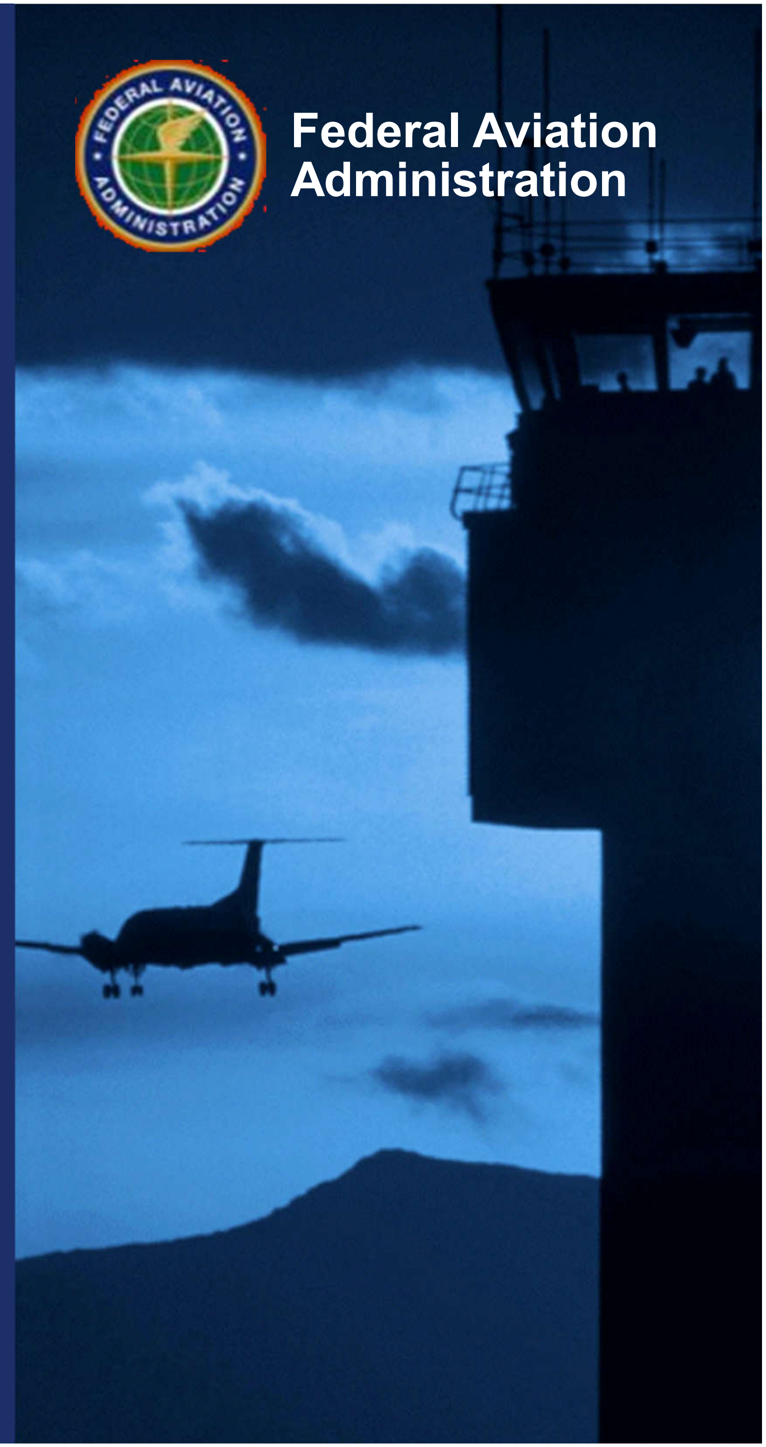
AIRPORT TECHNOLOGY R&D VISUAL GUIDANCE RESEARCH

