

# Visual Guidance Research & Development

**Update**

**Given by: Robert Bassey**

**IESALC Spring meeting May 7, 2015  
Washington, DC**



**Federal Aviation  
Administration**



# TOPICS

1. **End Of Life for LED Fixtures**
2. **Airport Linear Source Visual Aid**
3. **Electrical Infrastructure Research**
4. **Constant Current Regulator Research Projects**
5. **Safety Orange Visual Aids for Airport Construction**
6. **Airport Technology Research Taxiway**
7. **RSA/Approach Hold Signs and Markings**



# Method to determine end-of life for LED fixtures

The test includes two samples each of types L-850A Rwy C/L, L-850B Rwy TDZ, and L-850C, Rwy Edge.

Sample A4 a Rwy C/L fixture finally stopped operating after ~10,250 hours of continuous operation.

The rest of the operating samples, 2 TDZ and 2 Edge fixtures, continued to shift in color but at a slower rate of change than what had been previously observed.



# Method to determine end-of life for LED fixtures

Until the erratic behavior and eventual complete failure of sample A4 a Rwy C/L fixture, had exhibited the least light output depreciation (~15%).

Sample C1 a Rwy Edge fixture has now depreciated ~27%, sample B5a Rwy TDZ fixture ~50%, and sample C2 a Rwy Edge ~50%.

Sample A5 a Rwy C/L fixture had depreciated by 5% at the time of failure (~4780 hours).

Sample C1 a Rwy Edge fixture is approaching that point with a 27% light output depreciation.



# Airport Linear Source Visual Aid



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# Evaluation of Airport Pavement Linear Source Visual Aid

## PHASE ONE

- Perform a search of LED linear source products available that could be considered for outdoor application on airports.

## PHASE TWO

- Conduct a laboratory study to determine if a linear source has advantages in providing visual signal to the user compared to an array of point sources.
- Identify the key parameters for optimizing this application.



# Evaluation of Airport Pavement Linear Source Visual Aid

## PHASE THREE

- Conduct simulator and field evaluation for the most promising application for the linear light source found in Phase Two, which demonstrate the potential to provide a substantially improved visual cue.
- Develop a photometric equivalence between standard FAA point source lighting and a linear lighting source.



# Validation Study





# Evaluation of Airport Pavement Linear Source Visual Aid

## PHASE THREE

**Task 1: Conduct a simulation evaluation. (4 months)**

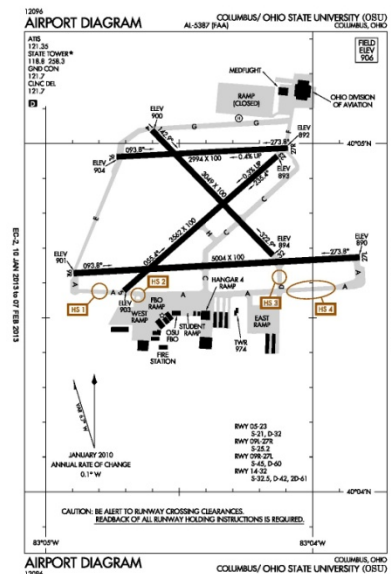
- Utilizing the FAA Technical Center's Simulation facility.
- Developing visuals
- Start of test 4/15.



# PHASE THREE

## Task 2: Conduct a field evaluation. (6 months)

- Utilizing the Partnership to Enhance General Aviation Safety, Accessibility and Sustainability (PEGASAS) Center of Excellence.
- Start of evaluation at Ohio State's airport 4/15



# Evaluation of Airport Pavement Linear Source Visual Aid



**Pictures of the linear fixtures and point sources on the ramp.**

**Approximate distance of 350-ft.**



# Schedule

Activity	Completion
Test Plan	02/28/12
Phase 1	09/30/12
Analysis/Decision Point	10/31/12
Phase 2	02/15/13
Analysis/Decision Point	02/27/13
Extended Phase 2	07/31/13
<b>Phase 3</b>	<b>07/31/15</b>
<b>Final Report to Sponsor</b>	<b>09/30/15</b>



# Electrical Infrastructure Research



# Issues resulting from LED implementation in the Current **6.6A** Series Airfield Lighting System

Added **complexity** and **cost** to the LED fixture due to the addition of electronics to mimic the **non-linear** dimming curve of incandescent lighting.



# EIRT Testing Team

## Recommended Two Paths

### → Path # 1:

- **Fixture Centric**
  - An airfield lighting architecture where the **fixture controls its intensity**

### → Path # 2:

- **Vault Centric**
  - An airfield lighting architecture that **directly controls the fixture intensity** from the **power source** in the **vault** (same as the traditional 6.6 amp)



# Architectures Tested

VAULT CENTRIC ARCHITECTURE



VAULT CENTRIC ARCHITECTURE



FIXTURE CENTRIC ARCHITECTURE



FIXTURE CENTRIC ARCHITECTURE





## Setup of the Fixture Centric Integration



# Roadmap Testing Phase

## → **Alpha testing at FAATC, May 2014**

- Integration including mixing of product
- Fixtures will be instrumented and monitored by FAA equipment to determine performance
- Identify any deficiencies, or adjustments to be made

## → **Beta testing at PEGASAS Airport July, 2014**

- Similar set up as alpha testing
- Large circuit
- Legacy mode will be available in case there is an issue with the circuit



