Training for Pilots: Operational Evaluation of RWSL (Runway Status Lights) at Los Angeles International Airport (LAX)

Maria Picardi Kuffner
MIT Lincoln Laboratory
8 April 2009
Overview of Runway Status Lights (RWSL)

- LAX RWSL consists of RWY Entrance Lights (RELs) and Takeoff Hold Lights (THLs)
- RWSL purpose
  - Reduce frequency and severity of RWY incursions and prevent RWY accidents
- 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 RWY
  - THLs provide a direct indication that it is unsafe to takeoff from a RWY
  - Lights driven automatically by MIT Lincoln Lab logic using fused surveillance data

If THLs or RELs are RED, STOP!
THLs are RED when it is not safe to take off, and RELs are RED when it is unsafe to cross a runway.
Remember: Lights indicate status only, never clearance!
“any unauthorized intrusion onto a runway, regardless of whether or not an aircraft presents a potential conflict.”

Most RWY incursions result from pilot deviations.
Motivation: Prevent RWY Accidents

- Detroit, MI: 1990
  - 8 Fatalities
- Quincy, IL: 1996
  - 14 Fatalities
- Milan, Italy: 2001
  - 122 Fatalities
- Lexington, KY: 2006
  - 49 Fatalities
- 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
REL and THL locations at LAX

- RWYs 6R/24L, 7L/25R and 7R/25L have runway status lights installed
- RELs at selected intersections (that correlate with FAA identified hot spots)
  - Y, Z, and AA to North of 6R/24L
  - V and E8 to South of 6R/24L
  - F and G on both sides of 7L/25R and 7R/25L
  - U on both sides of 7L/25R and to North of 7R/25L
- THLs at full-length takeoff point and intersection E8 takeoff point on RWY 24L
  - Two overlapping THL arrays with two rows of 16 lights for each array
High Level Operational Requirements

• Lights must not interfere with normal safe operations

• Lights timed to allow for ATC use of anticipated separation

• Lights must operate automatically for each operation
  – No controller action required

• RELs must accurately indicate that RWY is unsafe to enter or cross
  – RELs turn on (red) when RWY is unsafe, turn off when RWY is safe

• THLs must accurately indicate that RWY is unsafe for takeoff
  – THLs must have target in position for takeoff (in arming region) and target “on” RWY (in activation region) in order to turn on
  – THLs turn on (red) when RWY is unsafe, turn off when RWY is safe

• Lights indicate status only, never clearance to proceed
  – Red to off does not mean go, verbal clearance necessary as today
  – Off to red means stop for both pilots and vehicle operators
THL and REL Protocol for ATC

- No new procedures for RWSL
- Controllers are expected to use best judgment and applicable paragraphs from 7110.65 and 7210.3
- Do not clear pilots to take off through RED THLs
- Do not clear pilots or vehicle operators to cross through RED RELs
Pilots’ interaction with THLs

• If in position and holding on the runway and the THLs illuminate
  – crew should remain in position for takeoff
• If takeoff roll has begun and illuminated THLs are observed
  – crew should stop the airplane and ATC that they are stopped because of red lights
• If aborting the takeoff is impractical for safety reasons
  – crews 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
REL Protocol for Pilots and Vehicle Operators

- RELs indicate runway status only; they do not indicate clearance.
- Clearance will be provided verbally by ATC as under current procedures.
- When lights illuminate, the runway is unsafe to enter and the pilots must 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.
- Remember RELs indicate status only, never clearance!
Pilots’ interaction with RELs

• When RELs illuminate, the flight crew should remain clear of the runway.

• When cleared to either “cross the runway”, “position and hold”, or “immediate takeoff”, and RELs are illuminated; stop the aircraft and indicate to Air Traffic “TransAir 123 stopped with red lights” and then wait for further clearance.

