AIRPORT TECHNOLOGY R&D VISUAL GUIDANCE RESEARCH

Presented to: IES ALC Government Contacts Mtg.

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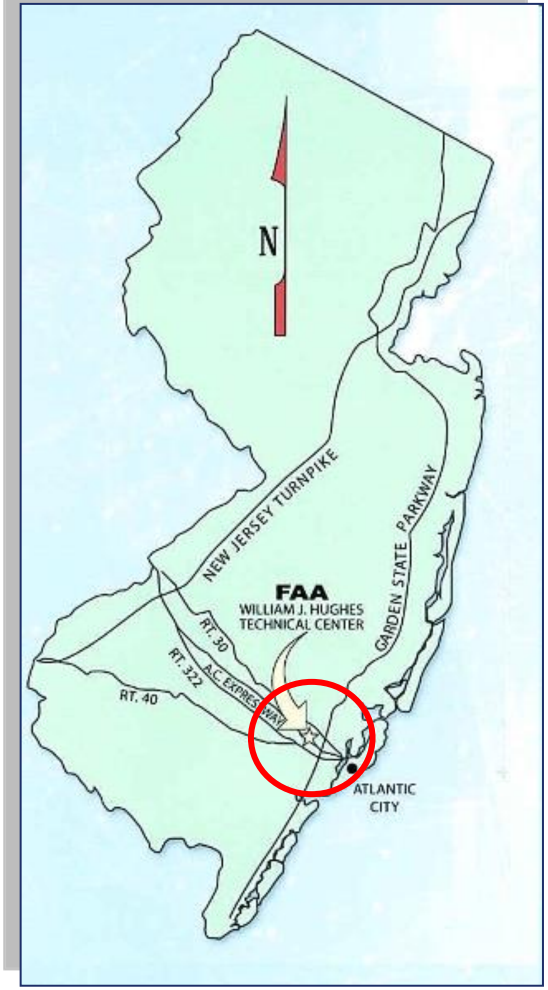
FAA William J. Hughes Technical Center at ACY

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



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, 110 and 120)
  - Airport Safety and Operations Division (AAS-300)
- **FAA Office of Planning and Programming**
  - Planning and Environmental Division (APP-400)
- **FAA Lighting Systems Office**
- **Other FAA Lines of Business as needed i.e. Air Traffic Organization & Flight Standards**

Research is funded under the Airport Improvement Program (AIP)

FAA Airport Safety

Research Program Areas (RPA)s

Over 150 Individual Projects

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, Runway/Taxiway Design, Capacity, Spaceports, Design Standards

Runway Surface Safety Technology

- Runway Friction, CFMEs, Winter Ops, TALPA RCAM, Deicing, EMAS, FOD Detection

Unmanned Aircraft Systems (UAS) 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

Aircraft Rescue and Fire Fighting (ARFF)

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

RPA S5 – Visual Guidance

Sub RPAs

Airport Lighting and Infrastructure

- Light fixtures
- Frangibility connections
- Airport electrical infrastructure
- Light Emitting Diode (LED) integration
- LEDs with infrared (IR) emitters
- Solar powered lighting & infrastructure
- Heliport/Vertiport lighting
- Obstruction Lighting

Lighting Innovations & Special Projects

- New airport lighting concepts
- Special Project – Wrong surface landing research
- FAA Research Taxiway
- FAA Photometric Laboratory
- Cooperative Agreement – Rensselaer Polytechnic Institute's Lighting Research Center

Airport Surface Markings Signs, and Vehicle Operations

- Airport signs
- Surface markings
- Vehicle operations with lighting and marking
- Runway incursion reduction

National Airspace System (NAS) Visual Guidance

- Approach lighting systems (e.g., MALSR)
- Visual NAVAIDS, (e.g., PAPI, VASI)
- VGSI Baffle Installations
- LED lamps with IR emitters (ATO Lighting Systems)
- Atlantic City Int'l Airport, Rwy 4 Experimental MALSR

Airport Technology R&D Visual Guidance Research

- **Parallel Runway Closure Conspicuity**
- **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**
- **PAPI Baffling**
- **In-Pavement Light Fixtures**

Parallel Runway Closure Conspicuity - NTSB

Research how to make a closed runway more conspicuous to pilots when one parallel runway remains in use, and implement a method to more effectively signal a runway closure to pilots during ground and flight ops at night.