# **Investigation of Maximum Constant Current Regulator Loading**

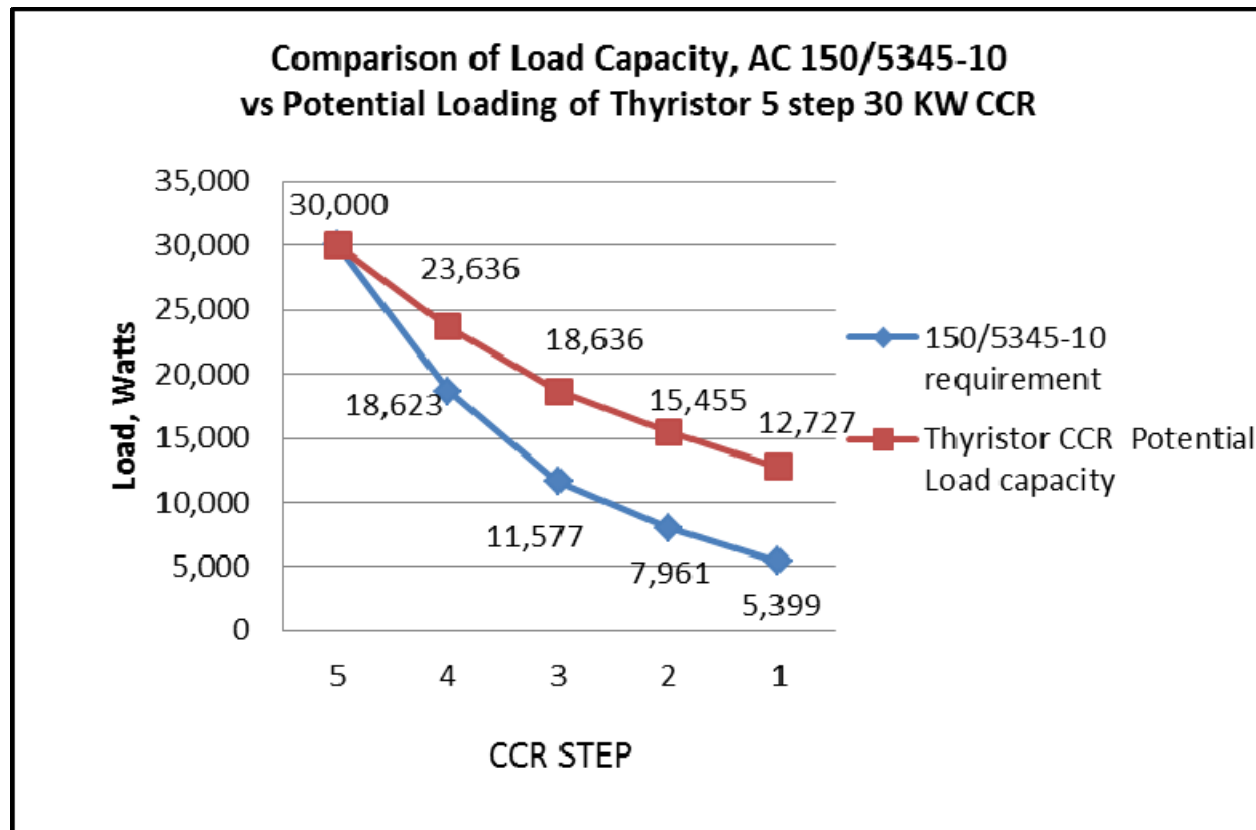


# Project Objectives

- **Investigation of reported overloading events of CCRs while at lower steps**
- **Investigate if restrictive maximum loading at lower steps for CCRs is specific for a particular CCR technology**
- **Identify the limitations of CCRs at lower steps**



Potential Load capacity of Thyristor CCR (red) vs  
Continuous operation of Certification Tested Load



# Test Locations

- ➔ **Louis Armstrong New Orleans International Airport (MSY), New Orleans, LA**
- ➔ **George Bush Intercontinental/Houston Airport (IAH), Houston, TX**
- ➔ **Ryan Field Airport (RYN), Tucson, AZ**



# **The Impact of Input Power Transients on CCRs**

# Project Objectives

- Investigate reports of CCR shutdown during a power changeover event. Make measurements on site to characterize the nature of the problems. Determine if the CCR resets and powers up after a zero voltage AC power glitch.
- Determine if the anomaly is related to the technology of the CCR or the control method used internally by the CCR. Also, verify if CCRs with similar technology or control methods have the same or similar issue.



## Set-up and timing measurements in process at the first airport investigation



# Project Milestones

- **Completed milestones to date**
  - Project Plan January 2015
  - Literature Review April 2015
  - First airport investigation April 2015
- **Remaining milestones of the research**
  - Project Test Plan
  - The Investigation Phase
    - Measurements at selected airports
    - Discussion selected airfield lighting manufacturers
  - Technical Report
    - Conclusions
    - Recommendations

# **Safety Orange Visual Aids during Airport Construction**



# Runway Construction Signs



# Taxiway or Movement Areas Construction Signs



# Field Evaluation Phase - Airports

- **TF Green State Airport (PVD)**
  - Runway 16/34 Closure for EMAS installation
- **Reno Tahoe Airport (RNO)**
  - Ramp Project
  - Taxiway Q pavement replacement project
- **Newport Municipal Airport (ONP)**
  - Runway Rehabilitation
  - Taxiway Project – Run Off Taxiway E – Slurry Seal
- **Orlando Sanford International Airport (SFB)**
  - Apron project
- **Midway International Airport (MDW)**
  - Taxiway K and Y resurfacing

