Runway Status Light System
Operational Concept

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Division 4 Seminar

20 February 2002

* This work is sponsored by the Federal Aviation Administration under Air Force Contract #FA8721-05-C-0002. Opinions, interpretations, recommendations and conclusions are those of the author and are not necessarily endorsed by the United States Government.
Outline

• Motivation
• Operational concept
• Requirements
• Operational scenarios
• Operational evaluation at Dallas Fort Worth Airport
• Summary
The Problem: Airport Surface Accidents

<table>
<thead>
<tr>
<th>Location</th>
<th>Fatalities</th>
<th>Date</th>
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<tbody>
<tr>
<td>Milan, Italy</td>
<td>118</td>
<td>2001</td>
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<td>Tapei, Taiwan</td>
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<td>2000</td>
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<td>Quincy, Illinois</td>
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<td>Los Angeles, California</td>
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<td>Detroit, Michigan</td>
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<td>Omsk, Russia</td>
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<td>Madrid, Spain</td>
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<td>1983</td>
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<td>Guilin, China</td>
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<td>1983</td>
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<tr>
<td>Tenerife, Canary Islands</td>
<td>583</td>
<td>1977</td>
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Runway incursions are accident precursors
Definition of Runway Incursion

“"A runway incursion is any occurrence on an airport runway involving an aircraft, vehicle, person, or object on the ground that creates a collision hazard or results in a loss of separation with an aircraft taking off, intending to take off, landing, or intending to land.""  
– Source: FAA Runway Safety Office
Runway Incursions 1993-2001

“Runway collisions at towered American airports could kill 700-800 ... over the next two decades” source: Prof. Arnold I. Barnett, MIT Sloan School
Pilot deviations and Operational Errors are root cause of runway incursions
Source of pilot confusion

Dallas Fort Worth International Airport

• Solution: increase situational awareness of pilots and vehicle drivers
Surveillance-driven lights provide situational awareness of runway status
Runway Status Lights Fixtures

- Two types of fixtures
  - In-pavement &/or elevated
- Two types of lights
  - LED or incandescent
- Two states
  - Red or off

- Indicate status only, not clearance!
High level block diagram

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

MIT/LL Light Control Logic

Controller Display

Field Lighting System
High level operational requirements

- Runway status lights operate automatically
  - No controller action required for operation
- Lights must accurately depict runway status
  - Lights must provide safety function
- Lights must not interfere with normal safe surface operations
**Runway Entrance Lights (RELs)**
- Indicate runway unsafe to enter
- Red if runway not safe for entry
- Otherwise off (no illumination)
• Takeoff Hold Lights (THLs)
  – Red if runway not safe for takeoff
  – Otherwise off (no illumination)
  – Two conditions required for “on”
  – Departure in position and runway blocked
• Takeoff Hold Lights (THLs) off
  – Departure in position
  – But runway is empty
• Takeoff Hold Lights (THLs) off
  – No departure in position
  – One aircraft on runway
• **Takeoff Hold Lights (THLs)**
  – Indicate runway occupied or soon to be occupied
  – Red if runway not safe for takeoff
  – Otherwise off (no illumination)
Runway Entrance and Takeoff Hold Lights

- Taxi Hold-Position Lights
- Runway-Entrance Lights
- Runway-Entrance Lights
- Taxi Hold-Position Lights
Operational Evaluation at DFW
Development Program on track

- Phase 1 (FY ’01 - ’02) Engineering Development
- Phase 2 (FY ’02 - ’03) Shadow Operations
- Phase 3 (FY ’03) Operational Evaluation at DFW

Photo courtesy of NASA Ames
Key Human Factors Issues: Controllers

- Tower display
- Workload
- Interference
Key Human Factors Issues: Pilots

- Status ≠ clearance
- Status lights not at all intersections
- Trust and confidence in status depiction
Summary

• Concept
  – Provide automatic depiction of runway status
  – Assure safety via increased pilots’ situational awareness

• Issues
  – Pilot and controller acceptance

• Accomplishments and Activities
  – Animated scenarios demonstrated to User Group (including Unions) and FAA Air Traffic Management
  – Operational Concept Document published
  – Operational Evaluation Plan in progress
  – Shadow Operations at DFW center tower this year