# Visual Guidance/ Runway Incursion

# Research & Development

## Update

**IESALC Fall Conference October 20, 2014**
**Orlando, Florida**

# Current Research Projects

## Lighting

- Linear Light Sources
- Airfield Lighting Infrastructure
- Constant Current Regulator Loading

## Signs

- Safety Orange Visual Aids for Airport Construction
- EMAS sign/lighting
- Approach Hold/Runway Safety Area signs/markings

## Markings

- Structured Methyl Methacrylate (MMA) Marking

# Airport Linear Source Visual Aid






# Experiments

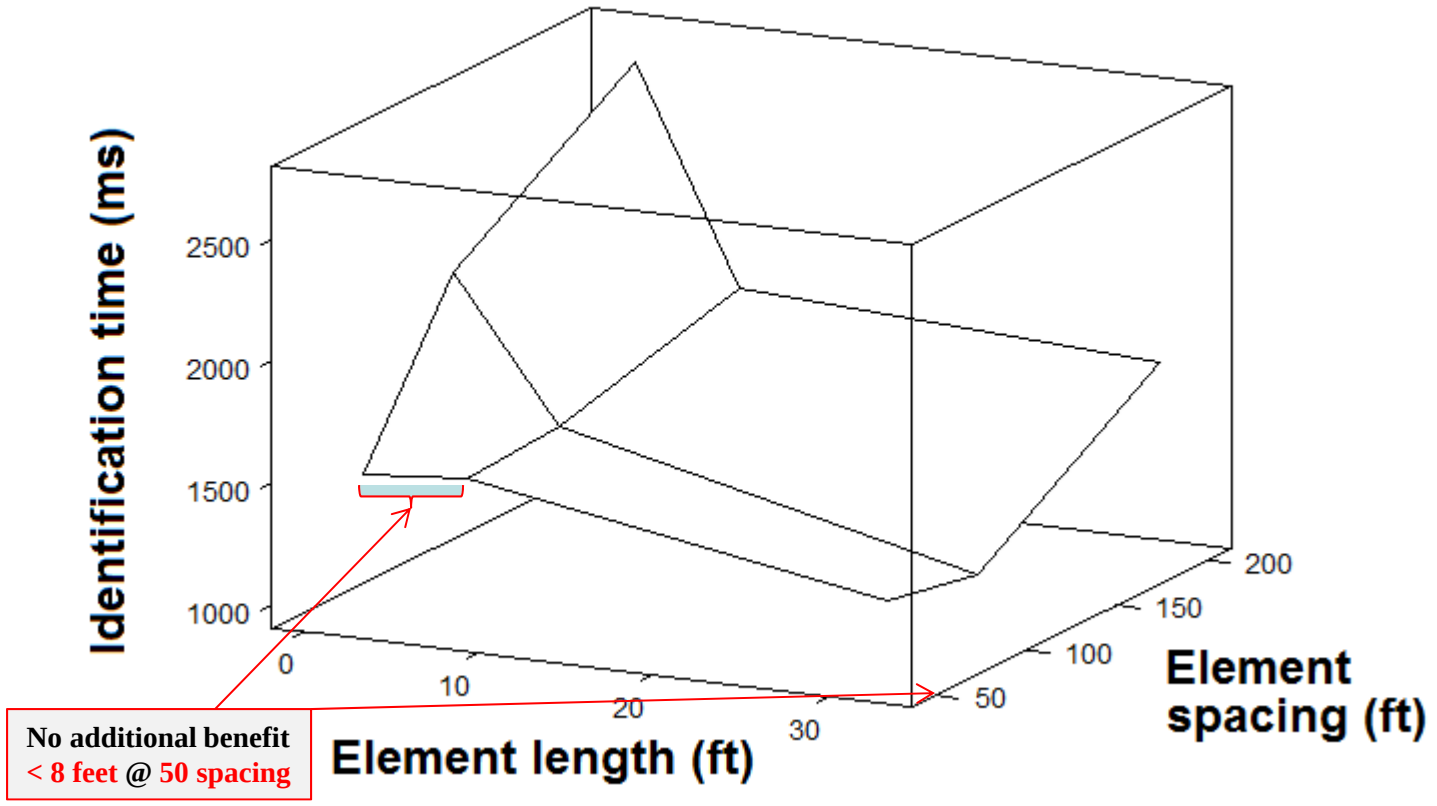
- Linear element spacing: 50, 100, 200 ft
- Linear element length: 2, 8, 32 ft
- Configurations: 90º (low-speed taxiway exit) and 30º (high-speed taxiway exit), left and right