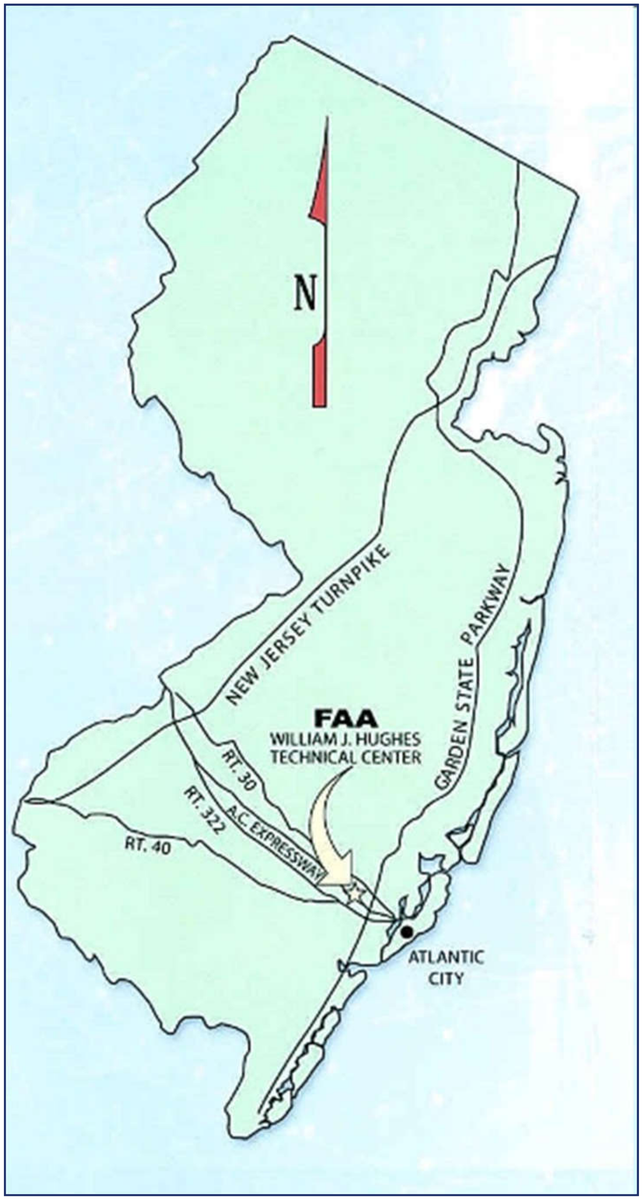


Presented to: IES ALC Government Contacts Mtg.

By: Joseph Breen, P.E.

Date: October 3, 2018

FAA William J. Hughes Technical Center at ACY



3,000 Federal/Contractor Employees
1,000 non-FAA Tenants
Over 5,000 Acres

FAA Technical Center at ACY

Who are we?

FAA Airport Technology R&D Branch (ANG-E26)

Airport Safety R&D Section

Airport Pavement R&D Section

Mission: Conduct the necessary research and development required to enhance the safety of operations at our nation's airports and to ensure the adequacy of engineering specifications and standards in all areas of the airport systems and, where necessary, develop data to support new standards.

http://www.airporttech.tc.faa.gov/

FAA
Airport Technology R&D Branch

Program Sponsors:

- **FAA Office of Airport Safety and Standards**
  - Airport Engineering Division (AAS-100)
  - Airport Safety and Operations Division (AAS-300)
- **FAA Office of Planning and Programming**
  - Planning and Environmental Division (APP-400)
- **FAA Lighting Systems Office**
- **Oher FAA Lines of Business as needed – Air Traffic Organization & Flight Standards**

Research is funded under the Airport Improvement Program (AIP)

FAA Airport Safety Research Program Areas

Visual Guidance
- Lights, Signs, Paint/Markings, LEDs, IR, Other Visual Cues, Incursion Reduction, Electrical Infrastructure, Photometrics, Obstruction Lighting, Lighting Innovations, Heliports, NAS Vis Aides, Special Projects

Airport Planning & Design
- RIM, Trapezoidal Grooves, Rwy/Taxiway Design, Capacity, Spaceports, Design Stds

Runway Surface Operations & Technology
- Rwy Friction, CFMEs, Winter Ops, TALPA RCAM, Deicing, EMAS, FOD Detection

UAS (Drone) Integration at Airports
- Airport Applications and Detection

Wildlife Mitigation
- Avian Surveillance/Deterrence (Radar), Wildlife Strike Data Collection/Analysis, Wildlife Management

Aircraft Braking Friction
- Aircraft braking performance on contaminated surfaces

Airport Safety & Surveillance Sensors
- Low cost surveillance, AeroMACS, Sensor Technology

Airport Noise & Environmental

ARFF
- ARFF Vehicles, Firefighting Systems, FF Agents, Tools, Composites, Technology, New Large Aircraft (NLA) Strategies & Tactics, Agent Methodology, NFPA/ICAO Stds

Over 150 Individual Projects

Airport Technology R&D Visual Guidance Research

- Technical Evaluation of Electrical Infrastructure for Light Emitting Diodes.
- Evaluation of Solar Lighting Systems on Airports
- FAA Research Taxiway
- Infrared Requirements for Developing an LED HIRL with Infrared Emitter
- Aircraft Detection Lighting Systems (ADLS)
- VGSI and Approach Lighting Baffle Efforts
- Obstruction Light with IR Testing

