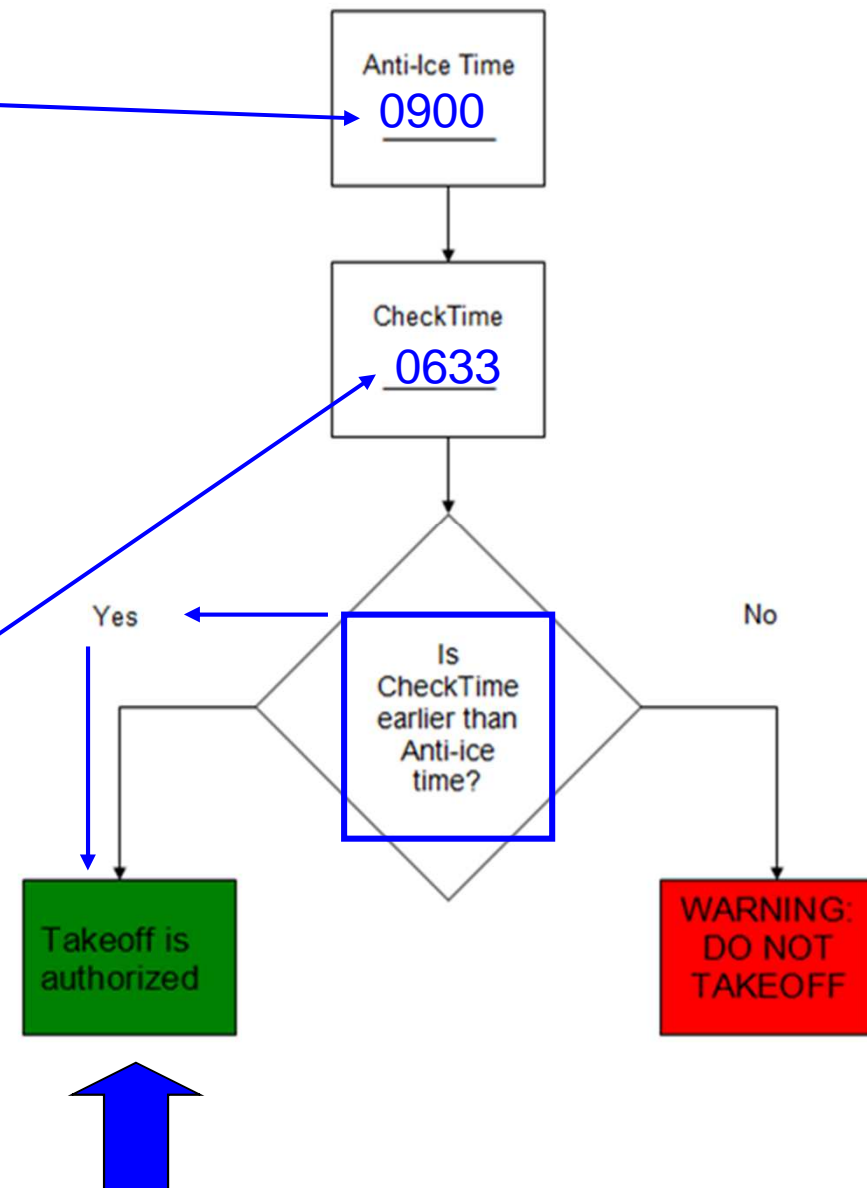
Anti-iced at  
**1500Z / 0900L**

ACARS

MESSAGE RECEIVED

KDEN  
N308

CHECK TIME  
**1233Z/0633L** CPGA  
1245Z/0645L KFS+  
1257Z/0657L GTYPEIV  
1412Z/0912L AGTYPE1



# If Weather Changes

- CheckTime system adjusts, modifying the time transmitted to the Captain
- Captain is encouraged to request CheckTime upon arrival at the aircraft, and update frequently.

# Improvements Based on LWE

- Reduction of the need for Type IV in very light or light snow
  - Environmental benefits
  - Cost savings
- Extended fluid effective time
- Elimination of PTOCC (CheckTime)
  - “Heavy Snow” no longer matters

# Simplification of pilot procedures

## Holdover Table Procedures

--Ascertain:

Time of day (day/night)

OAT

Visibility (tower/ground)

-Accomplish the Snowfall Intensity Flow Chart to determine applicable snowfall intensity

Is the snowfall intensity Heavy?

-If yes, do not depart unless PTOCC inspection is available

-If no, refer to the Holdover Table for the type of fluid used

-Determine holdover time based on very light, light or moderate snowfall intensity

-Monitor snowfall intensity and METAR changes during taxi. If conditions are changing, adjust holdover time as needed.

-At end of runway, make a final review of your holdover time.

