Runway Status Lights (RWSL) and Final Approach Runway Occupancy Signal (FAROS)

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Outline

• RWSL and FAROS Overview
• RWSL Prototype Locations *DFW*, *SAN*, *LAX*, *BOS*
• Recent RWSL Saves at DFW
• Results from Pilots’ Feedback at *DFW* and *SAN*
• Discovered Issues and Implemented Resolutions
• Summary and Next Steps
Overview of RWSL and FAROS

REL: Runway Entrance Lights
THL: Takeoff Hold Lights
RIL: Runway Intersection Lights

FAROS: Final Approach Runway Occupancy Signal

Airport Surface Detection Equipment (ASDE)
Transponder Multilateration
Airport Surveillance Radar (ASR)
Status of RWSL and FAROS

• RELs and THLs to date
  – RELs and THLs being tested at DFW-West
  – RELs being tested at SAN
• New RELs and THLs at DFW-East
• New FAROS at DFW
• New Runway Intersection Lights (RILs) at BOS
• New RELs for LAX’s closely spaced parallel runways
Objective of RWSL and FAROS

• Per NTSB’s *MOST WANTED*:
  – “Give immediate *warnings* of probable collisions/incursions *directly* to flight crews in the cockpit.”
• RELs warn unsafe to enter/cross RWY
• THLs warn unsafe to depart from RWY
• RILs warn unsafe to cross RWY intersection
• FAROS warns unsafe to land
Runway Incursion Distribution

Most runway incursions result from **pilot deviations**.

"Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and take off of aircraft"
Timeline of Selected Runway Accidents

- Tenerife: 1977 - 583 Fatalities
- Los Angeles: 1991 - 34 Fatalities
- Quincy, IL: 1996 - 14 Fatalities
- Milan: 2001 - 122 Fatalities
- Kentucky: 2006 - 49 Fatalities
- Detroit: 1990 - 8 Fatalities
- North Las Vegas: 2003 - 2 Serious Injuries
- Titusville, FL: March 2008 - 3 Fatalities
FAROS and RWSL High Level Block Diagram

Surveillance
- Transponder
- Multilateration
- ASDE-3
- ASR-9

MIT/LL Light Control Logic

Field Lighting System
- FAROS
- RELs
- THLs
- PAPIs

RWSL Test Display with FAROS, RELs and THLs on (red) due to traffic
Drawings of RWSL & FAROS

Runway Entrance Lights (RELs)

Takeoff Hold Lights (THLs)

Runway Intersection Lights (RILs)

Flash PAPIs indicate the runway is occupied!
Final Approach Runway Occupancy Signal (FAROS)

Note: Assessment of RWSL double-row THLs and RILs and FAROS flashing PAPIs is TBD.
Comments from pilots and Front Line Managers (FLMs)

“At first I thought 1 mile will do, but after watching an event I believe 1.5 miles is a good distance.”

“I think some of the activation points need to be tweaked just a little to reduce or eliminate unnecessary alerts.”
FAROS DFW Shadow Ops: Pilot Favorability (PRELIMINARY)

“"I like the fact that it gives information directly to the flight crews.""
FAROS DFW Shadow Ops: FLM Favorability (PRELIMINARY)

FAROS DFW Shadow Ops:
FLM Favorability (PRELIMINARY)

The active FAROS will be a valuable tool as long as the parameters are set properly.
Operational Requirements (1 of 2)

• RELs must have a/c landing or departing
• THLs must have a/c departing and a/c or vehicle “on” runway
• RILs must have a/c approaching RWY intersections at high speeds
• FAROS must have a/c landing and a/c or vehicle “on” runway
Operational Requirements (2 of 2)