Evaluation of New Electrical Infrastructure for LED Lighting

Electrical Infrastructure Research Team (EIRT) Background

- **The EIRT developed a three phase strategy:**
  - Phase 1: Investigate candidate LED infrastructure to test, characterize, and evaluate/identify optimal characteristics of the systems.
  - Phase 2: Optimize on results from Phase 1, and resolve and test prototypes to answer remaining questions.
  - Phase 3: Draft Performance Requirements for selected system architecture(s) to Incorporate into an Engineering Brief

EIRT Background (cont.)

- **Phase I of the research included the testing and evaluation of six different LED architectures.**
- **Based on the Phase I results, the EIRT test team classified the architectures into two main categories with common characteristics:**

Circuit Architectures

- **“Vault-centric”: Light intensity is controlled by a power source for the entire circuit. The fixtures are passive and directly track circuit current.**

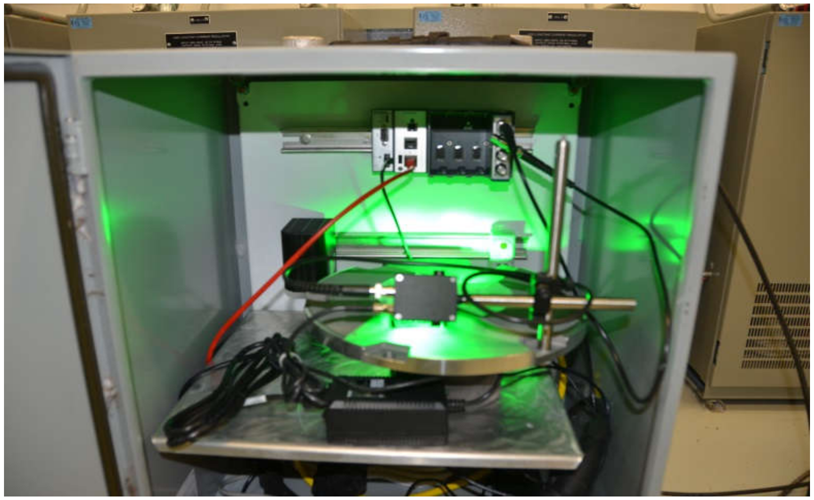
- **“Fixture-centric”: Each fixture controls its intensity level after digital intensity information is conveyed to it.**

Vault-Centric Infrastructure Testing

- **146 LED light fixtures were installed along FAA Research Taxiway including taxiway centerline and runway edge light fixtures.**
- **All light fixtures were connected in series.**

Vault-Centric Infrastructure Testing (Cont.)

- Three additional fixtures instrumented with photometric sensors to measure relative light output and current probes to measure fixture current.
- Each instrumented fixture was mounted in a separate mobile cabinet that can be connected at various points in the circuit, depending on requirements of specific tests.



Fixture-Centric Infrastructure Testing

- **136 LED fixtures, supplied by three manufacturers, installed on 3 respective sign pads along FAA Research Taxiway.**
- **Light fixtures mounted on each sign pad are connected in series consistent with current airport circuits.**

Fixture-Centric Infrastructure Testing (Cont.)

- **Three additional light fixtures instrumented with current probes to measure fixture current and count occurrences of successful intensity commands.**
- **Each instrumented light fixture was mounted in an orange electrical panel located adjacent to one of the groups of fixtures.**

Phase 2 - Cape May Testing

- **Testing at Cape May was conducted at the FAA's Research Taxiway.**
- **Each architecture was tested under a series of stress conditions to assess the operational margins and overall suitability of the each architecture for the airport environment.**

Fixture-Centric LED Architecture

- **The Fixture-Centric Architecture Has Proven Through Testing at Cape May to be Sufficiently Developed for Deployment in Airport Environments.**
- **The FAA will be Working with Industry to define and standardize the Core Technical Elements of the Fixture-Centric Architecture.**
- **These Core Technical Elements will be Incorporated into an Engineering Brief.**
- **These elements include the following:**
  - Message encoding protocol
  - Fixture behavior
  - Power source behavior

EIRT Schedule

- Phase 2 Test Report for Testing of Fixture-Centric and Vault-Centric Architectures at Cape May Completed September 28, 2018.
- Phase 2 Test Report will be Published by December 2018.
- Phase 3 Performance Requirements for Fixture-Centric Architecture to be Completed by January, 2019.
- Engineering Brief to be Published By End of FY2019.