- Effectiveness of additional Lighted X on closed runway
    - Multiple locations/setups
- Lighted X varying flash rates
- Lighted X flashing patterns
- Different size or colors of Lighted X
- Other supplemental lighting on airport
- Difference in effectiveness of LED vs Incandescent lighting in Lighted X
- Cost estimate of proposed alternatives
- Develop metrics to determine comparisons relative to safety improvements

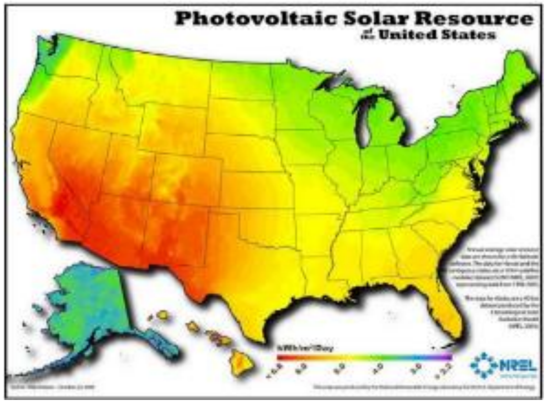
Electrical Infrastructure for LED Lighting (EIRT)

- **Conduct Validation Testing of Draft Fixture-Centric Architecture Performance Requirements to Ensure Full Functionality and Interoperability.**
- **Update and Finalize Performance Requirements Based on Results of Validation Testing.**
- **FAA Office of Airports to Initiate Development of an Engineering Brief for Fixture-Centric Architecture Based on Final Performance Requirements.**

EIRT Tasks/Schedule

- **Validation Testing of Fixture-Centric Architecture conducted at Cape May Airport.**
- **Final Performance Requirements for Fixture-Centric Architecture Completed in December 31, 2019.**
- **Final Report: Evaluation of New Electrical Infrastructure for LED Lighting, dated January, 2020**
- **Final Report: Low Current Airfield Lighting Architecture (LCALA) Performance Requirements, dated May 15, 2020**
- **Engineering Brief for Fixture-Centric Architecture to be Published By End of FY2020.**

Solar Airport Lighting and Infrastructure Testing and Analysis



Evaluate Solar Lighting Systems at Airports in Diverse Geographic Regions Based on Varied Solar Insolation, Ambient Temperature Range, and Snow Fall

- Cape May Airport (WWD) in New Jersey will be the Initial Prototype GA Airport Site for Evaluation with Data Acquisition.
- Solar Powered Lighting System Evaluation Initially Consisting of Laboratory Testing at Intertek and at Rensselaer Polytechnic Institute (RPI) and Field Testing at the Cape May Airport (WWD) in New Jersey.
- Laboratory Testing to Include Photometric and Autonomy Evaluations.
- Field Testing with Data Collection will be Initiated at WWD Monitoring Performance of Solar Panels, Charging Systems, and Batteries
- Multiple Site Surveys to be Conducted at GA Airports in the Other Four Geographic Regions Selecting One GA Airport from each Region for Solar Powered Lighting Evaluation.
- Evaluations to be Conducted over a Sufficient Period of Time to Allow for Assessment of Seasonal Solar Insolation and Related Battery Charging Capabilities.
- Allow for Assessment of Seasonal Solar Insolation, Ambient Temperature, and Related Battery Charging Capabilities.