- Experiment 1 - No Noise

30° Right

# Experiment 1 Results – No Noise

**Accuracy was always > 90%**



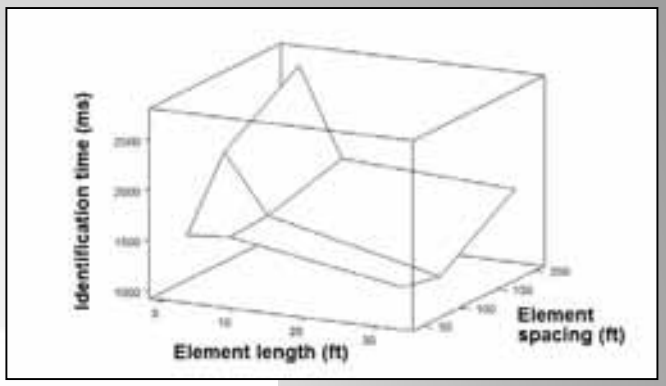
# Experiments 2 - 4

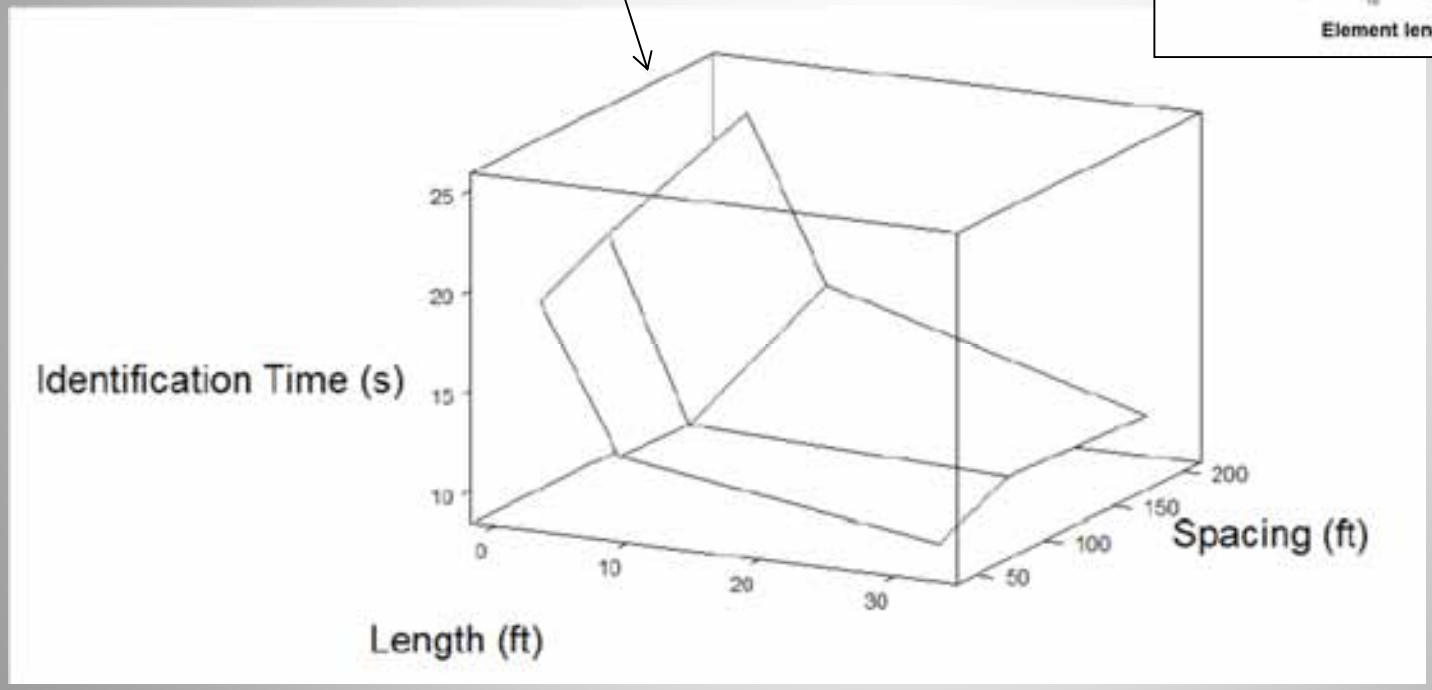
- Linear element spacing: 50, 100, 200 ft
- Linear element length: 2, 8, 32 ft
- Configurations: 90º (low-speed taxiway exit) and 30º (high-speed taxiway exit), left and right

