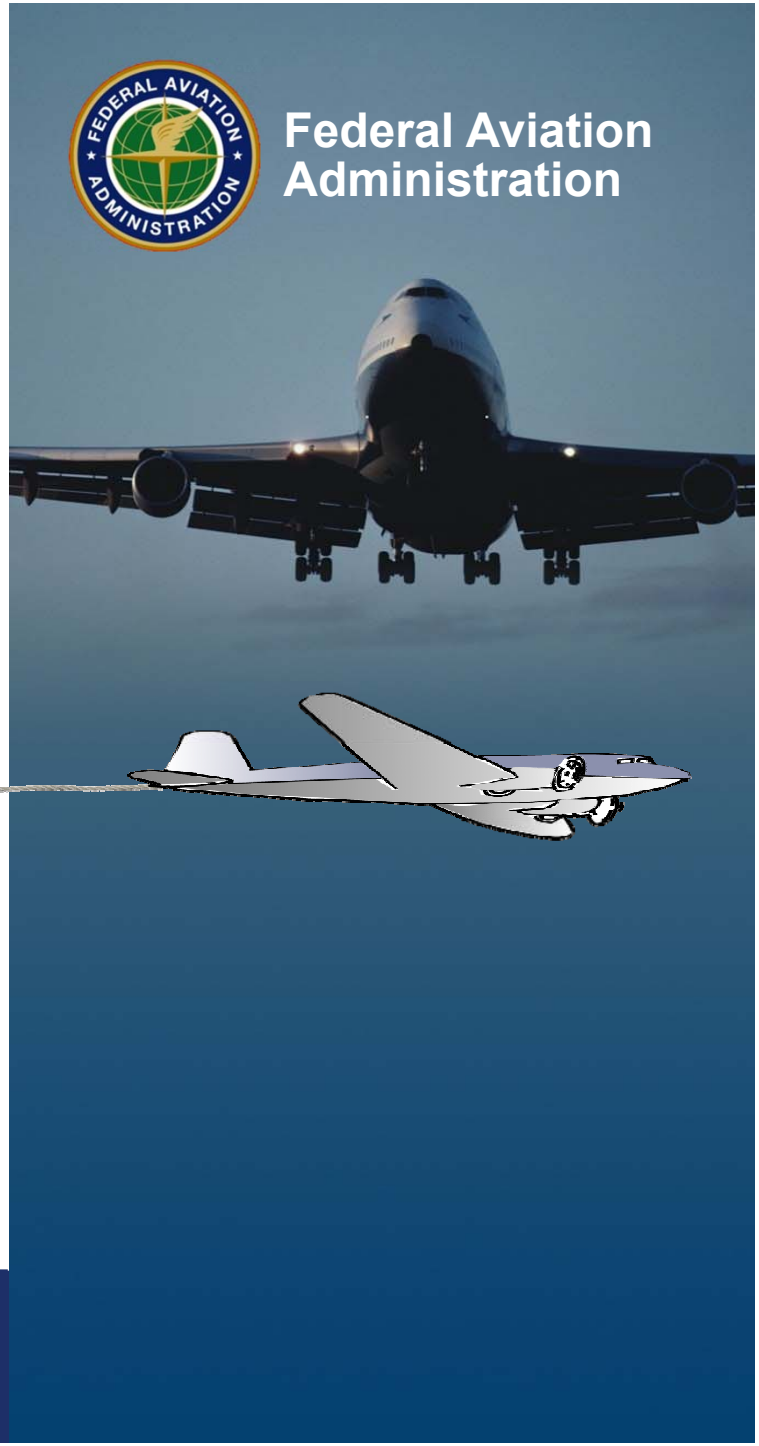
# Illuminating Engineering Society (IES) Government Contacts Sub-Committee Meeting