System Evaluations

- **Evaluations will be Conducted on the Following Airfield Components:**
  - Runway Edge/Threshold Lights
  - Taxiway Edge Lights
  - Obstruction Lights
  - Elevated Runway Guard Lights
  - Wind Cones
  - Airfield Guidance Signs
- **Component Selections will be Based on Compliance with FAA Requirements for Intensity and Chromaticity and will be Obtained from Three Manufacturers**

FAA Research Taxiway

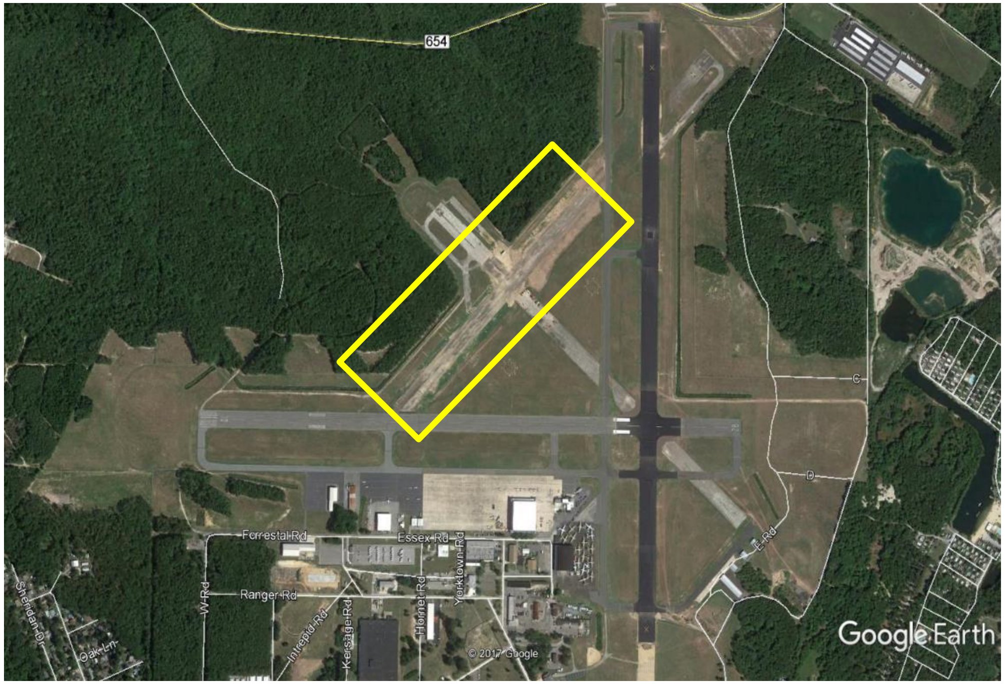
- **Single site to design, test, evaluate, monitor, and report on the performance of state-of-the-art airport safety and pavement technologies.**

- **Memorandum of Agreement (MOA) between FAA and Delaware River and Bay Authority (DRBA).**
  - November 15, 2010 through September 30, 2030.

- **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

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.
- Conduct field evaluations using prototype and standard lights

Field Evaluations

- **Location: An evaluation site was established at Otis AFB in Cape Cod, MA**
- **Objective: Determine if prototype lamps are discernable during operationally significant low visibility conditions at various ranges of interest**