- Experiment 2 - Visual Noise
- Experiment 3 - Dynamic
- Experiment 4 - Lower Intensity

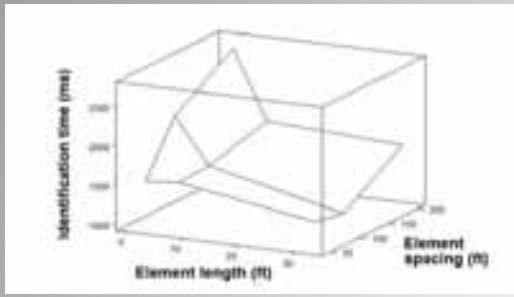
# Experiment 2 to 4 Results

**Same correlation between**
**Length and Spacing to Reaction**
**Time in all experiments**



# Developed Predictive Response Time Equation




$$RT\ (ms) = 286 - 607 \log L + 989 \log S$$

**Combinations of delineation element length and spacing to achieve the same relative response times expected from 2-ft-long delineation elements spaced at 50 ft and 100 ft.**

| | | | | | |
|---|---|---|---|---|---|
| Base Case 1 | Element length | 2 ft | **6.2 ft** | **12.0 ft** | **19.2 ft** |
| | Element spacing | 50 ft | 100 ft | 150 ft | 200 ft |
| | Relative response time | 1784 ms | 1784 ms | 1784 ms | 1784 ms |
| Base Case 2 | Element length | | 2 ft | **3.9 ft** | **6.2 ft** |
| | Element spacing | | 100 ft | 150 ft | 200 ft |
| | Relative response time | | 2081 ms | 2081 ms | 2081 ms |

# Validation Study

- Validation study was conducted using the 9 linear segments created with blue and green LED sources.
- For the experiment, prototype linear light source segments in 2-ft, 4-ft, and 8-ft lengths were used at a 25-ft and 100-ft spacing.
- The experiment was conducted in a large and enclosed space where the ambient illumination could be turned off.
- The results were consistent with the laboratory experiments using computer displayed images.

# Validation Study

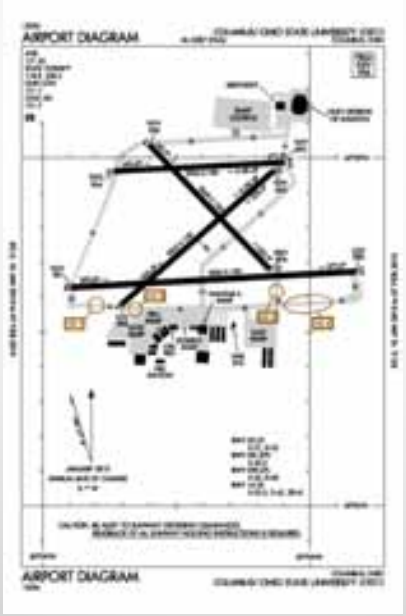
View of one of the test conditions as presented to observers that participated in the validation field experiment.

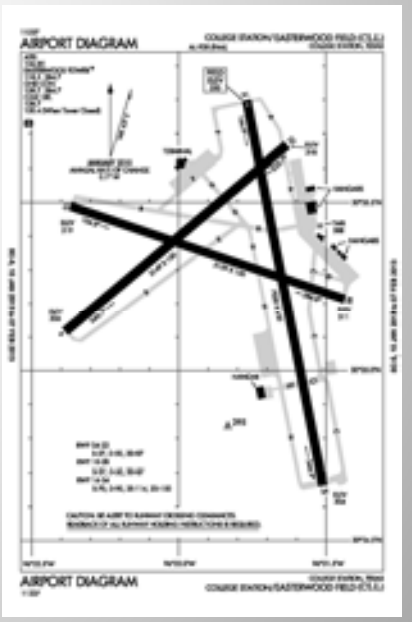
# PHASE THREE

- **Task 1: Conduct a simulation evaluation. (4 months)**
  - **Utilizing the FAA Technical Center's Simulation facility.**