• If the aircraft crosses the hold line and the flight crew observes illuminated lights, then the flight crew should stop the airplane and notify ATC that “TransAir 123 is stopped across the hold line because of red lights.”
THL and REL Protocol for ATC

- No new procedures for RWSL
- Controllers are expected to use best judgment and applicable paragraphs from 7110.65 and 7210.3
- Do not clear pilots to take off through RED THLs
- Do not clear pilots or vehicle operators to cross through RED RELs
RWSL Operational Evaluation Process

• Live surveillance data driving prototype RWSL safety logic, configuration and displays
  – Live and playback voice communications will be analyzed by MIT/LL
  – Transparent to normal ATC operations

• Objective of RWSL Operational Evaluation
  – Identification and mitigation of status light anomalies
  – Determination of operational suitability for ATC, pilots, and vehicle operators

• Focus of LAX testing on RELs and THLs
  – Closely-spaced parallel RWYs with frequently used high-speed exits
  – Similar to ongoing testing (extended operational evaluations) at DFW and SAN
RWSL website: www.RWSL.net

Portion of www.RWSL.net home page with one-click access to:

- Surveys (circled for emphasis here)
- Training Briefing
- Pilot information
• Three RWSL kill switches added near supervisor’s display
• North side has two kill switches
  – One kill switch turns off RELs on TWYs V, E8, Y, Z, and AA
  – One kill switch turns off THLs on RWY24L
• South side has one kill switch
  – One kill switch turns off RELs on TWYs F, G, and U
• Kill switches photo shown below
  – Toggle switch “off” to turn off (or kill) lights
RWSL Operational Evaluation Test Displays

- RWSL displays are not for operational use
  - RELs and THLs shown as red bars (at installed locations)
  - Bars turn red and blank consistent with lights turning on and off
  - Aircraft also shown (similar to ASDE-X situational display)
- RWSL displays can be shown on existing North and South airfield lighting control panels (ALC)
  - Press small black button labeled “RWSL” to bring up RWSL display on existing airfield lighting control display
- One display on monitor in ATC supervisor’s area
  - Press small black button labeled “RWSL” to bring up RWSL display on existing PC display
  - Supervisor’s display has a RWSL display and a commander window for RWSL interaction (turn lights on/off, adjust intensity levels, etc.)
RWSL Commander Window Layout

• Title bar states version shown
  – LAX

• Three buttons precede the title
  – Click red button to close
  – Click yellow button to minimize
  – Click green button to expand

• Three sections for RWSL functions (left) and status (right)
  – Airport Configuration
  – Surveillance Mode
  – Light Controls with Soft Kill Switch

• Help and Close buttons
  – Aligned on bottom row
  – “RWSL Commander” label
How to shut off RWSL

• Unless the system is creating anomalies it is to remain on throughout the Operational Evaluation

• Example requiring RWSL shutoff
  – Controller issues clearance to enter or cross the runway
  – Pilot/vehicle operator responds that RELs are on
  – Controller responds with hold short instructions
  – Controller re-assesses the situation and determines the runway is safe
  – Controller asks the pilot/vehicle operator if the lights are still on

• If lights reported still on, RWSL malfunctioning, turn it off
  – Once lights are off, ATC re-issues clearance or alternate instructions
  – Disable lights using commander window (easier recovery to service)
  – Turn off RELs or THLs using kill switch (quickest)
  – Rebroadcast ATIS message with RWSL activity omitted
  – Return RWSL to service (after malfunction ended and possible discussion)
  – Rebroadcast ATIS message with RWSL activity included
Operational Evaluation Schedule and Tasks

• **Daily testing**
  - All weather conditions present, all flows, 24/7

• **LAX air traffic supervisors in LAX TWR**
  - Verify ATIS states RWSL test in progress (or not if RWSL turned off)
  - Call or beep MIT/LL if problem occurs with RWSL

• **Assist in identifying RWSL anomalies:**
  - False Activation (FA) = light on inadvertently
  - Missed Detection (MD) = light off inadvertently
  - Interference (I) = interruption of traffic caused by light

  For example, a pilot may hesitate to accept a clearance or actually call the controller to question a clearance that is not consistent with an illuminated light even though the clearance is correct and the resulting action would be safe.