Donald Lampkins

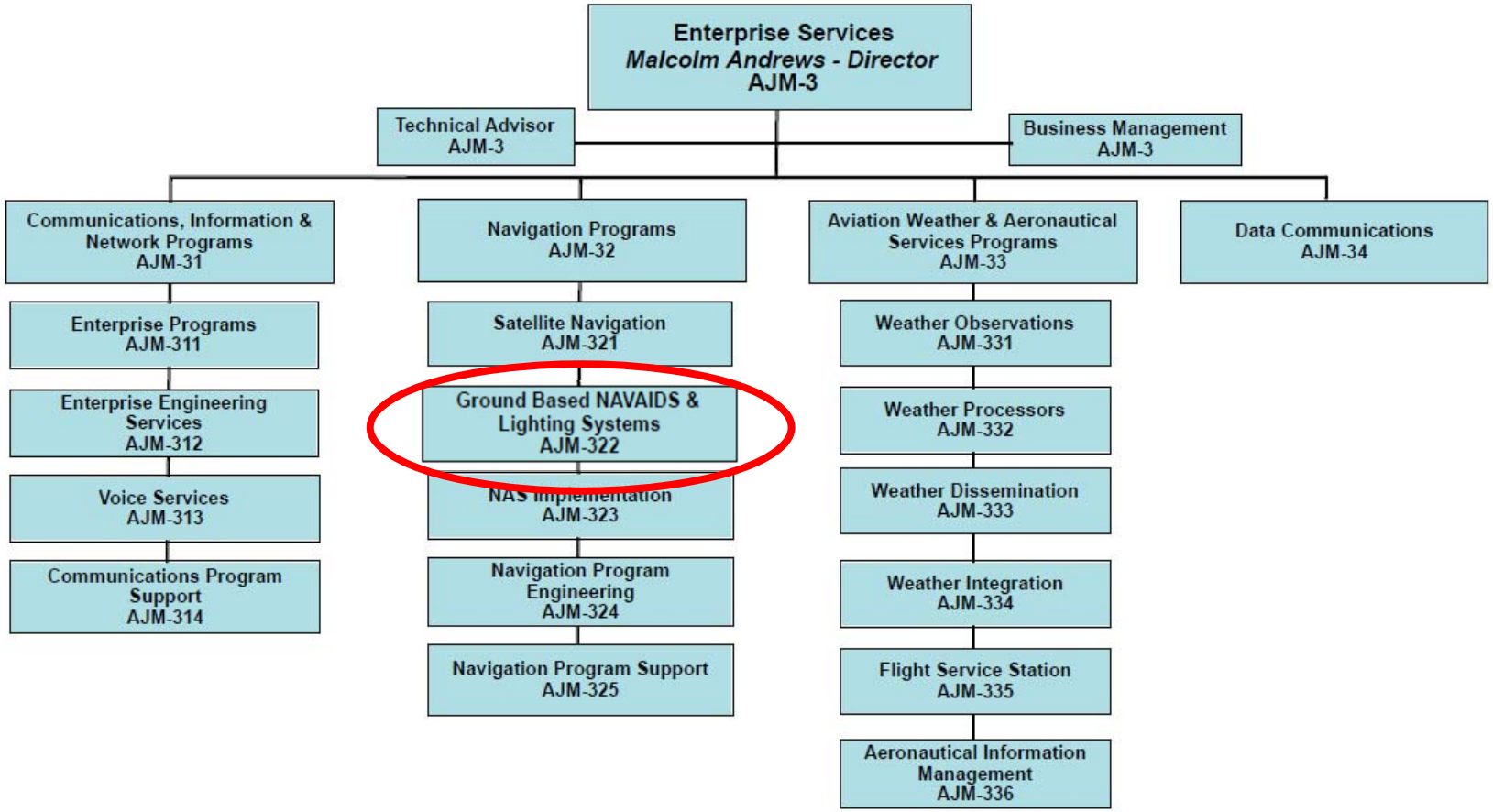
*Navigation Programs,*
*Lighting Systems Sub-Team*
*AJM-3222*