# 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.**
  - **Three of the six core members also own and operate their own airports (Purdue, Ohio State, Texas A&M).**

# 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** |
| **Phase 3** | **06/30/15** |
| **Final Report to Sponsor** | **09/30/15** |

# Electrical Infrastructure Research

# 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.
- LEDs must convert the supplied AC current to a DC current of lower amplitude at the array.

# Electrical Infrastructure Research 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)**

# 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

- Investigate reports of overloaded CCRs relating to a predominance of constant Volt-Amperes (VA) sign
- Investigate if restrictive maximum loading at lower steps for CCRs is specific for a particular CCR technology
- Determine any relationship between lower step loading and the use of Light Emitting Diode (LED) fixtures
- Determine if the lighting system power factor has an adverse effect upon the CCR
- Investigate the impact on power factor and input power when CCRs are under loaded.

# 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

# Schedule

| Event/Deliverable | Tentative Completion Dates |
|---|---|
| Airport Circuit Investigation/Testing | April 4, 2014 |
| FAATC Post Investigation/Testing | July 31, 2014 |
| Analysis/Draft Report | August 29, 2014 |
| Final Report/Recommendations | November 15, 2014 |

# Safety Orange Visual Aids during Airport Construction

# Safety Orange Visual Aids during Airport Construction

**Project Objective:**

**To produce measures to reduce the number of runway incursions and accidents that might be caused due to construction.**

**FAA is working with Air Traffic Organization Airport Construction Advisory Council (ACAC) on this project**

# Visual Aids and Markings used during Construction

## Current Visual Aids

# Scope of Work

- Collect data from existing construction sites
- Develop alternative sign and portable/reflective visual aids
- Simulation
- Field Installation and Evaluation – PVD, ISP, SFB, PDX, & ORD

# Field Installations at PDX

# Findings

- "CONSTRUCTION AHEAD" sign - 109 respondents
  - 87% sign was conspicuous.
  - 88% sign was comprehensible at an adequate distance.
  - 90% sign adequately notified them of the existing construction.
- "CONSTRUCTION ON RAMP" sign - 51 respondents
  - 92% sign was conspicuous.
  - 88% sign was comprehensible at an adequate distance.
  - 94% sign adequately notified them of the existing construction.
- Currently conducting additional research on TORA sign