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# Construction Ahead - PVD





# Construction on Ramp - PDX





# TORA - PDX

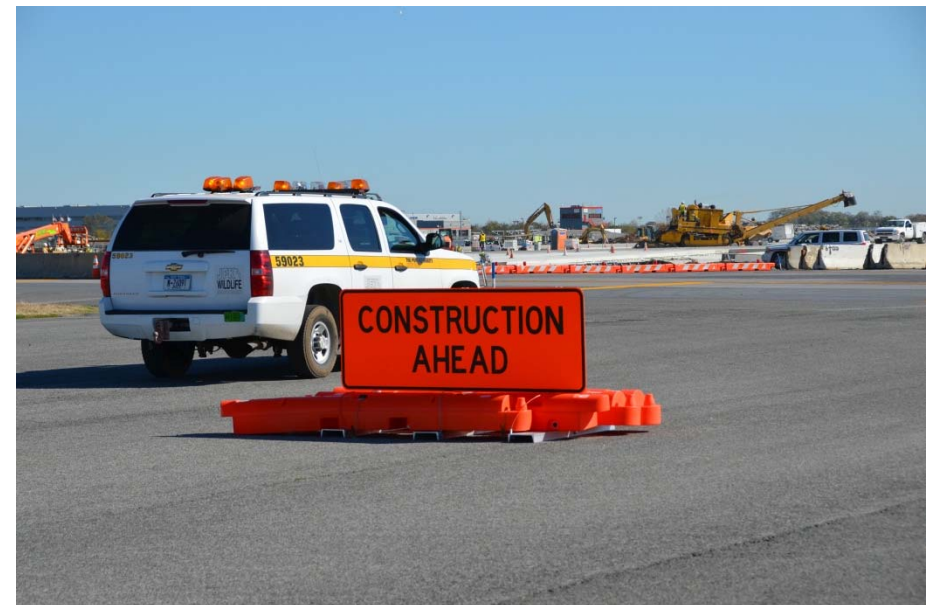


# Findings

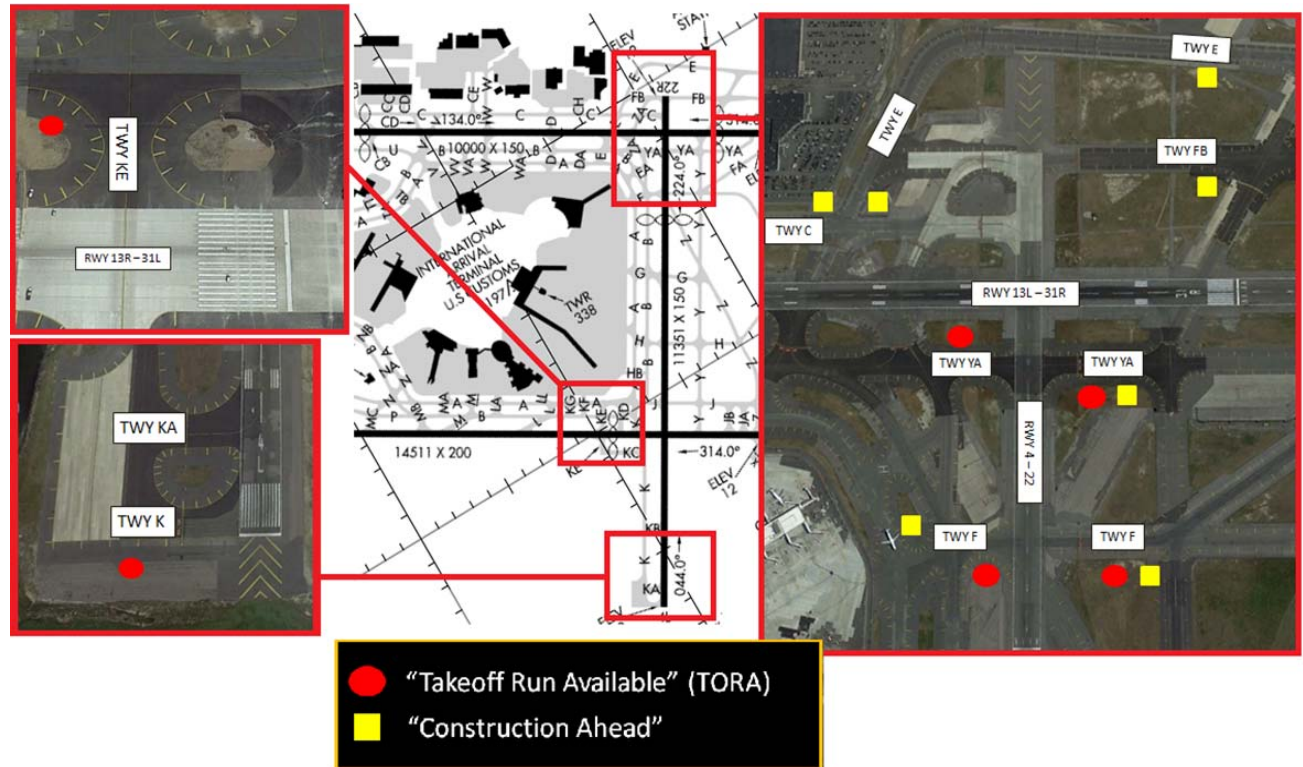
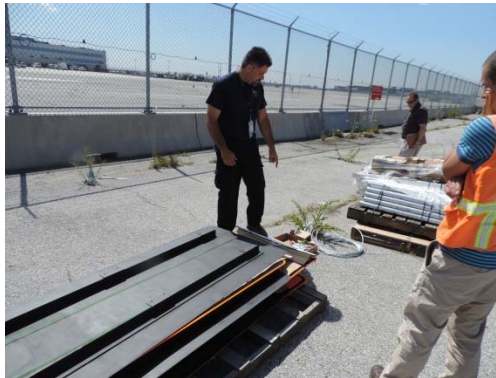
- **“CONSTRUCTION AHEAD” sign** - Of the combined total of one hundred nine (109) respondents, 87% of respondents strongly agreed or agreed that the sign was conspicuous. 88% strongly agreed or agreed that the sign was comprehensible at an adequate distance. 90% strongly agreed or agreed that the sign adequately notified them of the existing construction.
- **“CONSTRUCTION ON RAMP” sign** - Of the combined total of fifty one (51) respondents, 92% of respondents strongly agreed or agreed that the sign was conspicuous. 88% strongly agreed or agreed that the sign was comprehensible at an adequate distance. 94% strongly agreed or agreed that the sign adequately notified them of the existing construction.