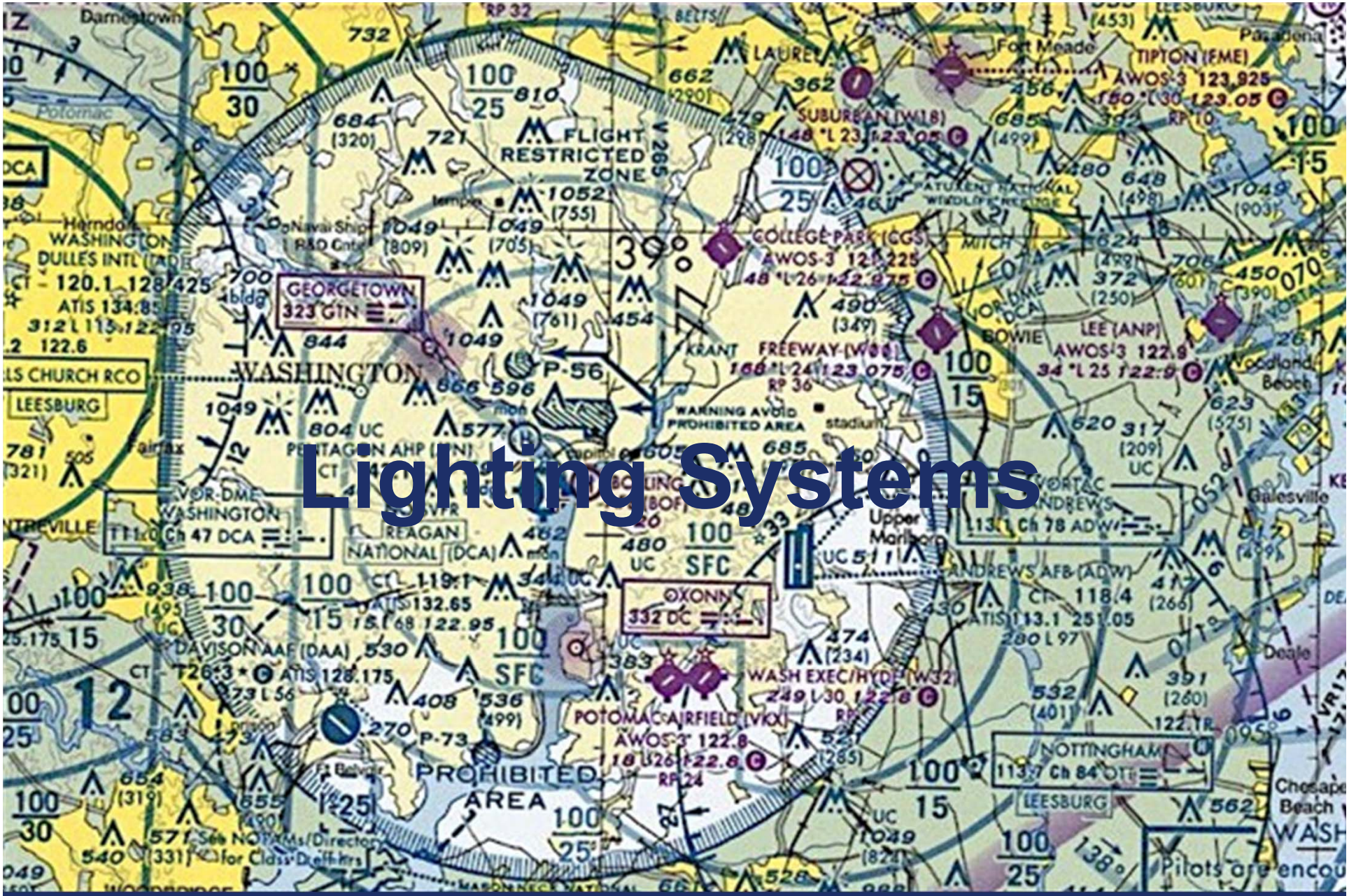
April 7, 2016

# Overview

- Organizational Structure
- Lighting Systems
- Advanced Lighting Concepts
- Active Projects
- Specification Updates
- Procurement Opportunities