# Enhanced Visual Aids for EMAS

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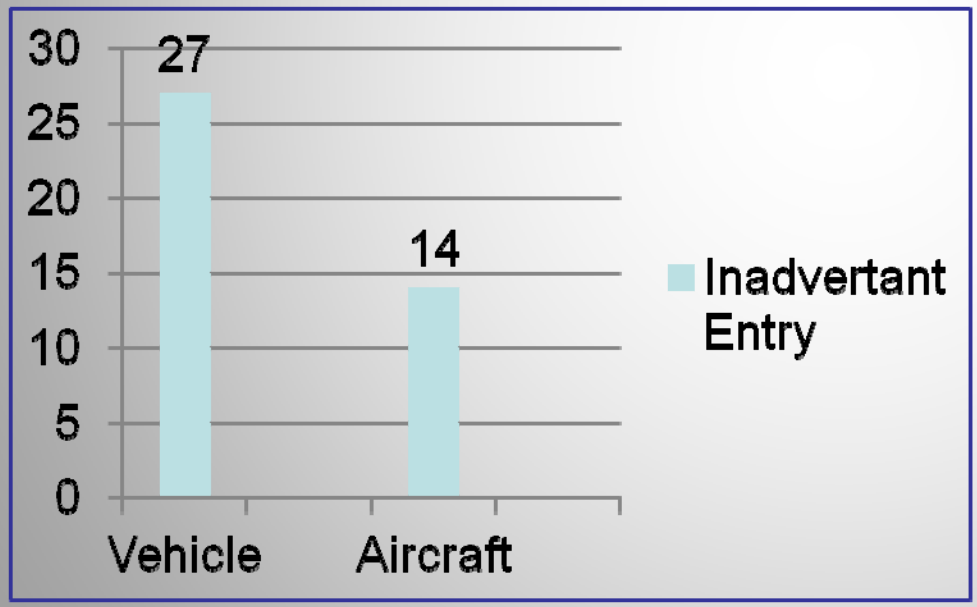
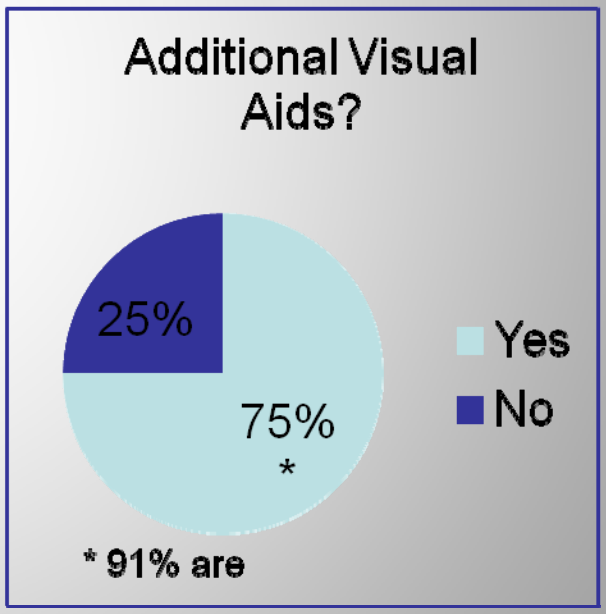
**Project Objective:** **Determine if additional EMAS visual aids are required for pilot awareness**

**Determine if additional EMAS visual aids are required for preventing inadvertent vehicle and aircraft entry**

# Enhanced Visual Aids for EMAS

- Surveyed 42 airports with 63 EMAS beds
  - Incidents
  - Existing markers in place
- Surveyed 399 pilots
- Input from SMEs (EMAS Manufacturer, Airport Certification Inspectors)



# Current EMAS Markings/Signage




# Scope of Work

- Simulations
- Field Evaluations
- Field Installations

# Enhanced Visual Aids for EMAS

- **Recommendations**
  - ✈ **Red, retroreflective markers, 18” or 24” in height, spaced 7.5’ apart around the sides and rear of EMAS.**
  - ✈ **Yellow, retroreflective markers, 18” or 24” in height, spaced 7.5’ apart along the front of EMAS.**
  - ✈ **Additional research for signage – currently ongoing**