# JFK Safety Orange Construction Signage



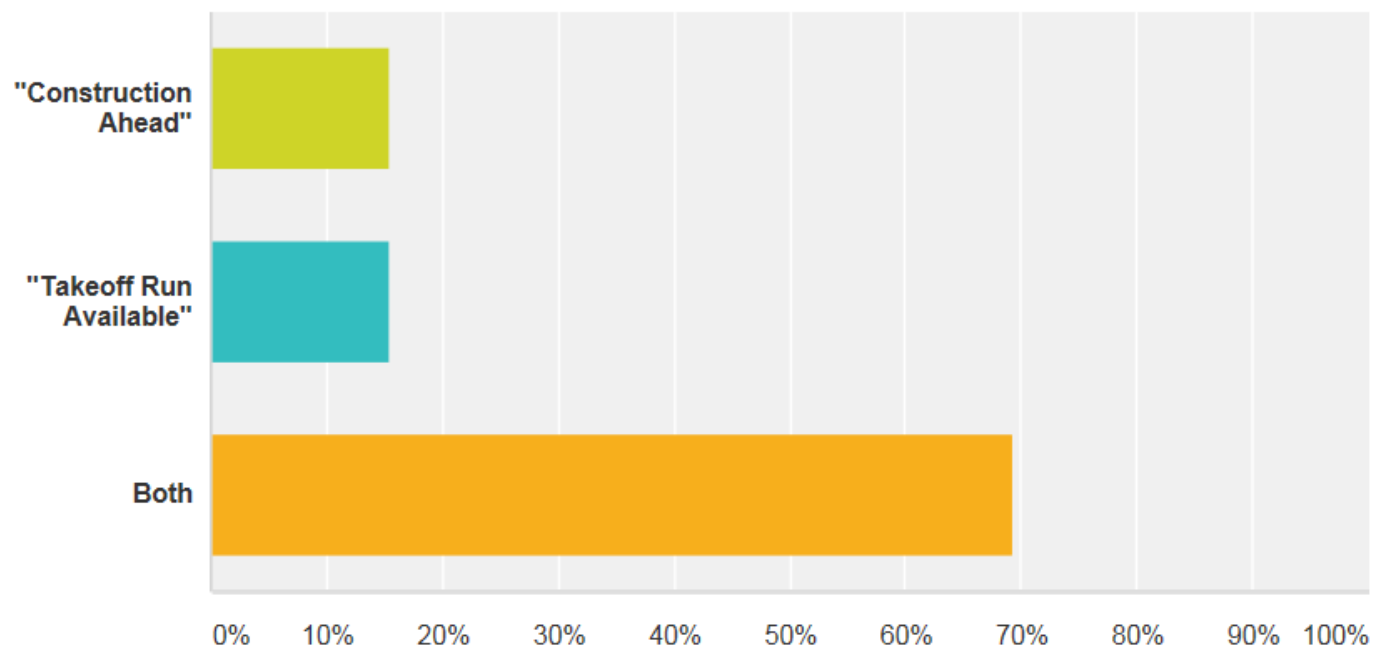
# Installed: September 2014



# Survey Participation to Date

Which type of orange signage did you observe?

Answered: 13 Skipped: 0



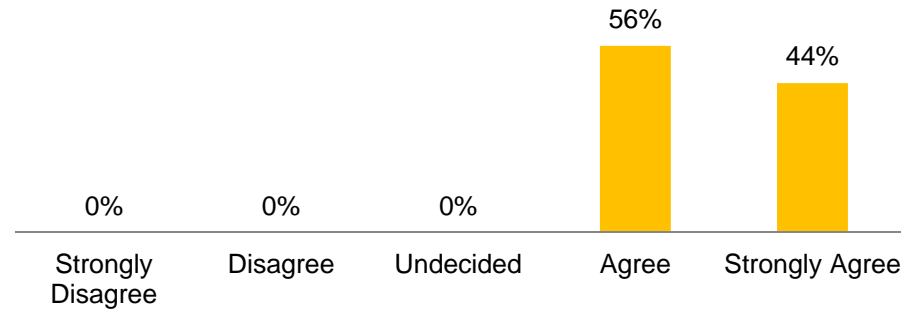


# Takeoff Run Available

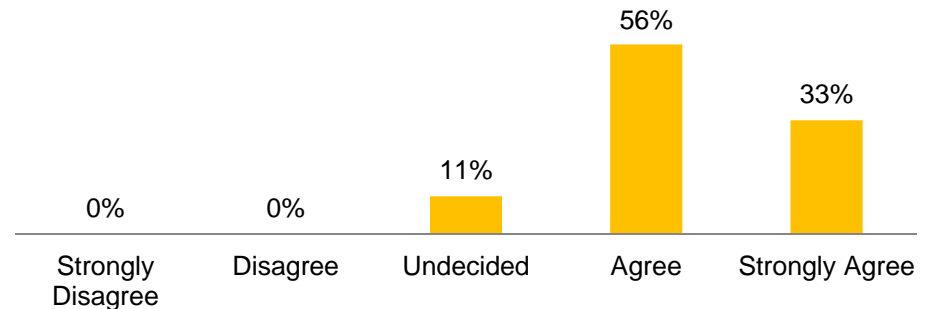


# TORA: Preliminary Results

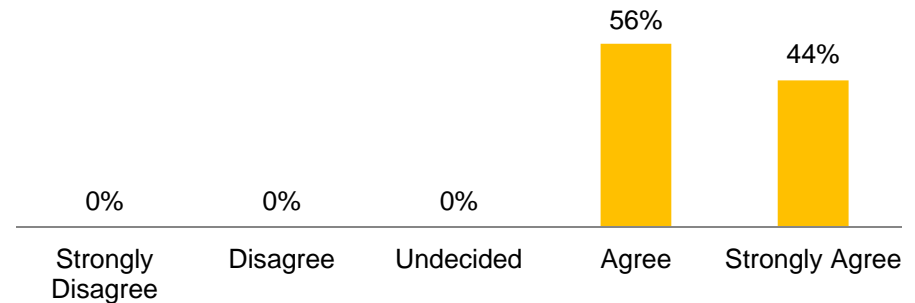
**The "Takeoff Run Available" sign was conspicuous.**