# Enterprise Services



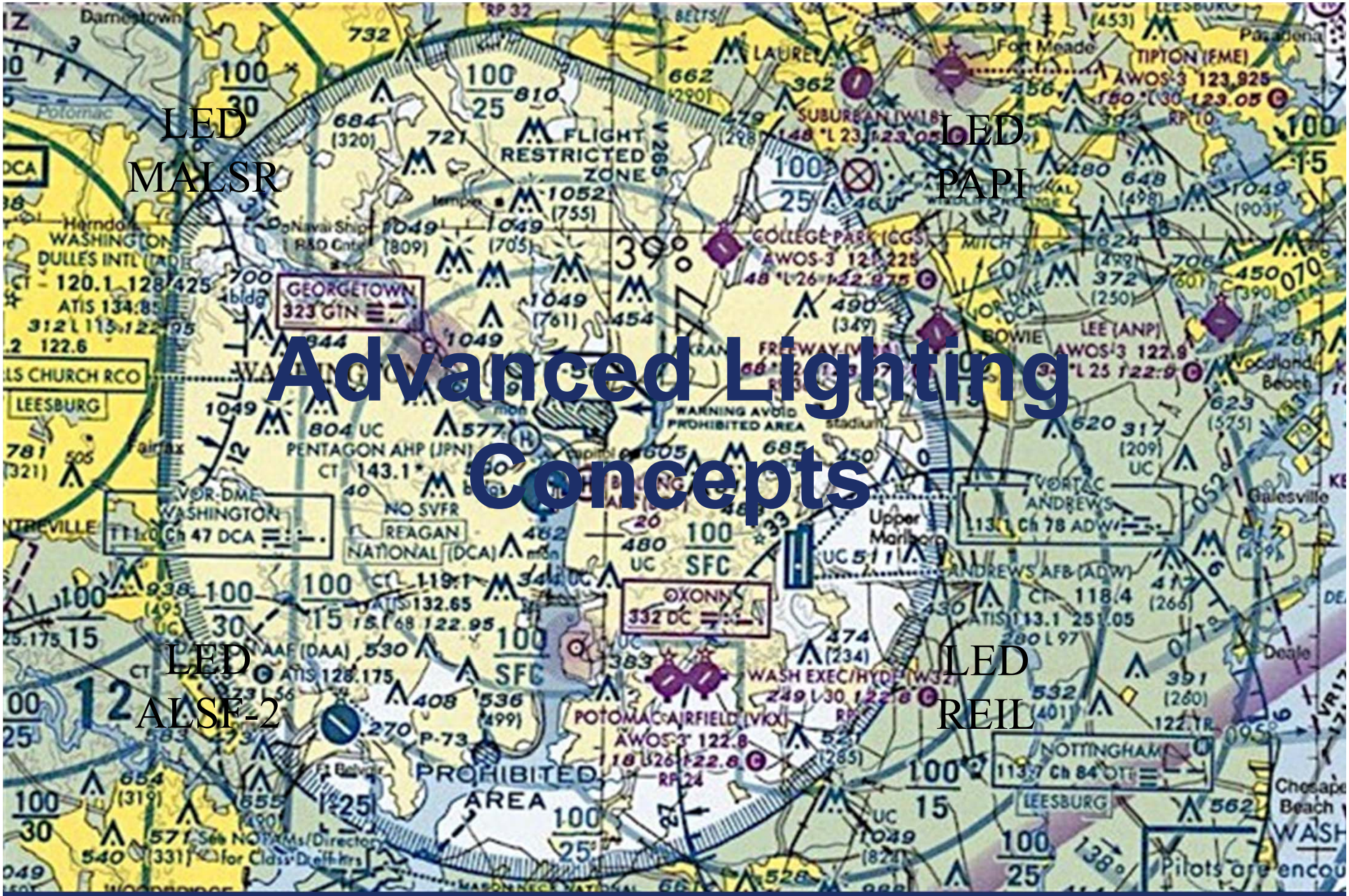

Lighting Systems

# Lighting Systems Team Contact Information

| Name | Projects | Phone |
|---|---|---|
| John Varas | Manager | 202.267.4539 |
| Renee Williams | RVR, LEDs, LIR | 202.267.9923 |
| Ndubuisi Nnorom | RRCS, RLMS, Semiflush Flashers | 202.267.9883 |
| Andrea Scott | RRCIU, MALSR | 202.267.4890 |
| Kevin Teel | RLMS, RRCIU | 202.267.3444 |
| Patrick Eigbe | REIL | 609.485.7857 |
| Donald Lampkins | MALSR, PAPI, LEDs | 202.267.7332 |

# Lighting Systems and Ancillary Equipment

- High Intensity Approach Lighting System with Sequenced Flashing Lights (ALSF-2)
- Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR)
- Precision Approach Path Indicator (PAPI)
- Runway Visual Range (RVR)
- Runway End Identifier Lights (REILs)
- Radio Remote Control System (RRCS)
- Radio Remote Control Interface Unit (RRCIU)
- Replacement  Lamp Monitoring System (RLMS)
- Lead-in Lights
- Semiflush Flashers & Steady Burners
- Low Impact Resistant (LIR) Structures
- Transformers
- Frangible Bolts
- Aiming Devices