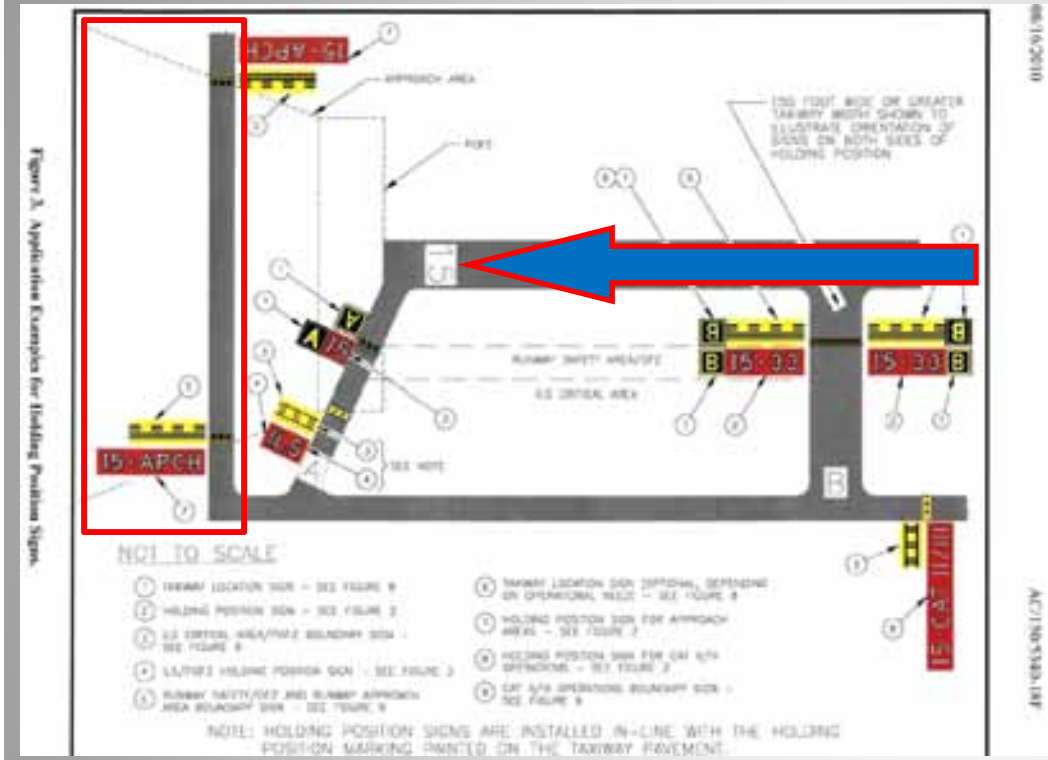
# APCH Hold/RSA Signage & Marking

# 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 Configuration




## The Problems:

Using  with 15-APCH can result in pilot confusion.

*"Do I have to hold short?"*

Pilots expect  to be near the runway entrance. Results in confusion when it's a long distance from the runway.

*"Why am I holding short so far from the runway?"*

Having only one runway designation on the sign, 15-APCH causes confusion when the APCH hold is being used for protecting DEP traffic.

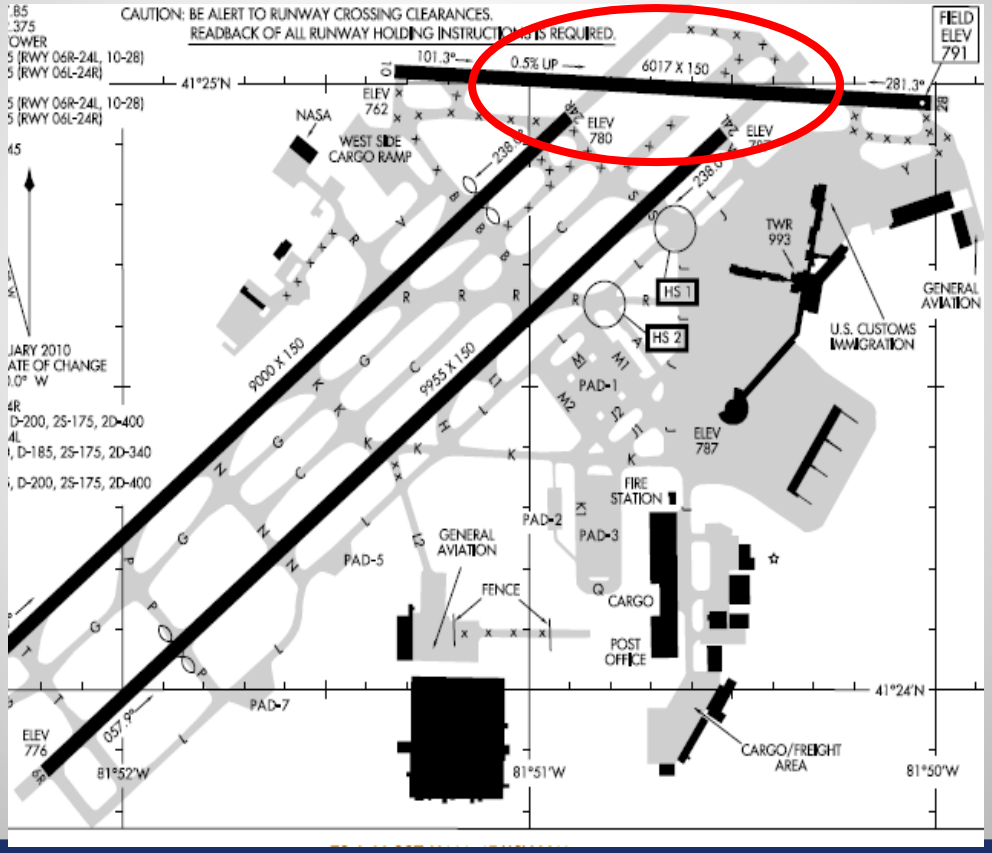
*"I don't need to hold short since RWY 15 isn't being used?"*

Requiring ATC Clearances to pass a holding marking when runway not active will increase ATC workload.