Evaluation of Solar Lighting Systems on Airports

- **Challenges to Photovoltaic (Solar) Powered Lighting Systems have included Limited Geographical Operational Areas, Panel Efficiency Limitations for Recharge, Capacity of Batteries, and Lighting Brightness.**
- **Developments Relating to LED Lighting Systems and Solar Technology Have Made Solar Powered Lighting Systems a Practical Alternative in Certain Airfield Environments.**
- **Solar Technology Advancements Present an Opportunity for Airports to Produce On-Site Electricity and Reduce Long Term Energy Costs.**

Evaluation of Solar Lighting Systems on Airports

- **Literature Review of Solar Power Lighting Technologies and Applications at Airports.**
  - **Applications to Include But Not Limited to Runway Edge, Runway Threshold/End, Obstruction, Taxiway Edge, and Elevated Runway Guard Lighting.**

- **Conduct Evaluations to Determine the Suitability and Reliability of Solar Power Lighting Systems for General Aviation (GA) Airports Across Various Airfield Lighting Applications.**

Evaluation of Solar Lighting Systems on Airports

- **GA Airports, Lighting Systems, and Geographic Locations to be Selected to Allow for Assessment of Varied System Installations and Environmental Conditions.**

- **Evaluations to be Conducted over a Sufficient Period of Time to Allow for Assessment of Seasonal Solar Irradiance and Related Battery Charging Capabilities.**

Evaluation of Solar Lighting Systems on Airports

- Literature Review to be Completed in December, 2018.
- Selection of GA Airports for Evaluation to Begin in Early 2019.
- Design, Installation, and Testing of Photovoltaic (PV) Lighting Systems Scheduled to Begin in Spring, 2019.

FAA Research Taxiway:
Cape May County Airport (WWD)

FAA Research Taxiway

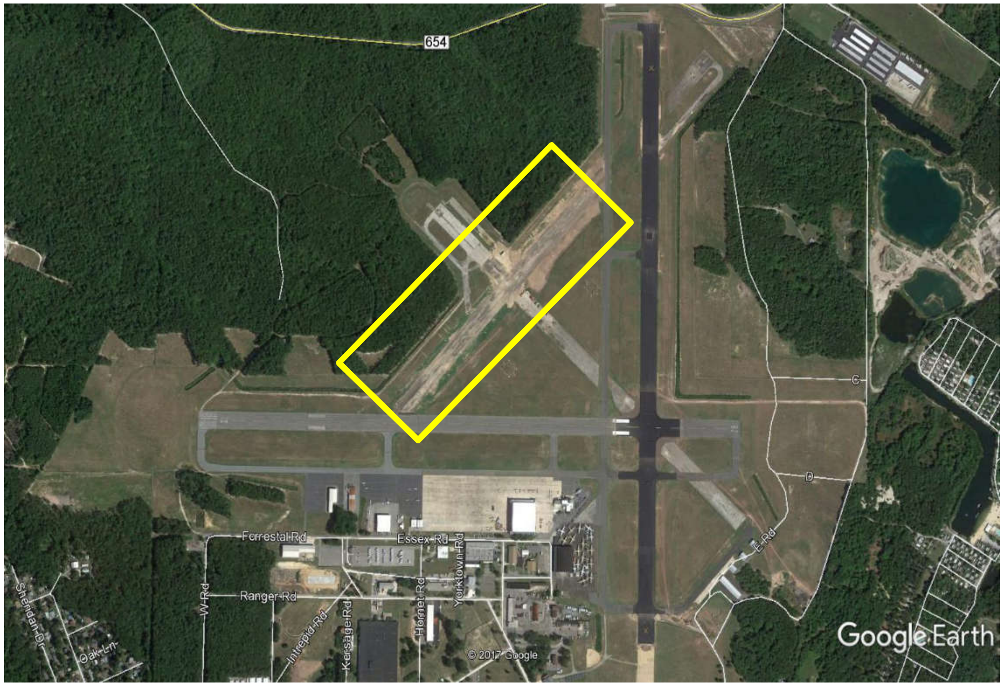
- **Single site to design, test, evaluate, monitor, and report on the performance of state-of-the-art airport safety and pavement technologies.**

- **Memorandum of Agreement (MOA) between FAA and Delaware River and Bay Authority (DRBA).**
  - November 15, 2010 through September 30, 2030.
  - Grants the FAA the "right to construct, operate and maintain Research Infrastructure" at Cape May County Airport (WWD) in Erma, NJ