**The "Takeoff Run Available" sign was comprehensible at an adequate distance.**



**The "Takeoff Run Available" sign adequately notified me of the distance available on the runway for takeoff.**



# Airport Technology Research Taxiway



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# Project Summary

- Memorandum of Agreement between the FAA and DRBA
  - November 15, 2010 through September 30, 2030.
  - Grants the FAA the “right to construct, operate, and maintain research infrastructure” at the Cape May County Airport (WWD).

MEMORANDUM OF AGREEMENT  
Federal Aviation Administration (FAA)  
and  
Delaware Bay and River Authority  
DTFASO-10-H-00131

This AGREEMENT ("Agreement") is made and entered into on 11/15, 2010 by and between the Delaware Bay and River Authority (hereinafter referred to as the **Authority**) for itself, its successors and assigns, and the Federal Aviation Administration (hereinafter referred to as the **FAA**), as represented by the William J. Hughes Technical Center, Airport Technology Research and Development Team.

**WITNESSETH**

WHEREAS, pursuant to the terms of a ground lease dated June 8, 1999, entered into between the County of Cape May, as landlord thereunder, and the Authority, as tenant thereunder, the Authority operates the airport known as the Cape May County Airport ("Airport"), located in the County of Cape May, State of New Jersey; and

WHEREAS, the **FAA** intends to conduct research at the Airport in areas including, but not limited to: visual guidance, runway surface operations, wildlife mitigation, airport planning and design, aircraft rescue and firefighting, pavement design, and other related research areas; and

WHEREAS, the parties listed above wish to enter into an Airport Research Agreement (hereinafter "Agreement") to provide for the construction, operation, and maintenance of Research Infrastructure at the Cape May Airport; and

WHEREAS, "Research Infrastructure" includes, but is not limited to: electrical infrastructure, visual aids, pavement materials, and other facilities for the support of research conducted by the **FAA**; and

WHEREAS, both the **Authority** and the **FAA** believe that this Agreement benefits both parties in that the establishment of a Research Infrastructure at the Airport has the primary purpose of improving safety in air transportation; and

NOW, THEREFORE, the parties mutually agree as follows:



# Project Summary



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# Project Summary

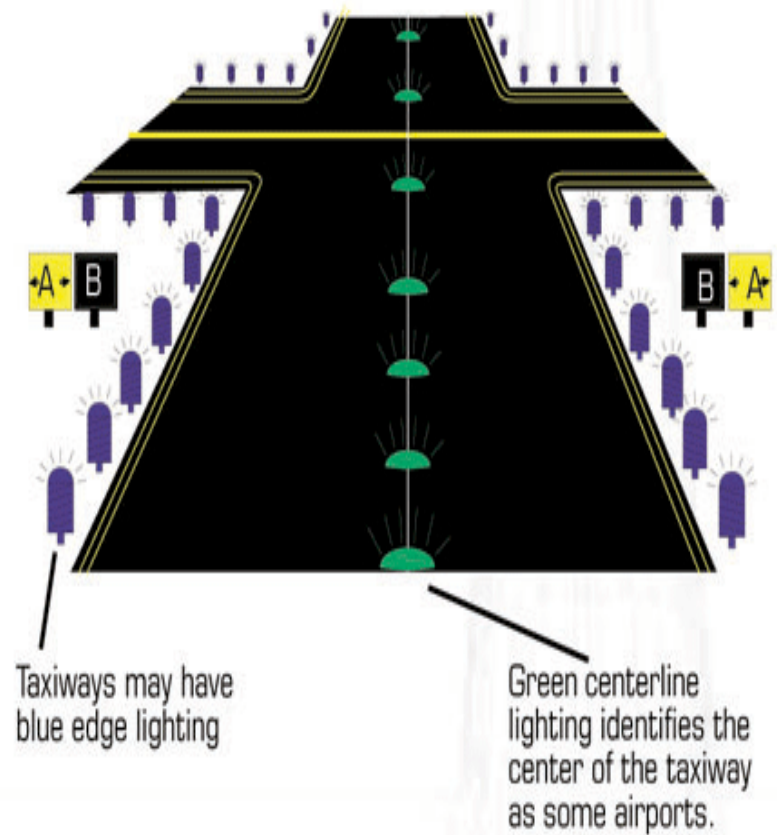


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# Project Summary

- **Primary use of the test bed will be for evaluating various airfield lighting systems.**
  - Centerline Lights
  - Runway Guard Lights – In-Pavement and Elevated
  - Touch Down Zone Lighting
  - Runway Status Lights
  - Will be reconfigurable – multiple duct banks, hand holes, pull boxes and conduit