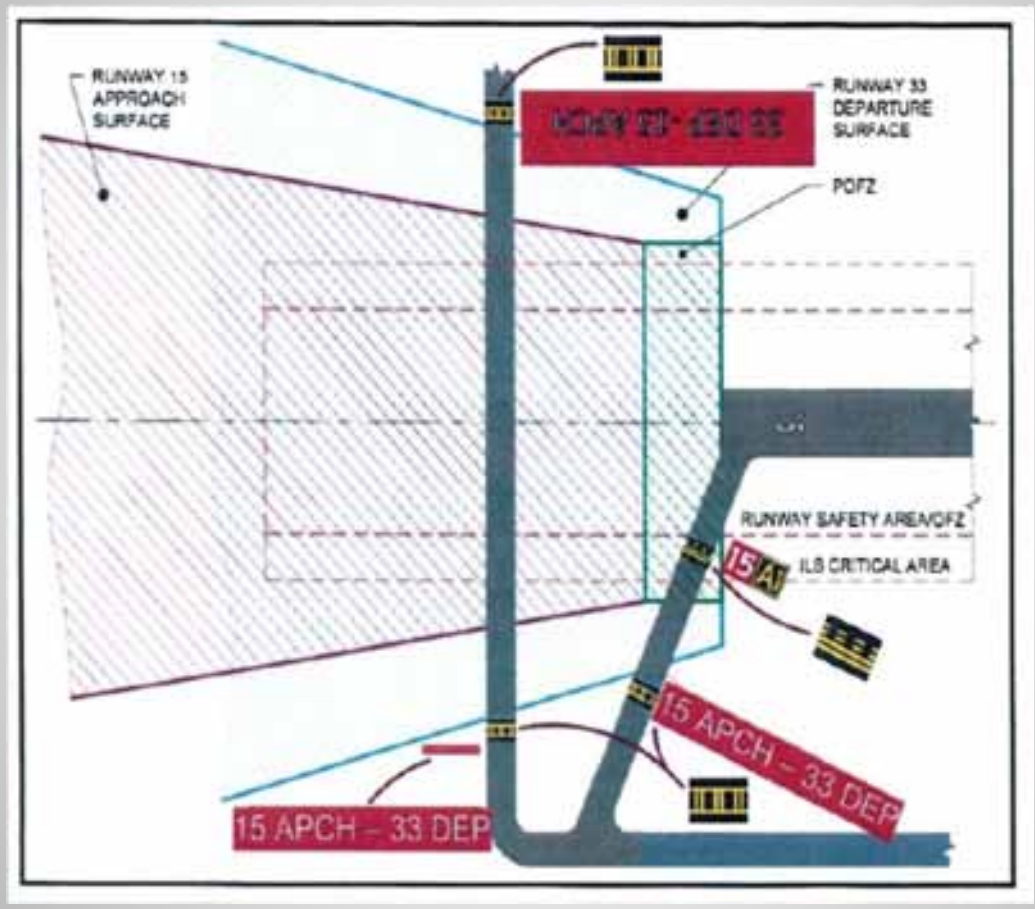
No standard marking/signage for RSAs that intersect runways

# CLE R&D Testing Location

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



# Proposed Configuration

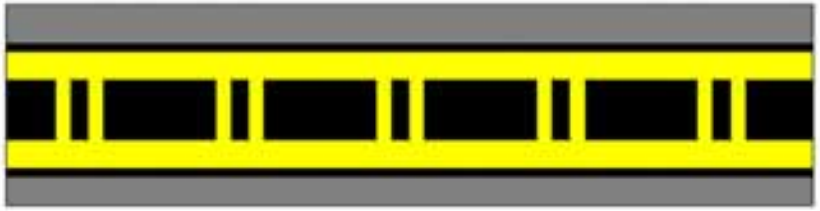


# Tested Configurations


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 - Signage Prior to R&D Testing