- **Taxiway opened in April 2017**

FAA Research Taxiway

- **Taxiway C**
  - Length – 3250 ft.
  - Width – 50 ft.
  - Pavement Width – 150 ft.
- **Full array of Taxiway <u>and</u> Runway Lights**
- **State-of-the-art Lighting Vault**
- **Six Pavement Test Strips**



FAA Research Taxiway

FAA Research Taxiway Lighting Vault

FAA Research Taxiway: Research Plans

- **Safety Projects**
  - Obstruction lights with IR testing
  - Electrical infrastructure testing – EIRT Test Team
  - Runway surface friction
  - UAS integration at airports
  - Future lighting research efforts

- **Pavement Projects**
  - Nondestructive Testing
  - Field and Laboratory Characterization of Pavement Materials
  - Long Term Aging Study of Various Paving Mixes

Infrared Requirements for Developing an LED High Intensity Runway Edge Light (HIRL) with Infrared (IR) Emitter

LED HIRL with IR: Objectives

<u>Conduct research to develop an efficient and effective LED HIRL fixture with an IR signature compatible with Enhanced Flight Vision Systems (EFVS).</u>

- Develop IR requirement based on legacy L-862 incandescent fixture measurement..
- Perform IR measurements (IR power output in watts per steradian, and IR beam pattern) on the legacy tungsten-halogen FAA L-862 (HIRL), which current EFVS system's utilizes, to determine current IR output
- Develop prototype fixtures.

LED HIRL with IR: Results

<u>Company 1:</u>

Selected an incandescent source for the IR output consisting of two bulbs, rated at a nominal input 20W that can supply a minimum average radiant intensity matching that of a legacy L-862 fixture in the range of 1450-1850 nm.

LED HIRL with IR: Results

<u>**Company 2:**</u>

Selected an IR igniter for the IR output rated at a nominal input of 45W that can supply a minimum average radiant intensity matching that of a legacy L-862 fixture in the range of 1400-2500 nm.

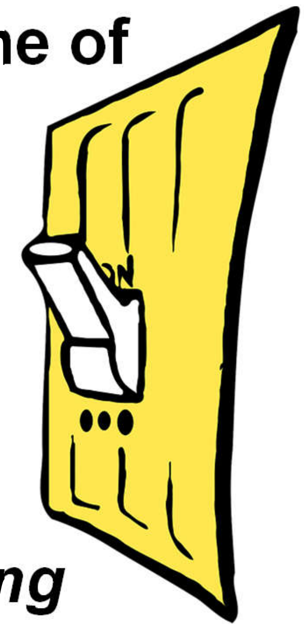
LED HIRL: Next Steps

- Company 1: Delivered one prototype at end of the contract
- Company 2: Delivered six prototypes at end of the contract
- Fixtures are undergoing independent laboratory testing
- The Office of Flight Standards will validate that the prototype fixtures have the necessary IR output for use with EFVS

Aircraft Detection Lighting Systems (ADLS)

ADLS Overview

New technologies are available that use radar to detect aircraft approaching a specified volume of airspace and turn on the obstruction lighting



- Lights stay OFF most of the time
- Lights only come ON when an aircraft is detected