*Adapted from Rod Machado's Private Pilot Handbook*



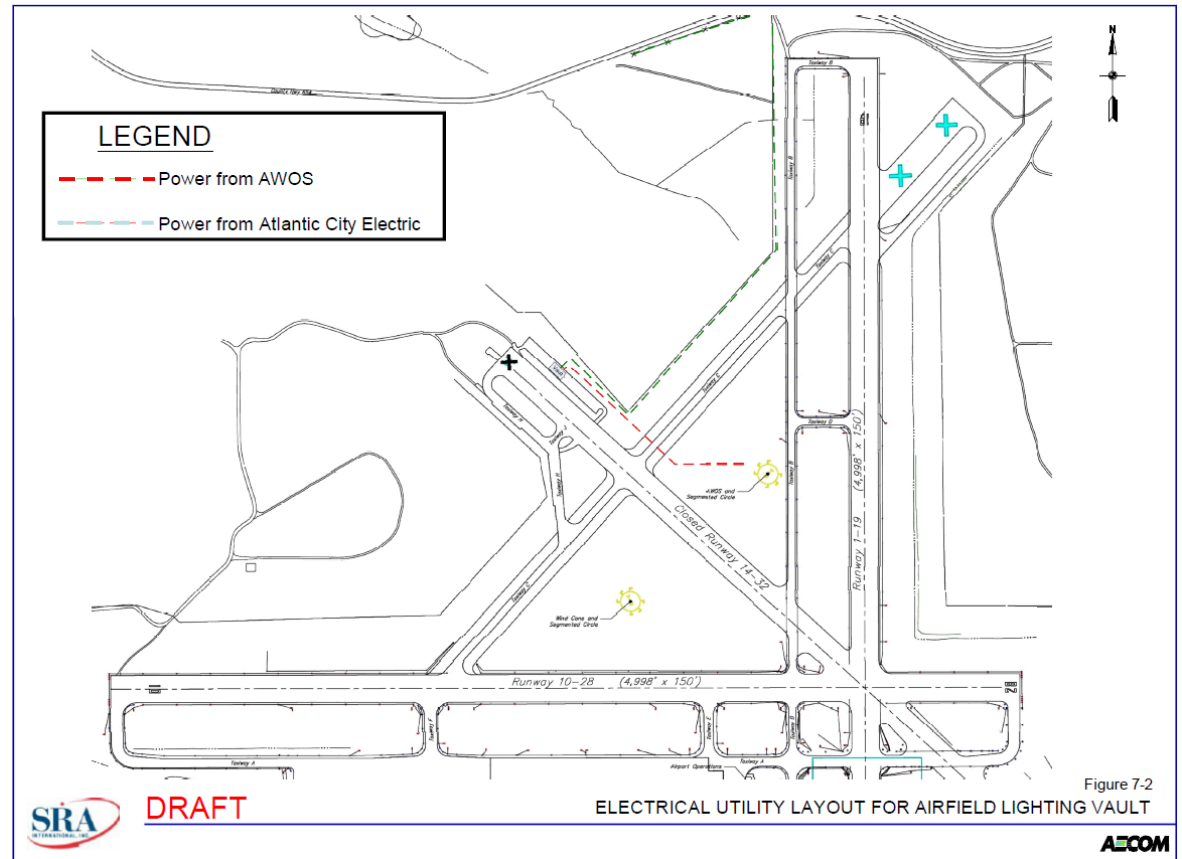
# Design

- **Taxiway C – Extend from Runway 10/28 to Taxiway B**
  - 50' wide full strength
  - 50' shoulders



# Design

- **Electrical Vault**
  - Install building to accommodate regulators, support equipment, staging area, and storage.
- **Power to be provided Atlantic City Electric**
  - Brought in from overhead lines along Fulling Mill Rd



# APCH Hold/RSA Signage & Marking



# APCH Hold/RSA Signage & Marking:

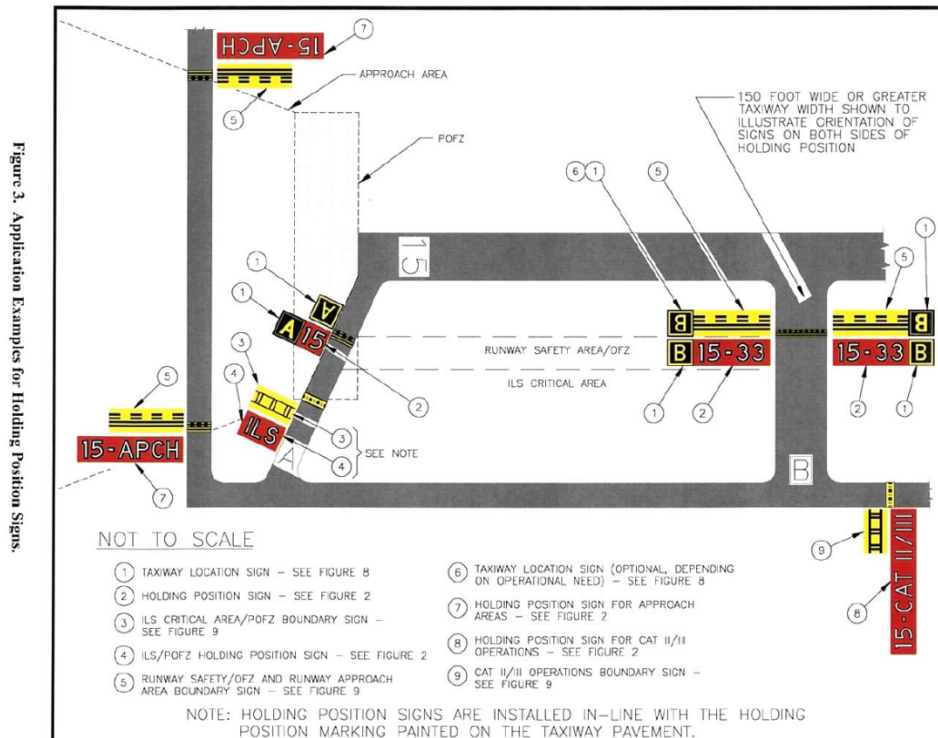
There are inconsistencies in implementing approach hold signs, marking and procedures among the nation's airports, causing confusion among ATC, pilots, airport operators and cert inspectors.

**Project Objective:** Install and test new signs and markings as recommended in the Safety Risk Management Document (SRMD) from the Approach Hold Workgroup to protect other critical surfaces like RSA, approach, departure, etc.