Field Evaluations: Lights

- **Two prototype LED HIRLs with IR**
- **Two standard incandescent HIRLs**


Prototype 1

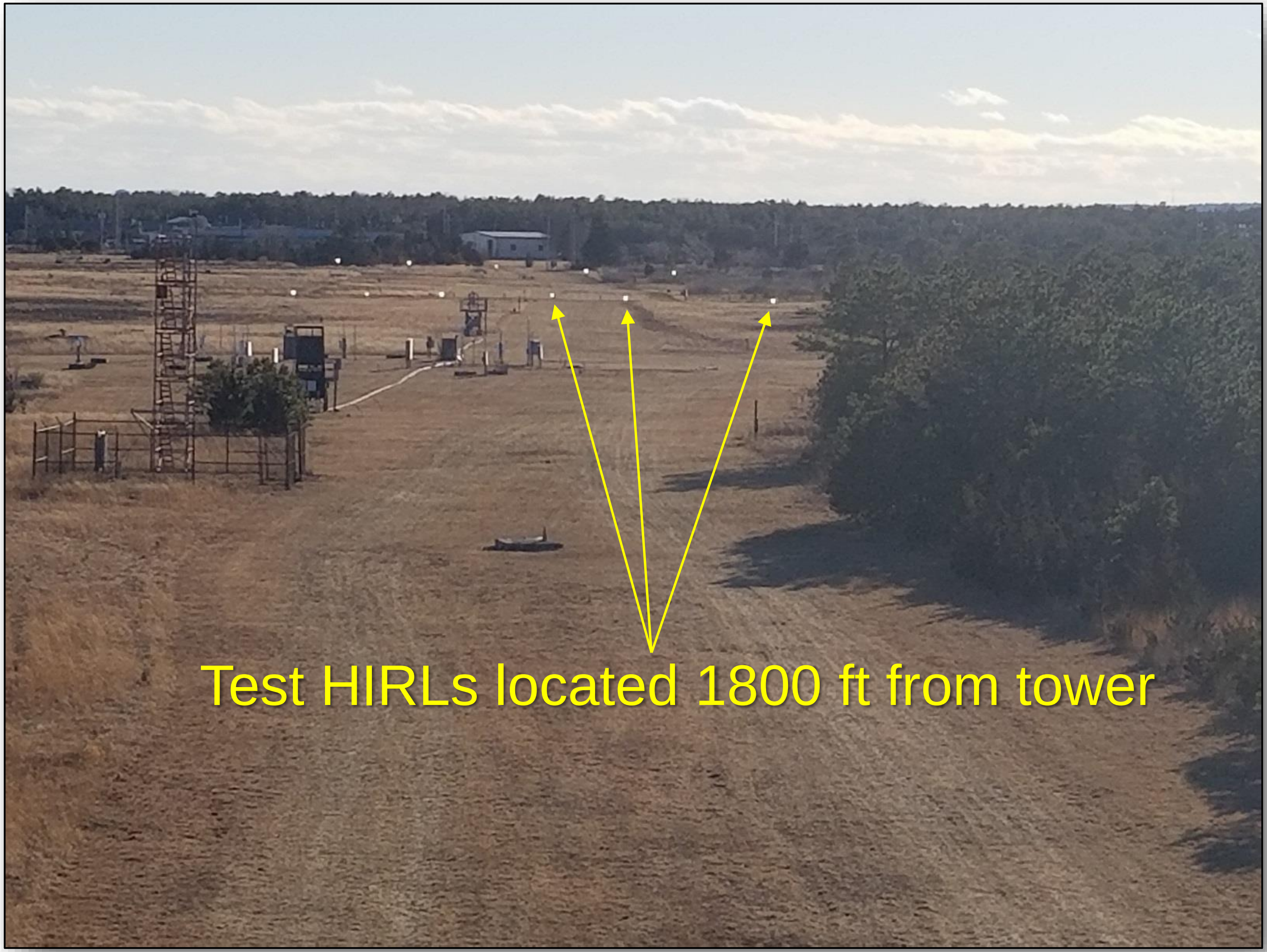

Standard


Prototype 2

Field Evaluations

- A 30 ft. tower was installed to provide the required viewing angle for data collection cameras
- Visible Spectrum Camera
- EFVS Camera