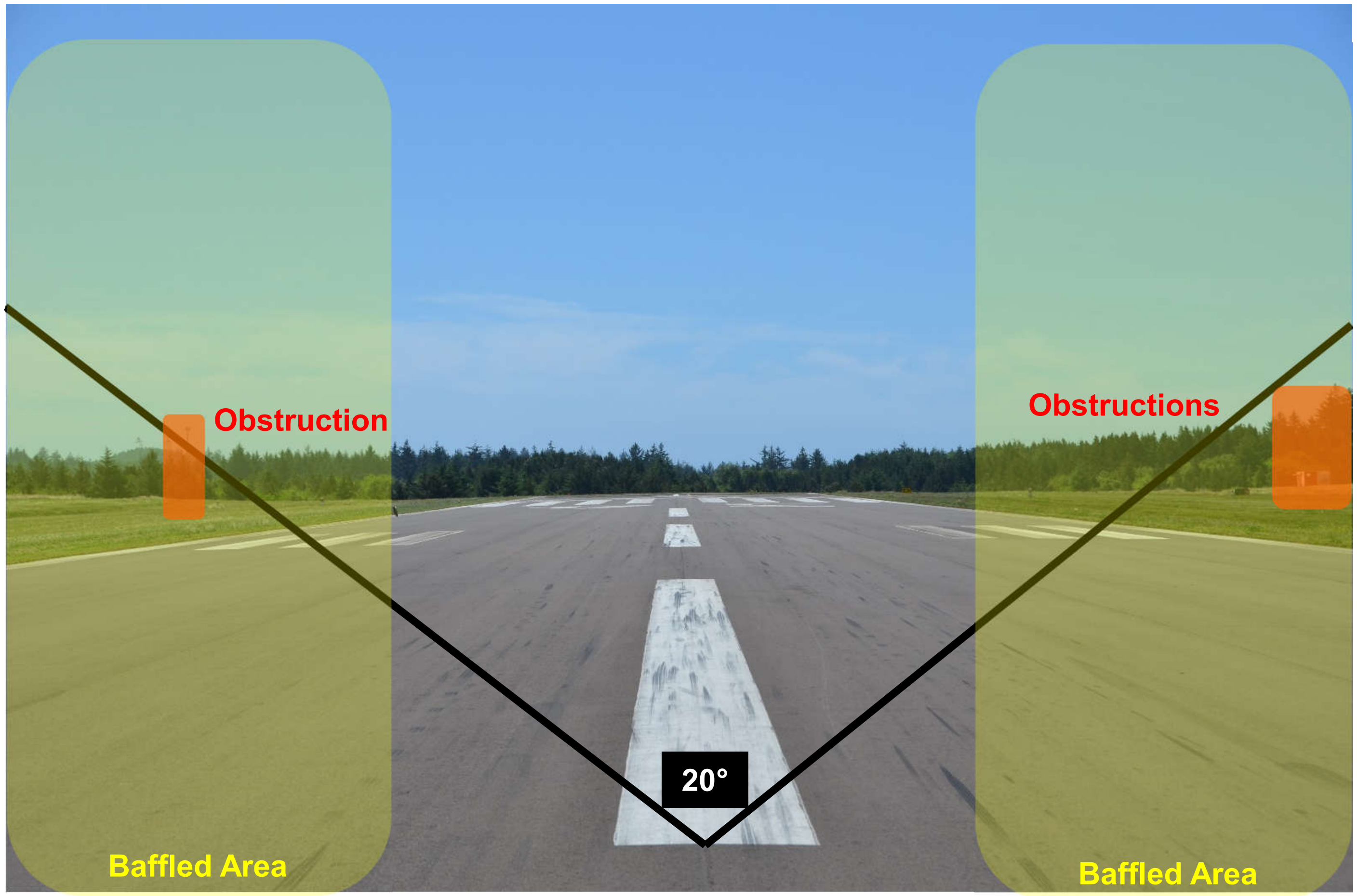
AC 70/7460-1L, *Obstruction Marking and Lighting with Change 1*, has new ADLS Chapter 14 – which provides details on system specifications

ADLS Radar

Visual Glide Slope Indicators (VGSI) and Approach Lighting Baffle Efforts

Precision Approach Path Indicator (PAPI)