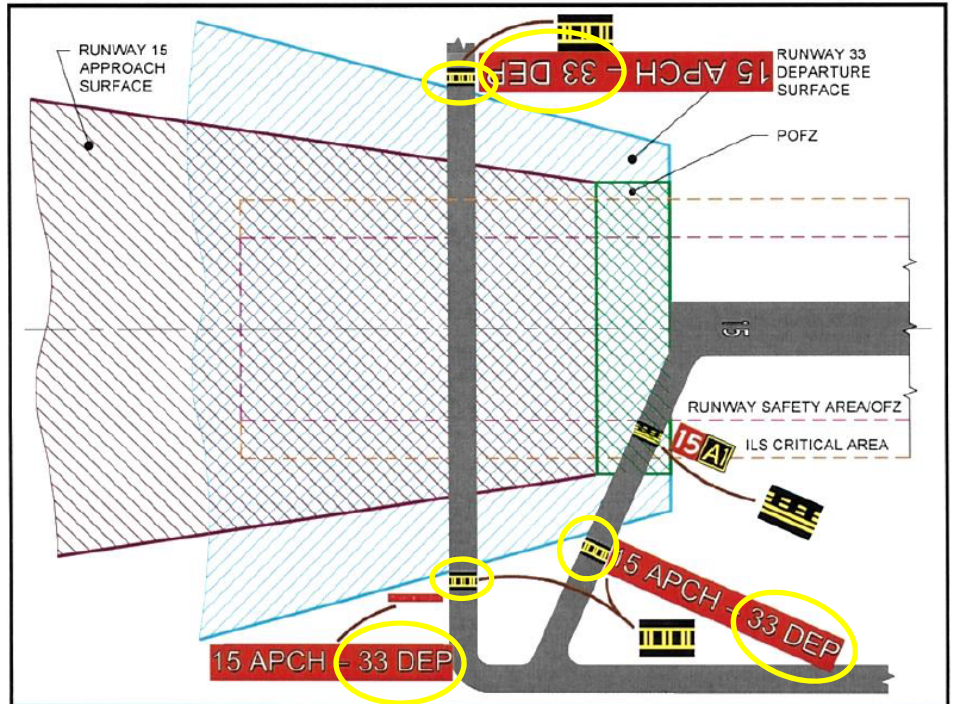


# Current



# Proposed

FIGURE 2-2. UPDATES TO AC 150/5340-18F, FIGURE 3



# Tested Configurations



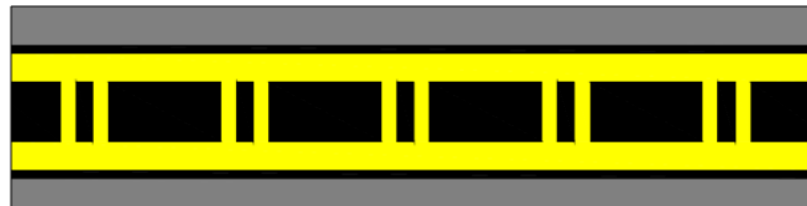
Stacking Display of Approach Hold Sign



Horizontal Display of Approach Hold Sign with Smaller Legend Height



Horizontal Display of Approach Hold Sign on Size 3 Sign with Size 3 Legend Height

