

LEDs in Aviation Lighting

IESALC Meeting

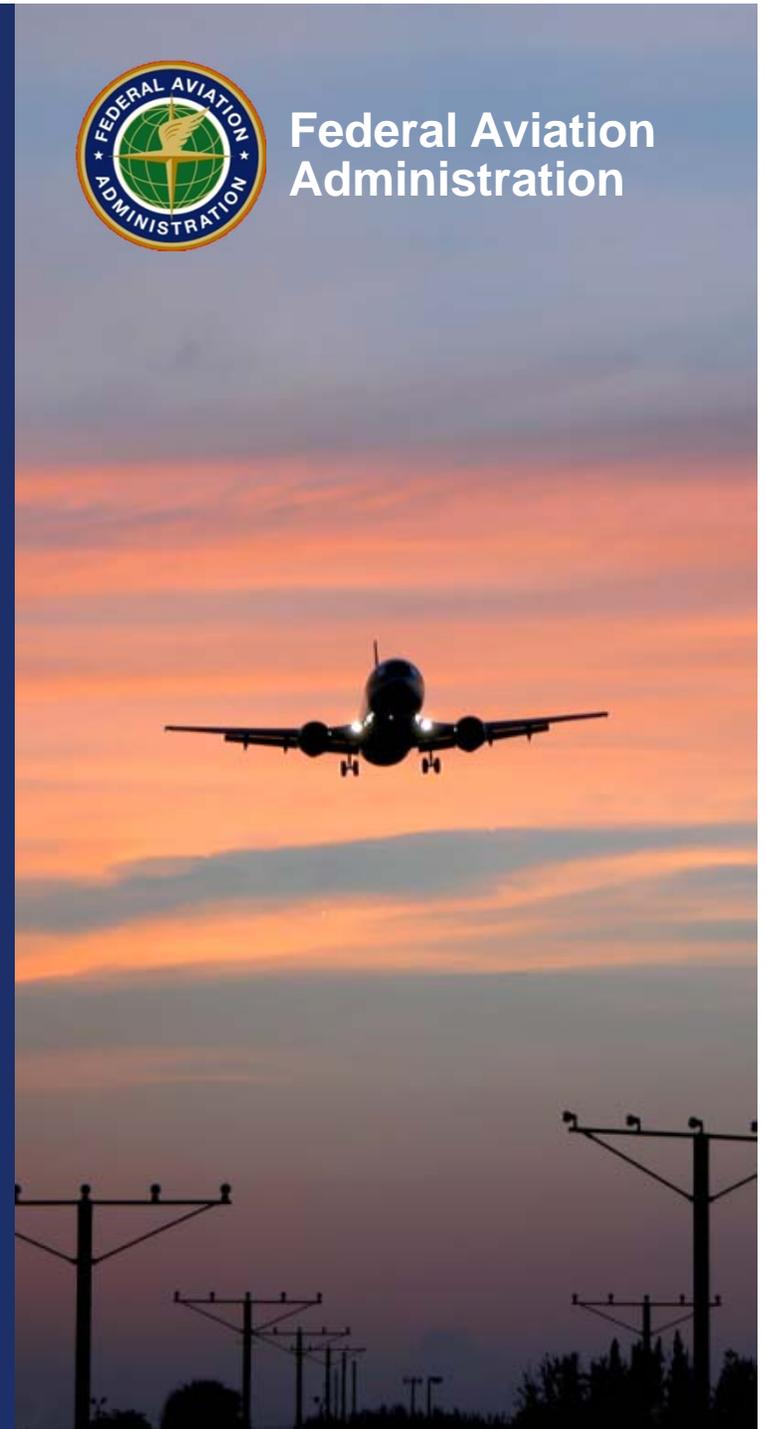
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Why LEDs in Aviation Lighting?

- **Light-emitting diodes (LED) have many advantages**
 - Reduced energy consumption, reduced maintenance cost, greater durability, and longer lifetime
 - Significant savings in airport operations budget
- **2007 Energy Independence and Security Act**
 - Mandated that incandescent lamps of certain wattages no longer be produced
 - Manufacturer's of incandescent Airport Lighting systems complying by changing to LED
- **FAA responsibility to ensure safe operations**
 - Equivalent or better level of performance and safety compared to incandescent lighting