PAPI Baffle Installation

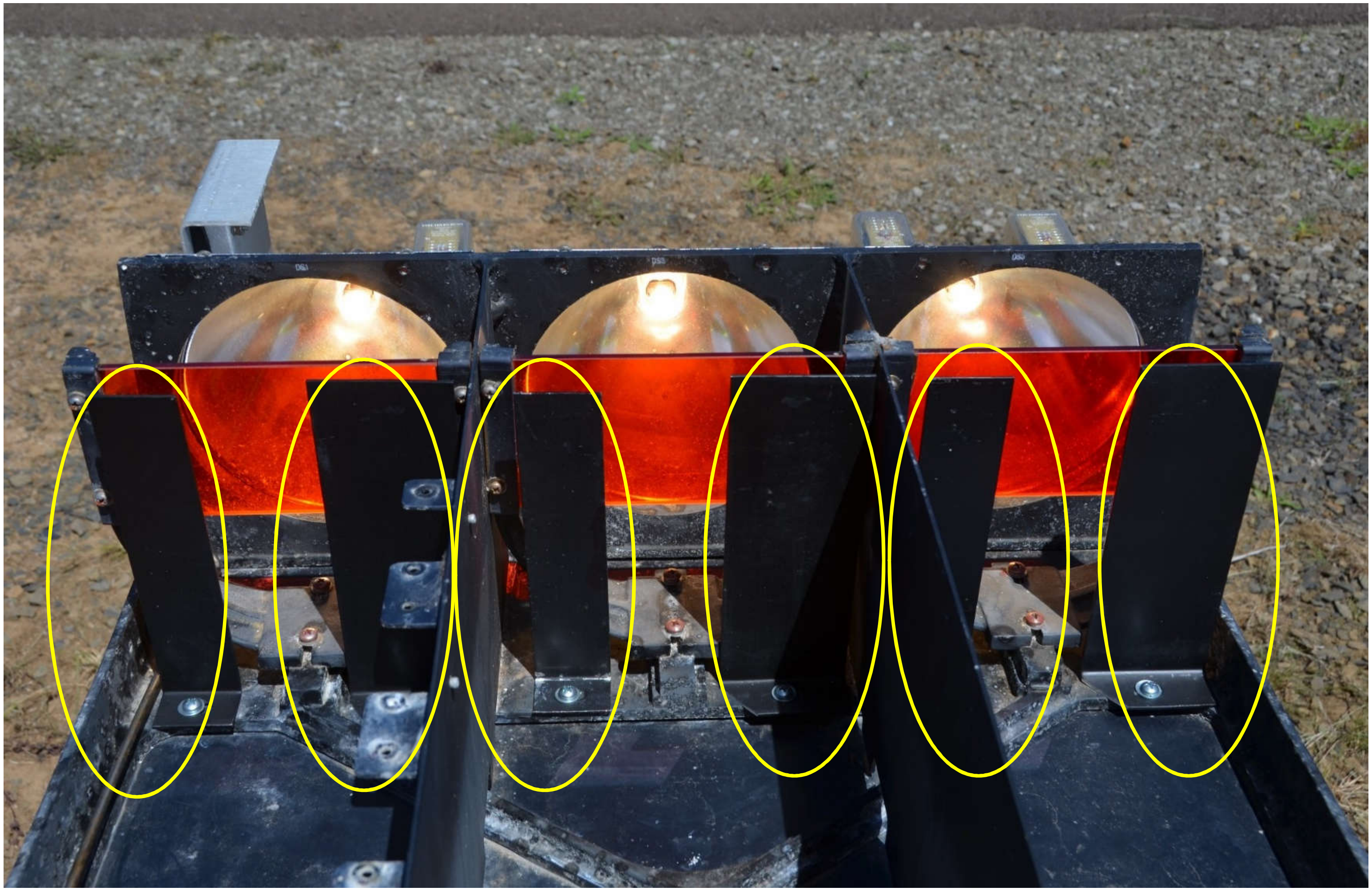


NOT TO SCALE

Newport Municipal Airport (ONP) Runway 34 PAPI Baffle

Newport Municipal Airport (ONP) Runway 34 PAPI Baffle

Baffles installed Inside Runway 34 PAPI at ONP



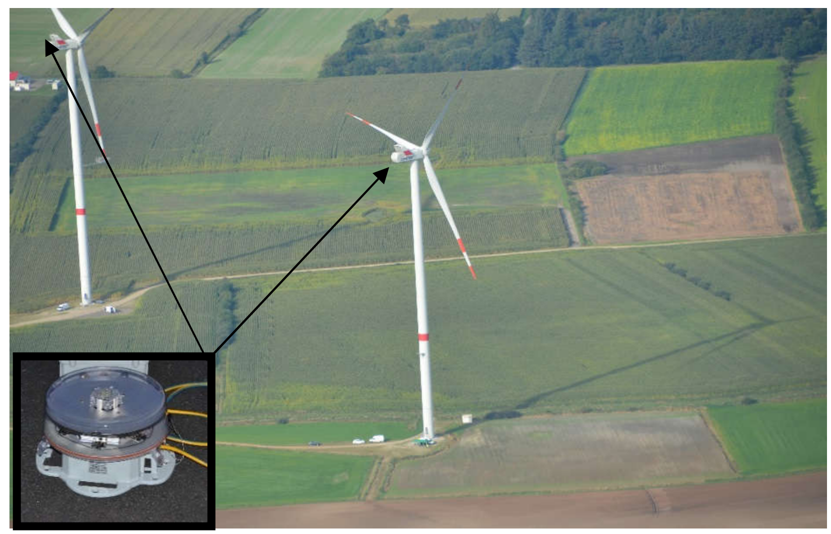
L-810(L) and L-864(L) Obstruction Light with IR Testing

Obstruction Light with IR Testing: Objectives

Conduct research to develop performance specifications for infrared (IR) emitters to be incorporated with L-810(L) and L-864(L) obstruction light fixtures.