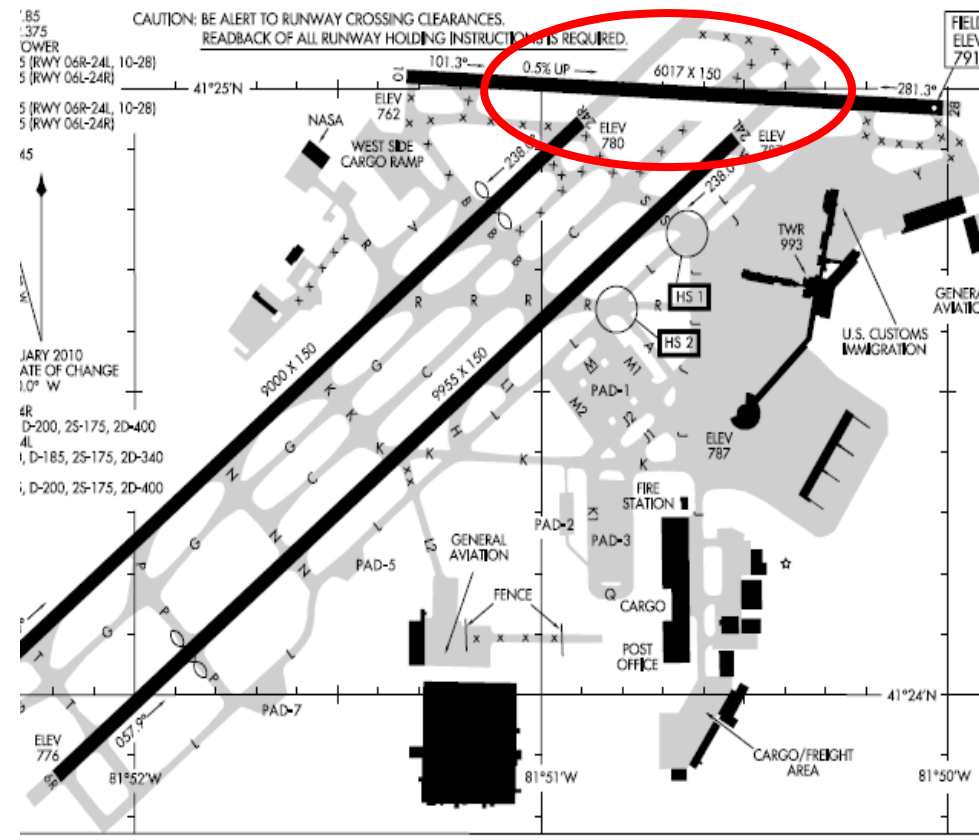


ILS/MLS Holding Position Sign Marking

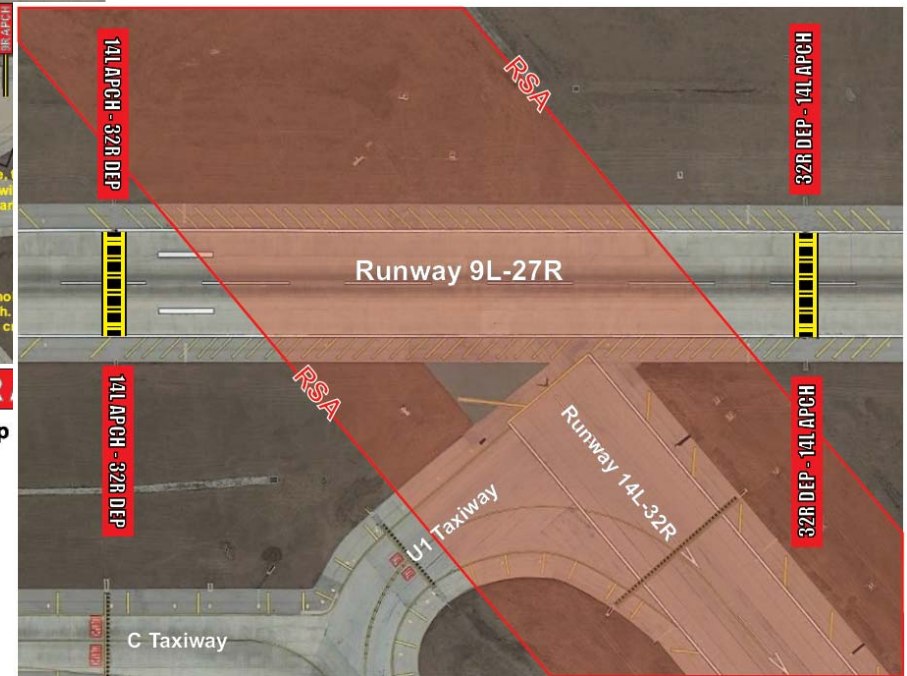
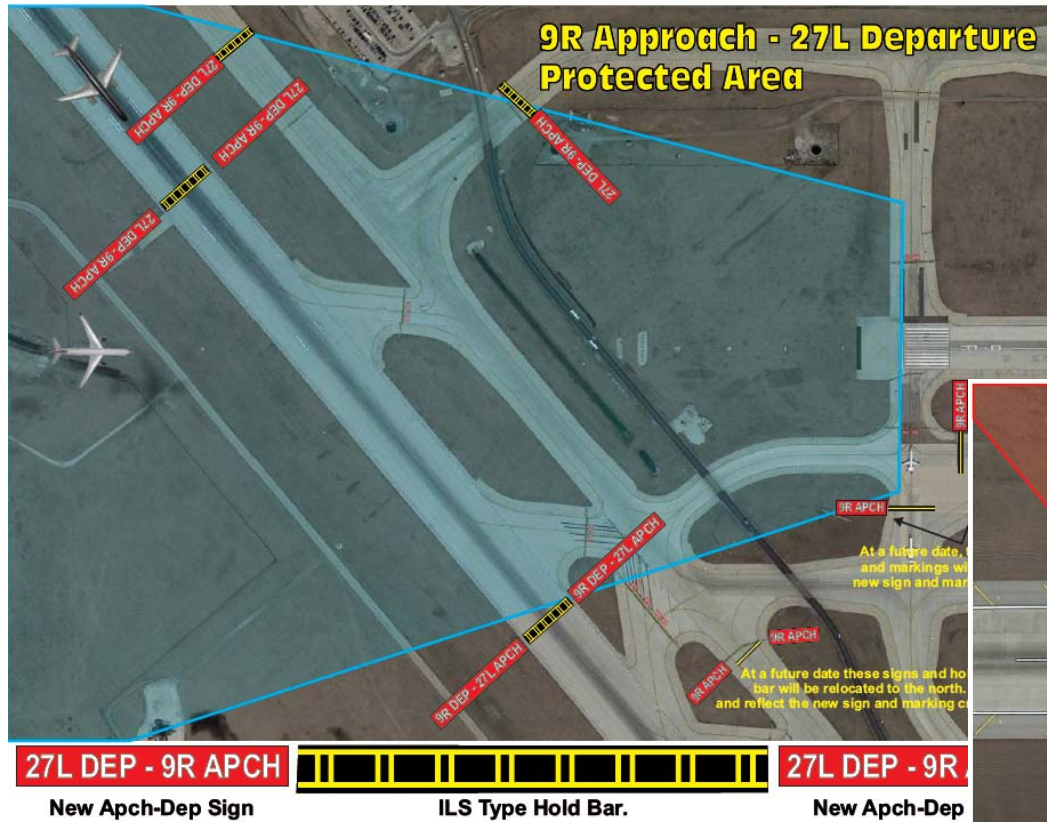


# CLE R&D Testing Location

- 8 signs and 4 markings on runway 10-28 have been changed.



# ORD – R&D Testing Locations



ORD has standard sized font, making the sign much longer than currently allowed in AC



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# Evaluation Approach

- **Surveying Pilots, ATC and Vehicle Drivers**
- **Comparing using new signage/markings:**
  - On runways protecting approach/departure surfaces with and without a RSA
  - On taxiways protecting approach/departure surfaces with and without a RSA
- **Findings Expected Summer 2015**



# Questions/Comments?

## **LED End-Of-Life Study**

### **Airport Linear Source Visual Aid**

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## **Electrical Infrastructure Research**

### **Constant Current Regulator Research Projects**

### **Safety Orange Visual Aids for Airport Construction**

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## **RSA/Approach Hold Signs and Markings**

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