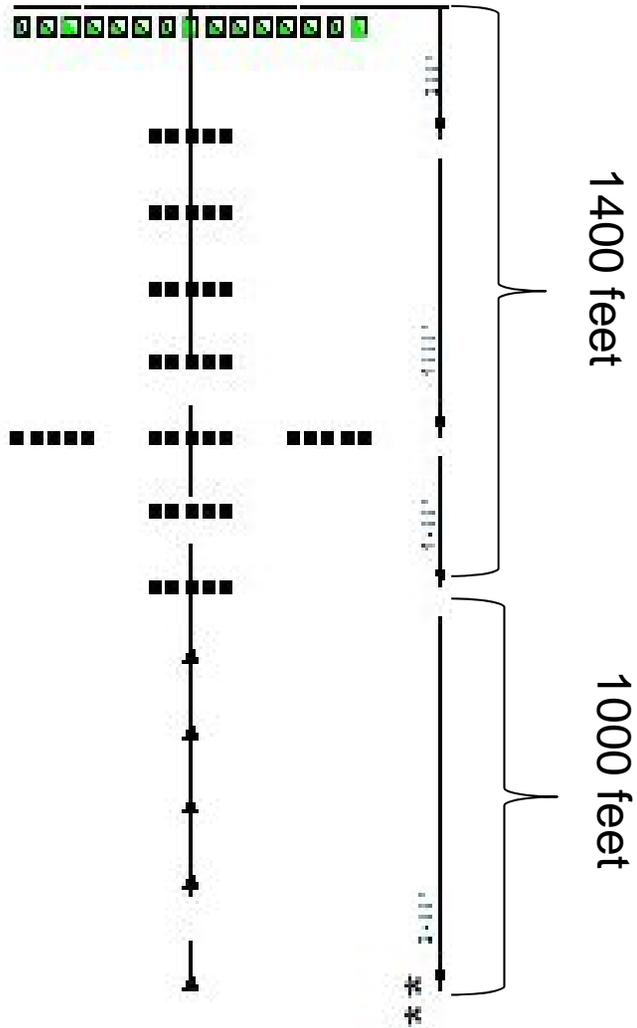
LED Aviation Lighting is becoming more prevalent



Port Columbus Int'l Airport (KCMH)
Columbus, Ohio, USA

New 28L-10R
LED Centerline/TDZ/Edge/End

Old 28R-10L
Halogen Lamps



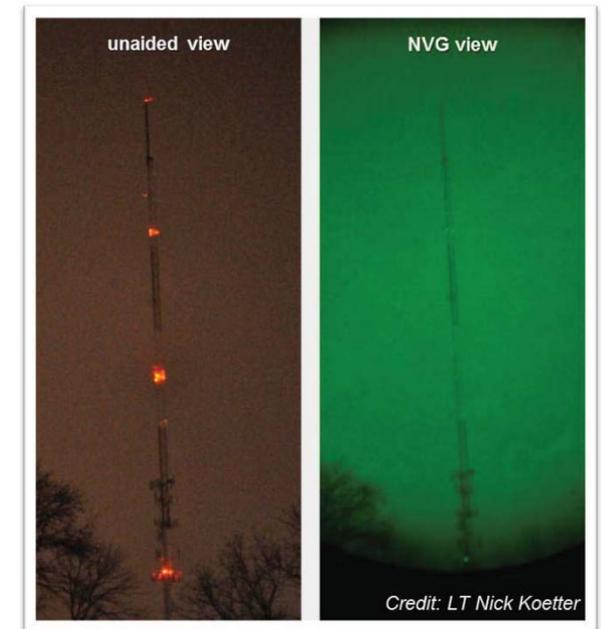
Medium Intensity Approach Lighting System (MALSR)

LED Integration into NAS

- **Identified several areas of concern:**
 - **LED Obstruction lighting**
 - Incompatible with some Night Vision Goggles popular with helicopter operators
 - **Incompatibility of LED with Enhanced Vision Systems**
 - Approach lighting systems and runway lights
 - **Unintended Consequences**
 - Runway Centerline Lights
 - **Brightness perception of LED vs. incandescent**
 - Pilot survey responses

LED Obstruction Lighting

- **LEDs are difficult to see with Night Vision Goggles (NVG) used by helicopter operators**
 - 60% of HEMS pilots use NVGs
 - 30% of obstacles are LED equipped
 - Most obstacles/towers not FAA regulated
- **FAA LED Work Group assessed risk**
 - Short term recommendations
 - Validate/verify aeronautical charting reqmt's
 - Extend AIP funding restrictions for LEDs
 - Update FAA guidance to operators
- **Work with lighting and NVG manufacturers to find a technical solution**



LED and Enhanced Vision Systems

- **Current Enhanced Flight Vision Systems (EFVS) cannot sense LED airport lighting**
 - EFVS is key enabler for NextGen low visibility initiatives
 - LED doesn't produce heat or infrared (IR) signature
- **Working with lighting and aviation community to develop technical solution**
 - Develop requirement for LED compatibility with EFVS
 - Enable continued operation of Legacy EFVS aircraft
- **FAA has funded research on LED and EFVS compatibility**
 - Demonstration flights will soon be initiated on FAA prototype LED MALSR at Atlantic City (ACY)



ANC RWY 07L RCLs- An Unintended Consequence



Sample Pilots Survey on LED

- “LED's are great. As long as the light is similar to what the old technology was.”
- “The centerline lights can distort the landing environment. **I find it harder to judge the aircraft height above the runway**”
- “**Far more visible, easier to see from a long distance**, stand out better from surrounding lights”
- “The lights are **way too bright even on the lowest setting**. When we asked the Raleigh tower controller to dim them, he said they were on the dimmest setting”
- “Most LED runway centerline and touch down zone lights are **too bright during the landing phase**”