- RELs, THLs, RILs and FAROS must
  - Turn off once warning condition(s) no longer met
  - Not interfere with ATC operations
  - Operate automatically for each operation
  - No ATC action required
  - Accurately depict unsafe to proceed
Locations of Runway Status Lights at DFW, SAN, LAX (TBD), and BOS (TBD)
RELs, THLs and FAROS at DFW
RELs at SAN
RELs and THLs at LAX
RELs, THLs and RILs at BOS
Recent RWSL *Saves* at DFW
THL save at DFW: 5 Feb 2008

- EGF301 cleared for intersection takeoff on 36R. About 26 seconds later tower cleared AAL1116 to cross runway 36R. During EGF301’s departure, THLs illuminated as AAL1116 crossed. EGF301 rejected the takeoff because of red THLs. EGF301 was cleared for takeoff again 25 seconds later.

<table>
<thead>
<tr>
<th>Pilot</th>
<th>“EGF301 you cleared us for takeoff but we had the red lights”</th>
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<tbody>
<tr>
<td></td>
<td><em>Eagle 301 slows to taxi and RELs turn off</em></td>
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<tr>
<td>Tower</td>
<td>“EGF301 no sir it was just position and hold runway 36R intersection Bravo”</td>
</tr>
<tr>
<td>Pilot</td>
<td>“Ah, OK we’ll hold in position but we got cleared for takeoff sir”</td>
</tr>
<tr>
<td></td>
<td><em>Eagle 301 stops</em></td>
</tr>
<tr>
<td>Tower</td>
<td>“EGF301 36R, ah, cleared for takeoff now”</td>
</tr>
<tr>
<td>Pilot</td>
<td>“ Cleared for takeoff EGF301”</td>
</tr>
</tbody>
</table>
• AAL379 was cleared for departure on 36R and 20 seconds later MES3675 crossed 36R during AAL379’s takeoff roll. THLs illuminated and AAL379 aborted. After exiting the RWY, AAL379 was cleared for takeoff on 36R four minutes later.

“After cleared for take-off, we began to roll and I noticed the RWSL lights turn red. I looked down the runway and saw an aircraft crossing the runway left to right (Mesaba regional jet) and aborted the takeoff (max speed below 80 knots). The RWSL worked awesome. I noticed that BEFORE I saw the intruding regional jet.”
Results from Pilots’ Survey
Responses
DFW: Pilot Exposure to RELs

- Comprehension: 99%
- Acceptance: 92%
- Effectiveness: 87%
- Suitability: 95%

% Favorability
SAN and DFW Combined Results

- Comprehension: 93%
- Acceptance: 90%
- Effectiveness: 89%
- Suitability: 92%
Discovered Issues and Implemented Resolutions
Conspicuity and distinctness of THLs

• THLs changed to double row of 16 lights each instead of existing single row of 11 at DFW

New

• FAA EB64a drafted Feb 2007

• THLs installed at DFW East on R/Ws 17R/35L and 17C/35C
Uniqueness of THLs

- SAN RWY 27 red lights along centerline prior to displaced threshold
- SAN Airport removed these lights after feedback from pilots and ATC
Resolutions to Pilots’ Concerns

• **Timing**
  – SAN RELs turn red sooner for RWY 27

• **Conspicuity**
  – Five lights added to THLs (low visibility)
  – THLs, RELs wired separately (THLs brighter)

• **Distinctiveness**
  – Second row THLs added (distinct from end-of-RWY lights)
  – SAN deleted red lights prior to displaced threshold RWY 27
Summary and Next Steps
Summary

- Pilot/ATC training and feedback critical
- Feedback improved training and timing
- Pilot/ATC feedback is overall positive
- SAN and DFW successfully extended
- DFW runway incursions reduced 70%
  - 18L/36R with RWSL per GAO (2007)
Next Steps

• FAA and airports to test RWSL
  – RELs, THLs at DFW-East
  – FAROS at DFW (West and East)
  – RELs and THLs at LAX
  – RELs, THLs and RILs at BOS

• RWSL to 22 airports in NAS by 2011

• RWSL/FAROS briefed to IFALPA
  – Interest in potential deployments overseas