-If holdover time has been exceeded, return to ramp for additional de-ice/anti-ice treatment.

## LWE Procedures

--Request information via ACARS.

-Monitor information during taxi if conditions are changing

-Make final request within five minutes of departure.

-If time has been exceeded, return to ramp for additional de-ice treatment.



# Airport Requirements for LWE

- Airlines may only use LWE procedures at airports where the proper equipment is installed.
- Service providers (SureWx / Vaisala) install their proprietary meteorological equipment on the airport, usually next to existing airport equipment

# Summary

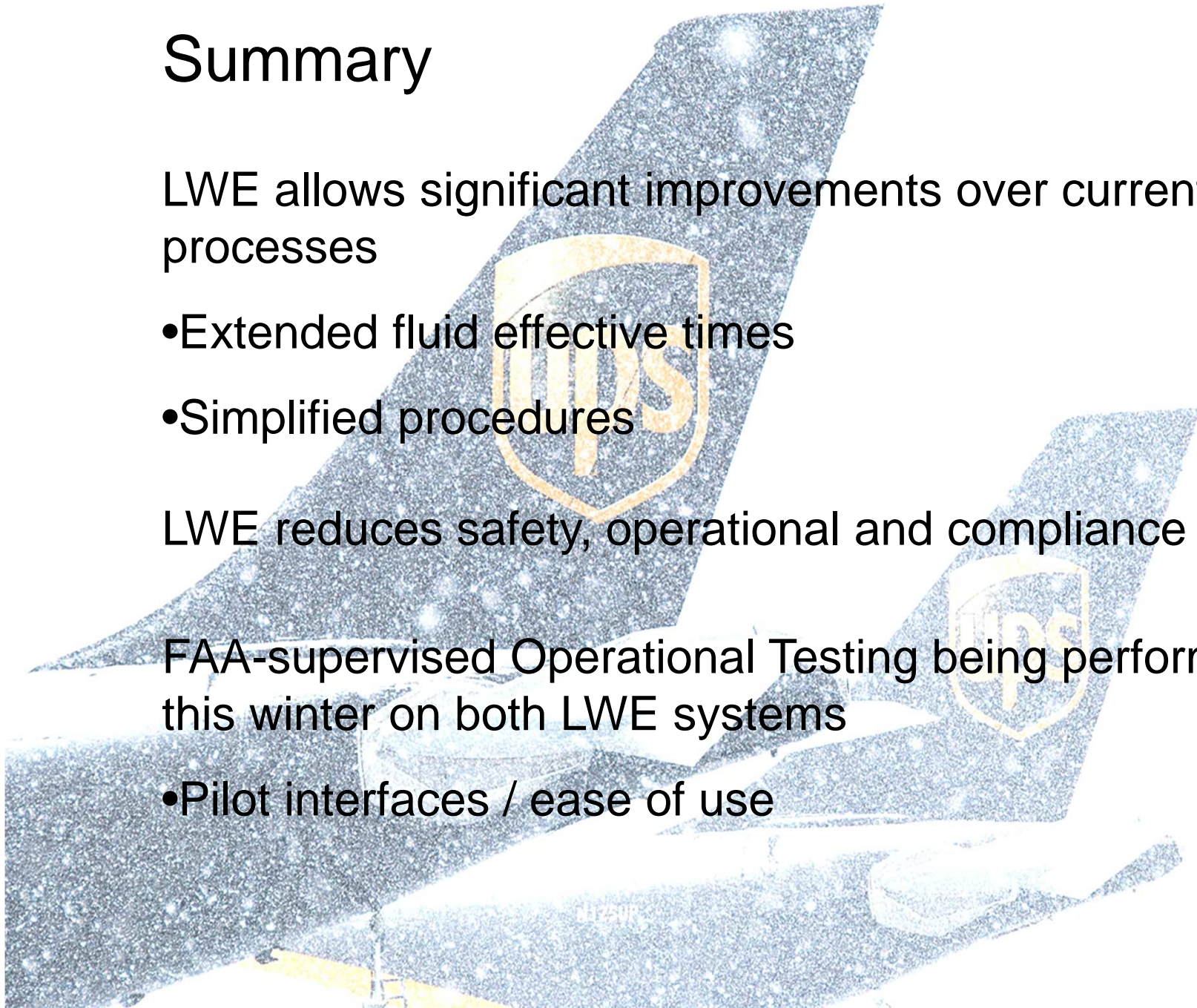
LWE allows significant improvements over current processes

- Extended fluid effective times
- Simplified procedures

LWE reduces safety, operational and compliance risk

FAA-supervised Operational Testing being performed this winter on both LWE systems

- Pilot interfaces / ease of use





Questions?