• **LAX air traffic controllers in LAX TWR cab**
  - React as trained if pilots or vehicle operators question red lights
  - **DO NOT CLEAR THROUGH RED LIGHTS**
Example of Anomaly Requiring Shutoff

- Controller issues clearance to enter or cross the runway.
- Pilot/vehicle operator responds that RELs are on.
- Controller responds with hold short instructions.
- Controller re-assesses the situation and determines the runway is safe to enter or cross.
- Controller asks the pilot/vehicle operator if the lights are still on.
- If lights are reported as still on, then RWSL is malfunctioning - turn RWSL off.
- Once lights are off, controller re-issues clearance or alternate instructions.
- Controllers must never instruct a pilot or vehicle operator to disregard the lights.
Procedure for RWSL Shutoff

- Unless the system is creating anomalies it is to remain on throughout the Operational Evaluation
- If anomalies are impeding the flow of traffic, ATC supervisor will:
  - Disable lights using commander window (easier recovery to service)
  - Turn off RELs or THLs using kill switch (quickest)
  - Rebroadcast ATIS message with RWSL activity omitted
  - Return RWSL to service (after malfunction is over and possible discussion with FAA test team)
  - Rebroadcast ATIS message with RWSL activity included
RWSL Pilot Training and Feedback

• Pilot Training
  – Jeppesen 60-8 pages published to subscribers
  – Notices to Airmen (NOTAM) on www.faa.gov
  – Training briefing posted on www.RWSL.net
  – LAX airlines encouraged to add RWSL information into recurrent training

• Pilots Feedback
  – Pilots requested to submit survey responses online at www.RWSL.net
  – Click on surveys tab
  – Select LAX REL survey and/or LAX THL survey

• Vehicle Operators Training and Feedback
  – LAX airport authority will train with relevant portions of this briefing
  – Vehicle operators requested to submit (relevant portions of) survey responses online at www.RWSL.net
Operational Evaluation Schedule and Tasks

- **Daily testing**
  - All weather conditions present, all flows
  - RWSL operates 24/7

- **LAX air traffic supervisors in LAX TWR**
  - Verify ATIS has notice of RWSL test in progress (or not if RWSL has been turned off)
  - ATIS message will state facilities choice of words, such as:
  - “Runway Status Light operational evaluation in progress on runways 24L, 25L and 25R. Do not cross illuminated red lights at taxiway intersections. Do not take off through red lights on runway 24L. Transponders should remain on while evaluation is in effect.”
Operational Evaluation Responsibilities

• LAX ATC supervisors in LAX TWR cab
  – Observe timing of RWSL turning on and off with traffic
  – Observe RWY status light anomalies
    False Activation, Missed Detection, Interference
  – Please note anomalies and comments using Notebook

• LAX air traffic controllers in LAX TWR cab
  – React as trained if pilots or vehicle operators announce or question red lights
  – DO NOT CLEAR THROUGH RED LIGHTS

• LAX vehicle operators and pilots
  – React as trained to lights on airport
  – DO NOT CROSS RED LIGHTS
  – DO NOT TAKE OFF THROUGH RED LIGHTS (pilots only)
  – Please note responses and comments using online surveys
LAX RWSL Operational Evaluation Summary

- **Goal**: test RWSL with live operations and expert observation by LAX ATC personnel and airline pilots

- **Method**: evaluate correlation between ATC clearances, target movement and RWSL

- **Results**: observe and record instances of anomalous light operation and subject matter experts’ observations
  - Assess RWSL accuracy and any interference with normal, safe operations
  - Evaluate comprehension, acceptance, effectiveness, and suitability of RWSL (both RELs and THLs) in preventing RWY incursions at LAX