- **The current signs protecting the approach/departure surfaces for runways 24L/R and 6L/R (shown below) will be modified for this evaluation**

# CLE- New Signs/Markings with R&D Testing


(Not to scale)

CLE has reduced font on standard length (4-mod) sign

# New Phraseology - Examples

If an aircraft is landing:

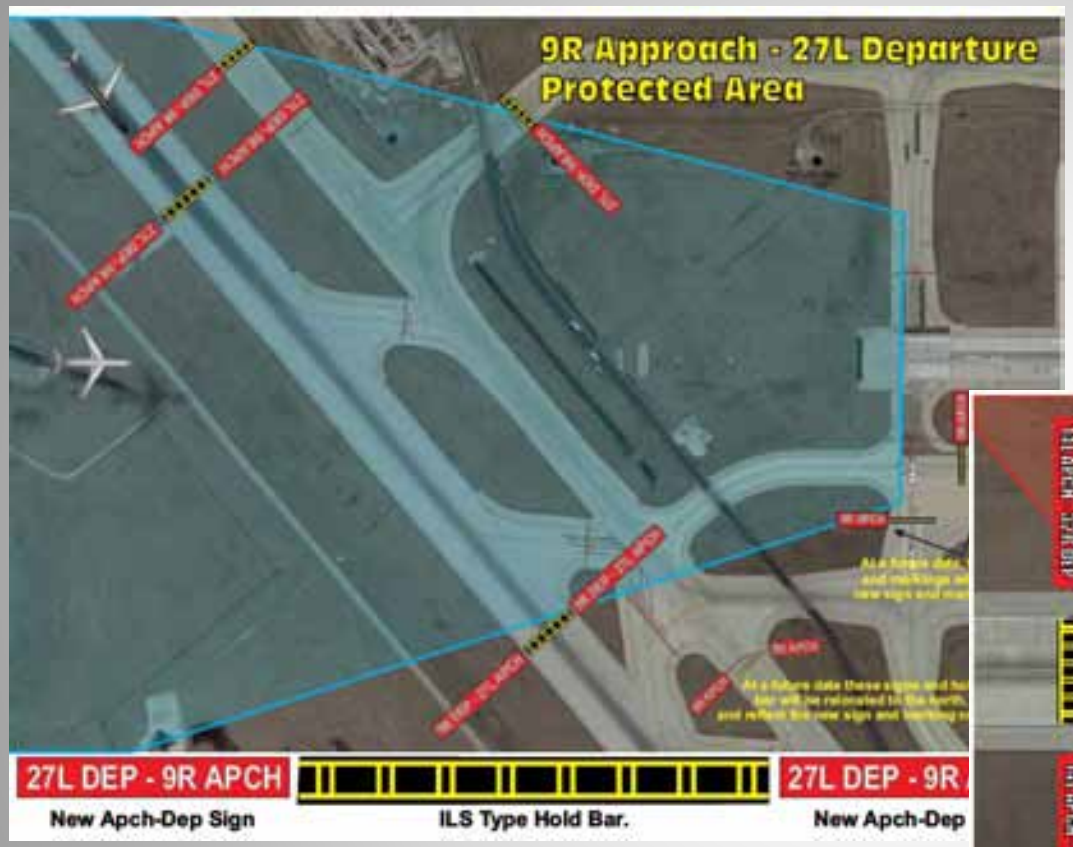
"Hold Short Runway 24L Approach."

or

If an aircraft is departing:

"Hold Short Runway 6R Departure."

# ORD – R&D Testing Locations





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

# Evaluation Approach

- **Surveying Pilots, ATC and Vehicle Drives**
- **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
- **Preliminary Results:**
  - Confirmed using mandatory hold for APCH sign causes confusion among pilots/drivers
  - Ladder-style marking may not be best for protecting RSAs on intersection runways.
- **Findings Expected Summer 2015**

# Structured Methyl Methacrylate (MMA) Marking


12


12
13
14
15

# Questions/Comments?

**Linear Light Sources**
**Electrical Infrastructure Research**

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**Constant Current Regulator Loading**
**Safety Orange Visual Aids for Airport Construction**

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**Enhanced Visual Aids for EMAS**
**RSA/Approach Hold Signs and Markings**

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**Crash-Test Performance of Frangible Connections**

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