Outline

• Runway Status Lights (RWSL) Motivation & Overview

• BOS RWSL Adaptation for Operational Evaluation

• RWSL Light Logic
  – Runway Entrance Lights (RELs)
  – Takeoff Hold Lights (THLs)
  – Runway Intersection Lights (RILs)

• Pilot & Air Traffic Control Protocol
RWSL Motivation & Overview
Motivation: Prevent Runway Accidents

1977
- Tenerife, CI: 1977 - 583 Fatalities
- Los Angeles, CA: 1991 - 34 Fatalities
- N. Las Vegas, NV: 2003 - 2 Serious Injuries
- Titusville, FL: March 2008 - 3 Fatalities

1990
- Quincy, IL: 1996 - 14 Fatalities
- Detroit, MI: 1990 - 8 Fatalities

1991
- Milan, Italy: 2001 - 122 Fatalities

1996
- Quincy, IL: 1996 - 14 Fatalities

2001
- Milan, Italy: 2001 - 122 Fatalities

2003
- N. Las Vegas, NV: 2003 - 2 Serious Injuries

2006
- Lexington, KY: 2006 - 49 Fatalities

2008
- Titusville, FL: March 2008 - 3 Fatalities
Boston Runway Status Lights (RWSL) Overview

• Runway Status Lights purpose
  – Prevent runway accidents
  – Reduce frequency and severity of runway incursions

• How do Runway Status Lights do this? By increasing pilot and vehicle operator situational awareness
  – RELs provide a direct indication that it is unsafe to cross or enter a runway
  – THLs provide a direct indication that it is unsafe to takeoff from a runway
  – RILs provide a direct indication that is unsafe to cross or enter a runway-runway intersection

• RWSL at BOS consists of RELs, THLs, and RILs

THLs

RILs

RWSL photograph from LAX
High-level Operational Requirements

• Lights must operate automatically for each operation
  – No controller action required
• RELs must accurately indicate that runway is unsafe to enter or cross
  – RELs turn ON (red) when the RWY is unsafe
  – RELs turn OFF when the RWY is safe
• THLs must accurately indicate that runway is unsafe for departure
  – THLs turn ON (red) when the RWY is unsafe
  – THLs turn OFF when the RWY is safe
• RILs must accurately indicate that runway intersection is unsafe to enter or cross
  – RILs turn ON (red) when the RWY is unsafe
  – RILs turn OFF when the RWY is safe
• Lights must not interfere with normal safe ATC and airport operations
• Lights indicate status only, never clearance to proceed
• Lights are timed to allow for use of anticipated separation by ATC
Most RWY incursions result from **pilot deviations**.
Runway Status Lights (RWSL) Generic Operational Concept

RWSL safety logic uses fused surveillance to automatically illuminate lights - directly warning pilots that a runway is unsafe.

RELs: Runway Entrance Lights
THLs: Takeoff Hold Lights
RILs: Runway Intersection Lights

Runway Entrance Lights (RELs)
RELs mean STOP! The runway is unsafe to enter or cross.

Takeoff Hold Lights (THLs)
THLs mean STOP! The runway is unsafe for takeoff.

Runway Intersection Lights (RILs)
RILs mean STOP prior to runway intersection ahead!
BOS RWSL Adaptation for Operational Evaluation
RWSL System Architecture

Airport Surface Surveillance
- Primary Radar
- Transponder Multilateration
- ASR-9

Terminal Area Surveillance

Fusion
- State Machine
- Prediction Engine

Light Activation Logic

Field Lighting System

RWSL Test Displays

MIT Lincoln Laboratory

BOS RWSL OpEval Training for Pilots – 9
JEO & MPK 9/28/11
RWSL Adaptation at BOS

**RELs (7) at selected intersections**
- 4L/22R at E and K
- 4R/22L at E (east)
- 9/27 at C (north)
- 15R/33L at D (west)

**THLs (2) at full-length takeoff points on 9 and 15R**

**RILs (2) on 9 at 15R/33L (west of intersection) and on 15R at 9/27 (north of intersection)**

**THLs and RILs on runway 9 share 18 fixtures**
RWSL Light Logic
REL Logic

- RELs turn **ON** when high-speed traffic exists or is predicted to be on the runway
  - Departures turn on all RELs downfield during takeoff roll at or above a site adaptable speed parameter
  - Arrivals turn on all RELs on the projected runway at a site adjustable distance parameter from the threshold (0.5 nmi for BOS)

- **All RELs turn OFF** when:
  - Departures are declared airborne by RWSL logic (usually 100’)
  - Arrivals have landed and slowed to taxi speed (usually below 35 kts)