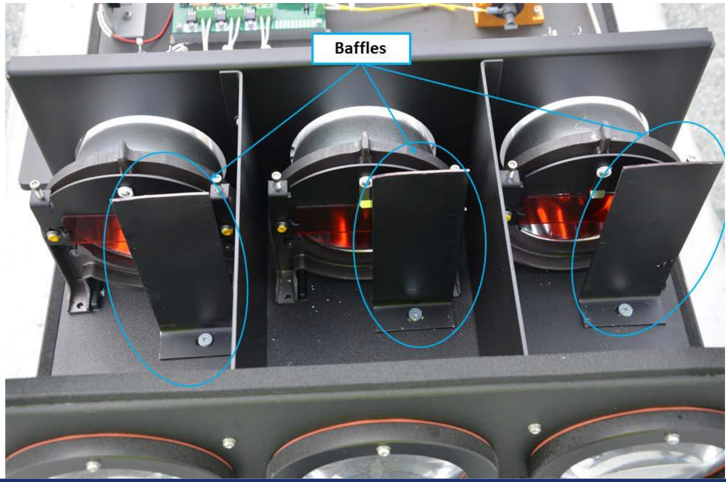
Field Evaluations: Tower View



Precision Approach Path Indicator (PAPI)

What is PAPI "Baffling"

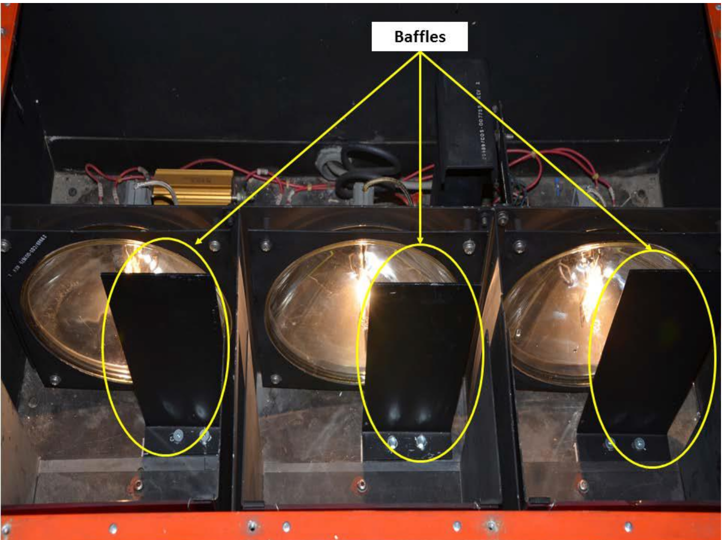
- **Retrofitting the PAPI by adding metal shields called "Baffles" to…**
- **Reduce the PAPI light signal lateral coverage to satisfy FAA Flight Inspection criteria.**
- **So pilots <u>DO NOT</u> see PAPI light signal and potential fly into a obstacle.**
- **FAA R&D +50 airports in 8 years**
- **Why?**