656 survey responses: 65% negative/30% positive*

**As of February 12, 2015*



FAA Progress on LED Technology

- **Runway approach lighting and Visual Aid systems**
 - 2009: NextGen Optimization of Navigation Technology
 - Funding for LED airport lighting development
 - 2010 - 2014: LED PAPI design, development & testing
 - Operational deployment planned in 2015
 - 2010 - 2014: LED MALSR design, development & testing
 - Prototype LED MALSR at FAA Technical Center (Atlantic City)



FAA Progress on LED Runway Lighting Systems

- **Raleigh Durham (RDU) Airport N.C. reported excessive brightness issues with their LED runway centerline and touchdown zone lighting systems in late 2011.**
- **Members of FAA HQ and the William J. Hughes Technical Center (FAATC) & manufacturer conducted a site visit to RDU to investigate and determine how to dim LED runway centerline lighting and touchdown zone lighting to an acceptable level**
- **In March of 2012, we issued changes to Engineering Brief 67 that revised the specification to alter the dimming curves applicable to both color and white light LED runway lighting. The revised dimming curves (based on lamp current and intensity) in Engineering Brief 67D are now the standard used for all new LED runway lighting.**
- **Recommendations to change the lowest steps of the FAA standard dimming curve in Engineering Brief 67 were provided. The maximum allowable percentage of white light output**
 - **for the lowest setting (Step 1) was changed from 1.65% to minimum 0.15% and maximum 0.7% and**
 - **the maximum allowable percentage of light output for Step 2 changed from 3.0% to minimum 1% and maximum 2.0%**
- **AC 150/5340-30H prohibits mixing LED and incandescent technologies on the same lighting system. Interspersing LED light fixtures with incandescent fixtures is also prohibited.**

FAA Progress on LED Taxiway Lighting Systems

- **Several airports including Richmond International Airport (RIC) & Cincinnati have reported brightness issues (Too Bright) with LED taxiway centerline lighting.**
- **Our investigation concluded “green” taxiway centerline lighting brightness issues are associated with the airport using a 3-step constant current regulator (CCR) power source versus a 5-step CCR. The 5-step CCR provides more latitude with brightness steps especially when using LEDs.**
- **We have added a “Note” to AC 150/5340-30H, “Design and Installation Details for Airport Visual Aids” for LED high intensity taxiway centerline lighting as follows:**
 - **“Note: A 5-step CCR is necessary to control LED high intensity lighting systems. This is because a 3-step CCR may not adequately reduce LED intensity at the lowest brightness step. See Engineering Brief 67 for additional information about LED lighting systems.”**
- **This note will provide guidance for designers to use the 5-step CCR system for future projects and to retrofit for existing installations that are problematic.**
- **The use of a 5-step regulator for an LED taxiway centerline lighting system is now the standard for new installations**

LED Symposium (Oct 7 – 8, 2014)

- **FAA and Industry symposium on LED airport lighting**
 - Ensure safe integration and transition from incandescent to LED lighting
- **Primary objectives:**
 - Identify needed areas of research and testing
 - Achieve collaboration from stakeholders
 - Establish plan of action and timelines
- **Established 3 Working Groups**
 - Science, Operational Test, and MALSR
 - Design/conduct operational testing of LED airport lighting

LED Flight Test – Near Term

- **FAA/Industry partnership to work LED issues**
- **Complete flight test plan**
 - Test criteria (duration, environment, aircraft type) being defined
 - Flight and ground test assets
 - Success criteria
 - Single Engine Propeller testing
 - Test “stroboscopic” effect of LED lights
- **Testing at existing LED installations**
 - Runway edge, centerline, touchdown zone, and taxi lighting
 - FAA Flight Inspection
- **Initial testing at Atlantic City prototype LED MALSR**
 - Brightness perception testing on approach lighting system

LED Flight Test - Far Term

- **Establish a Low Visibility Operations Test Site**
 - For FAA research, testing and certification of NextGen avionics/airport lighting systems
- **Emphasize Aircraft “Centric” Approach**
 - Approach and landing capabilities with advanced avionics to replace some airport lighting infrastructure

Challenges Moving Forward

- **Leveraging existing funding, resources, test assets, sharing costs (within FAA, with industry, etc)**
- **Education and awareness for aviation community**
- **Mixed LED/incandescent ground lighting**



Next Steps

- **Initiate operational flight testing**
- **Complete cost and schedule estimates ASAP (as a minimum for FY16)**
- **Brief progress on testing and cost estimates by summer 2015**

In Conclusion

- **LED lighting presents a new paradigm in aviation that affects:**
 - The FAA
 - The industry
 - The traveling public
- **Research and testing in the laboratory and operational environment is a mandate:**
 - To ensure the highest degree of safety is maintained