- Wavelength
- Vertical beam width
- Minimum intensity

L-810



L-864

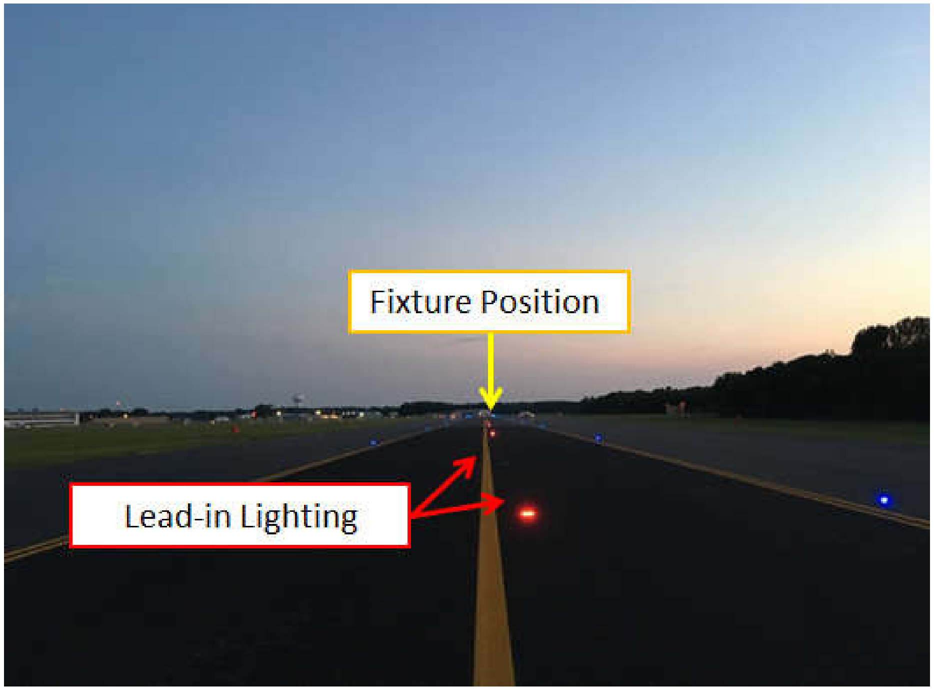
Obstruction Light with IR Testing: Project Overview

- **Literature review**
- **Market survey**
- **Acquired samples of L-810(L) and L-864(L) fixtures, with IR and traditional incandescent fixtures**
- **IR laboratory testing**
- **Flight testing conducted on the FAA Research Taxiway at Cape May County Airport (WWD)**
- **Final report**

Obstruction Light with IR Flight Testing Set-up

L-810 Fixtures

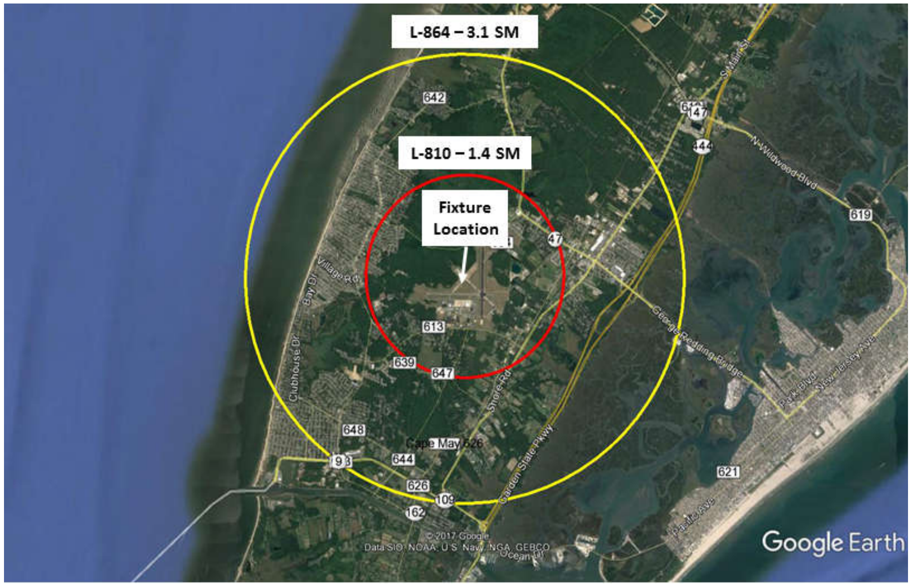
L-864 Fixtures



Obstruction Light with IR Flight Profiles

Flight Profile 1

Flight Profile 2



Questions?