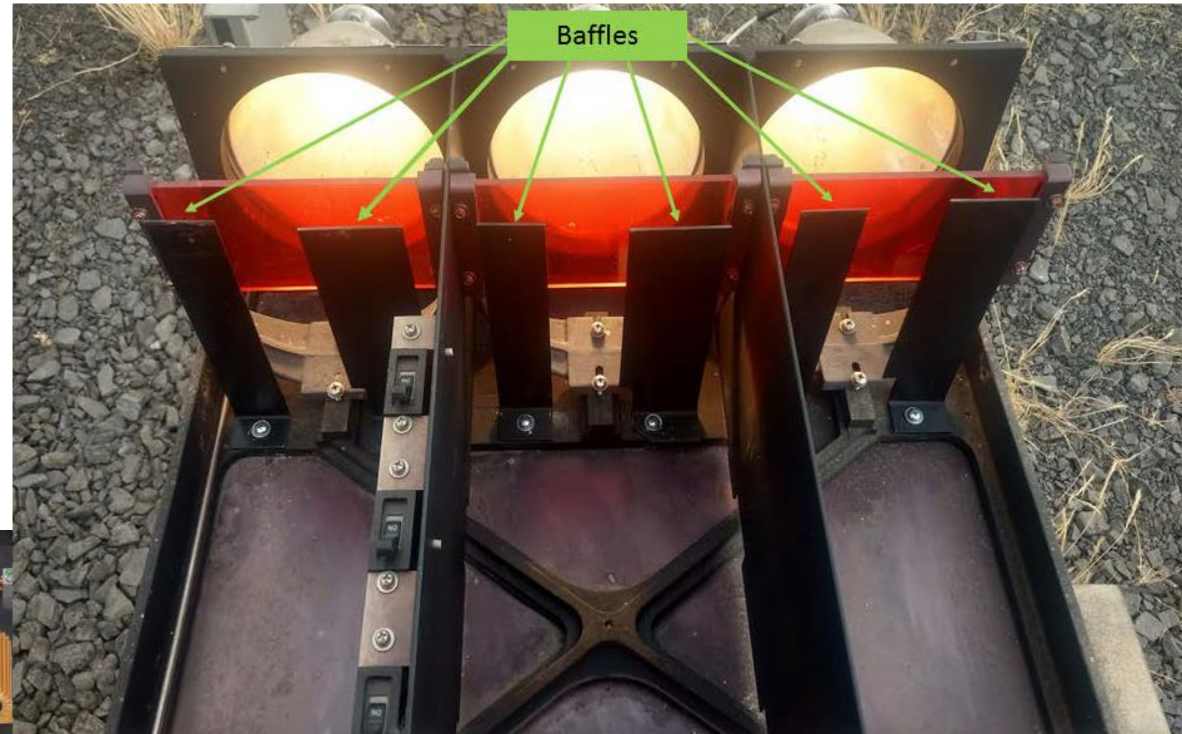


Baffle Effect

Forces the pilot to fly closer to extended runway centerline (away from an obstacle) to see the PAPI light signal

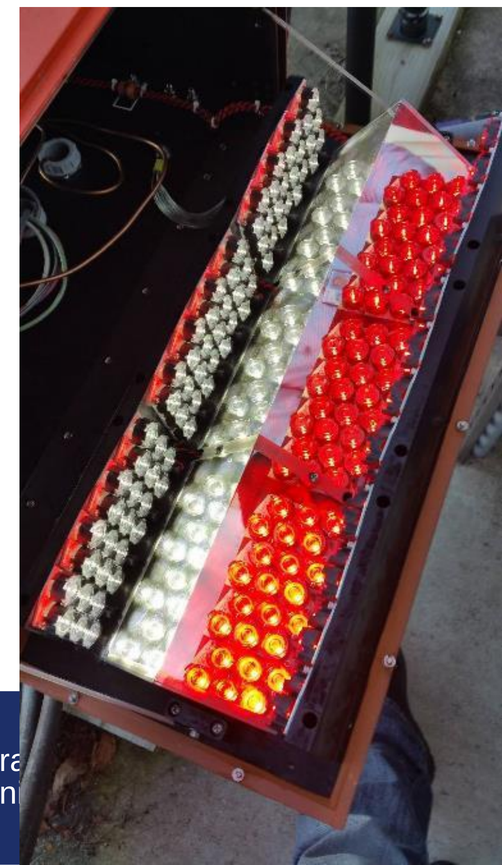
Can Baffle Any Legacy PAPI LHA





NBP LED PAPI = New Challenge

- **Traditional baffle methods DO NOT WORK.**
- **Tech Center developed a patent pending solution**