- **RELs at specific intersections:**
  - Individual RELs turn off just prior to the intersection being cleared to reduce interference with ATC use of *anticipated separation*
  - Individual RELs may be on at intersections just ahead of aircraft in landing roll-out
Configuration of Runway Entrance Lights (RELs)

RELs are red when it is unsafe to enter the runway

- RELs along taxiway centerline for last-second situational awareness
- Distinct from Surface Movement Guidance and Control System (SMGCS) stop bar
THL Logic

THLs turn **ON** in front of aircraft in position on the runway when it is **UNSAFE** to takeoff

- Aircraft in position for takeoff (or just beginning takeoff roll) sees red lights when another aircraft or vehicle is on the runway

**THL logic at Boston also give status of intersecting runways**

- Aircraft in position for takeoff (or just beginning takeoff roll) see red lights when a high-speed arrival/departure on a crossing runway is a potential conflict at the intersection

**THLs turn off when the runway is **SAFE** for an aircraft to takeoff, however, THLs **NEVER CONVEY ATC CLEARANCE****
Configuration of Takeoff Hold Lights (THLs)

THLs are red when it is unsafe to depart

- THLs configuration is double-row/1,500 feet longitudinally along runway centerline
- Pilot feedback resulted in addition of ten lights and a second row
RIL Logic

- RILs turn **ON** when the runway-runway intersection is or will soon be occupied by an aircraft or vehicle and a conflict exists
- RILs indicate that it is *unsafe* to cross or enter the runway-runway intersection
  - For conflicts involving two high-speed targets: RILs may turn on for one or both runways based on a target’s projected ability to stop prior to the intersection
  - If LAHSO arrivals can stop before the hold point there is no conflict and lights will not illuminate
Configuration of Runway Intersection Lights (RILs)

RILS are red when it is unsafe to cross a runway intersection

RILs are installed as a double row on either side of runway centerline

Runway Intersection Lights Concept

I need to STOP!!!
Pilot Protocol for RWSL
Protocol for Pilots Viewing Red RELs

• If RELs illuminate red, the runway is unsafe to enter or cross and the pilots should stop immediately
• When the lights are off, pilots/vehicle operators may not enter or cross the runway without ATC clearance
  – In some instances (anticipated separation), RELs may be illuminated while the clearance is being given, but should be turned off by the time the controller has finished issuing the clearance

RELs indicate runway status only; they do not indicate clearance!

DO NOT CROSS RED LIGHTS even if cleared by ATC
Protocol for Pilots Viewing Red THLs

- If in position and hold or line up and wait on the runway and THLs illuminate red:
  - Pilots should remain in position for takeoff
- If takeoff roll has begun and illuminated THLs are observed:
  - Pilots should safely stop the aircraft and notify ATC that they are stopped because of red lights
- If aborting the takeoff is impractical for safety reasons:
  - Pilots should proceed according to their best judgment of safety (understanding that the illuminated THLs indicate the runway is unsafe for departure) and contact ATC at the earliest opportunity

THLs indicate runway status only; they do not indicate clearance!

DO NOT CROSS RED LIGHTS even if cleared by ATC
Protocol for Pilots Viewing Red RILs

- If RILs are illuminated red, the runway intersection is unsafe for entry or crossing
  - A pilot or vehicle operator seeing illuminated RILs should safely stop!
- If stopping is impractical for safety reasons
  - Pilots or vehicle operators should proceed according to their best judgment of safety (understanding that the illuminated RILs indicate the runway intersection is unsafe to enter or cross) and contact ATC at the earliest opportunity

- In critical conflict situations
  - Pilots or vehicle operators should utilize the information from RILs (intersection is unsafe) then take the appropriate actions to prevent a collision according to your best judgment of safety

RILs indicate runway status only; they do not indicate clearance!

DO NOT CROSS RED LIGHTS even if cleared by ATC
RWSL Protocol for ATC

• No new procedures for RWSL

• Controllers are expected to use best judgment and applicable paragraphs from 7110.65 and 7210.3

• ATC should not clear pilots to takeoff through RED THLs

• ATC should not clear to cross/drive through RED RELs or RILs

If RWSL is illuminating lights abnormally, then ATC should disable RWSL. Pilots should not cross RED lights!
RWSL Pilot Training and Feedback

• Pilot Training (in progress)
  – Jeppesen pages published to subscribers
  – Notices to Airmen (NOTAM) on www.faa.gov
  – Training briefing posted on www.RWSL.net
  – BOS airlines encouraged to add RWSL information into recurrent training

• Pilots Feedback
  – Pilots requested to submit survey responses online at www.RWSL.net
  – Click on “BOS” tab
  – Select “Survey”