OXC – R&D Flight Evaluation of LED Baffles

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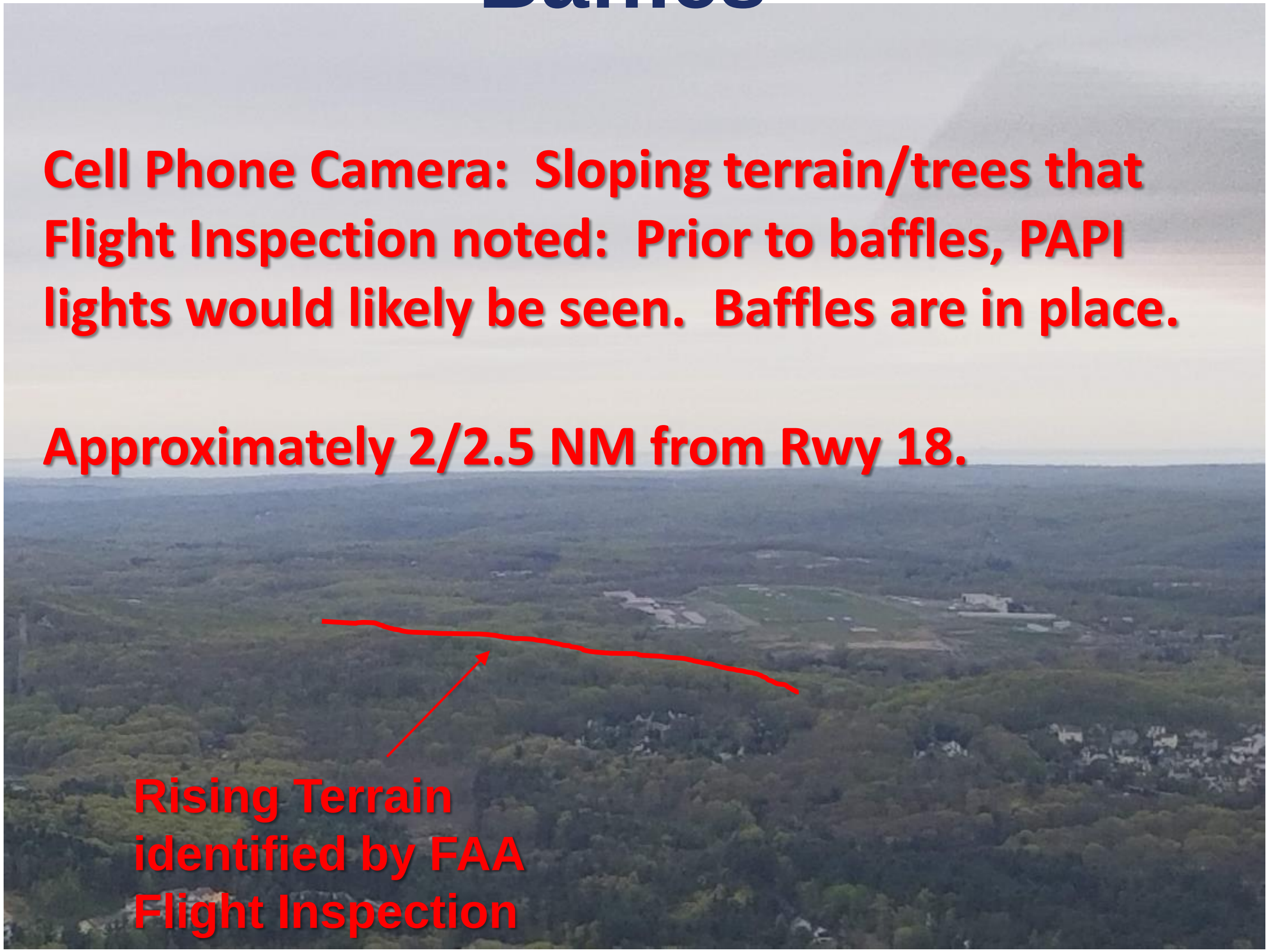
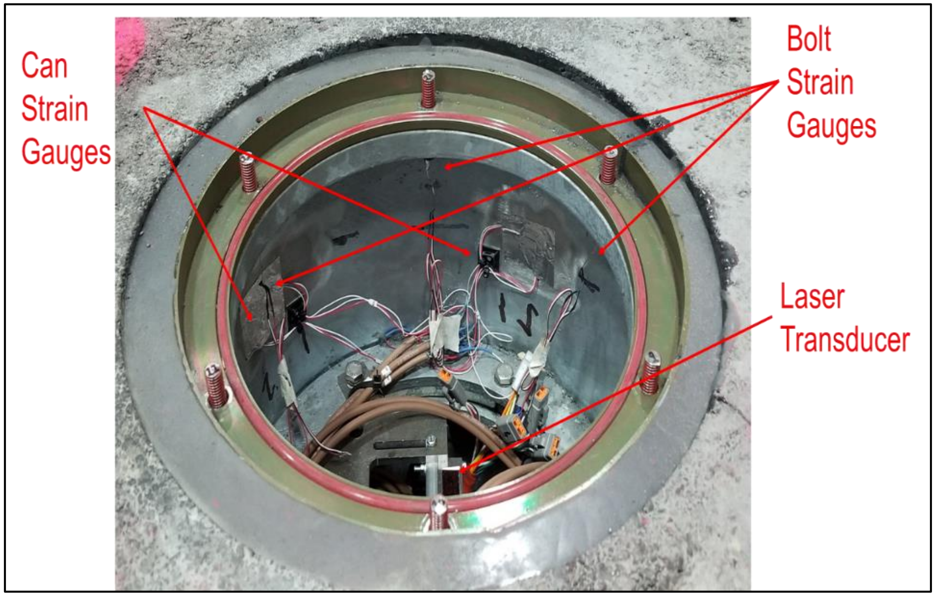


In-Pavement Light Fixture Testing and Evaluation

Testing of In-Pavement Light Fixtures

- **Incidents have occurred at US Airports where In-pavement Light Fixture bolted connections have failed, resulting in L-850A light fixtures completely separating from their associated L-868 light bases.**
  - Subject instrumented light fixtures to controlled trafficking, utilizing the NAPTV, with incrementally increasing levels of wheel loading.
  - Assess the effects of incrementally increasing levels of wheel loading on the test items with respect to the ultimate failure of the In-Pavement Light Fixture Assemblies.
- **Four test item configurations identified and constructed.**

Fixture Base Instrumentation



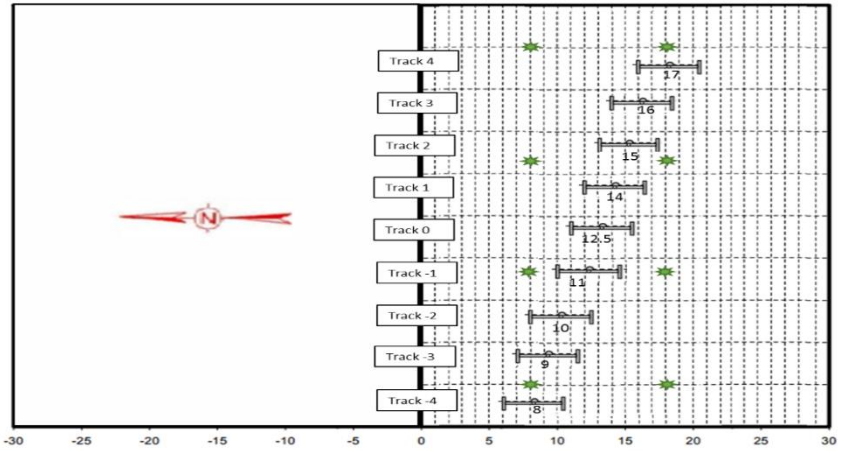
In-Pavement Light Fixture Testing

- **Heavy Weight Deflectometer (HWD) Testing**
- **Static Loading**
- **In-Motion (Trafficking) Loading**
- **National Airport Pavement Test Vehicle Used to Apply Static Loading and In-Motion (Trafficking) Loading**

HWD Testing

In-Motion Trafficking Loading

- 3D Gear Load Increments
  - 50,000 Pounds/Wheel
  - 54,000 Pounds/Wheel
  - 59,000 Pounds/Wheel
  - 63,000 Pounds/wheel
  - 65,000 Pounds/Wheel
- Total 3D Gear Loading Equals Wheel Load x 6
- Two Passes Conducted at Each Load Increment at Each of Nine Lateral Gear Locations



Next Steps

Follow-on testing will include trafficking of previously installed In-Pavement Light Fixtures in the NAPTF with the test vehicle to monitor mounting stud relaxation over time.

Testing will also be conducted with selected coatings applied to In-Pavement Light Fixture Assembly spacer rings to assess the influence on static friction coefficient to resist joint slippage.

Questions?