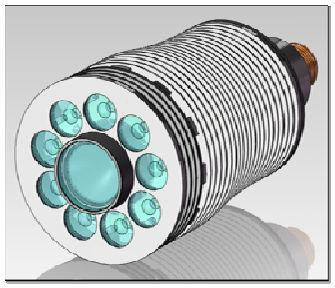



# Advanced Lighting Concepts

# MALSR Initiatives

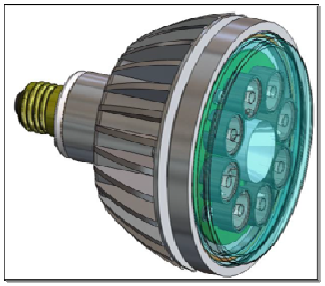
## Service Description

- The MALSR provides visual information on runway alignment, height perception, roll guidance, and horizontal references for Category (CAT) I precision approaches and Special Authorization CAT II Operations



## Roadmap to the future

- Transition from current PAR-38 incandescent lamps to energy efficient LED technology
  - Developing alternative LED lamps that can use existing lamp fixtures to minimize cost of conversion
  - Establish a transition plan to replace incandescent lamps
  - Determining need to retain some infra-red emission to support enhanced flight vision systems (EFVS) and Night Vision Systems (NVS)
- Transition from current PAR-56 threshold lamps to LED technology
  - Rely on LED technology to improve reliability and maintainability and reduce ops costs



# ALSF-2 Initiative

## Service Description

- The ALSF-2 provides visual information on runway alignment, height perception, roll guidance, and horizontal reference for all categories of precision approaches, primarily Category (CAT) II/III

## Roadmap to the Future

- Evaluate potential for reducing footprint and number of lamps needed to support CAT II/III approaches

- Leverage lessons learned from the MALSR program to implement Light Emitting Diode (LED) in the ALSF-2 design to the extent possible

# PAPI Initiative

## Service Description

- PAPI provides visual approach slope information to pilots and enables them to make stabilized descent and approach clearances over obstructions
  - PAPI is used primarily to support Visual Flight Rules (VFR) operations

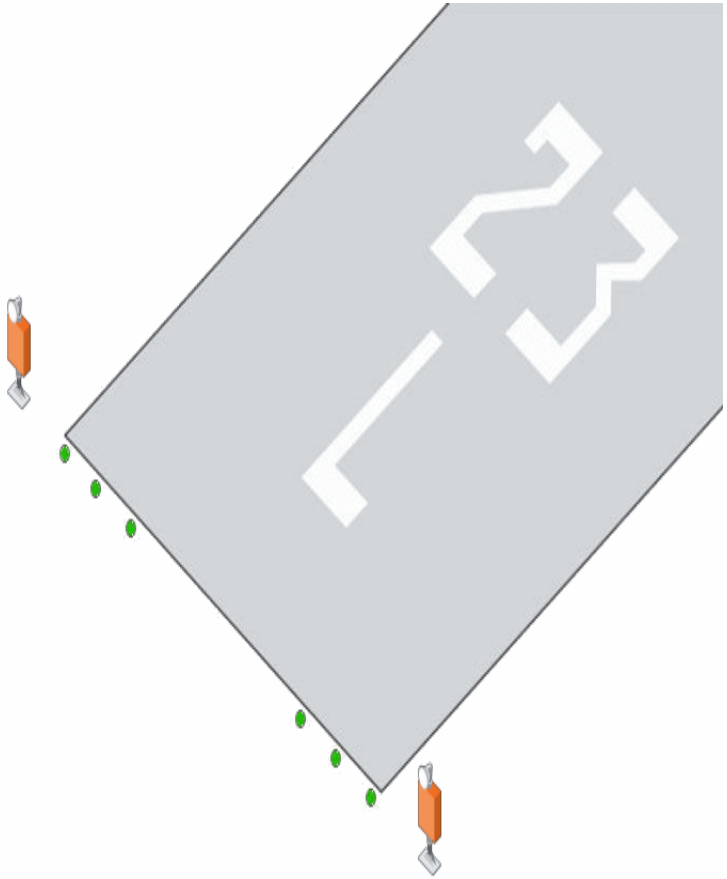
## Roadmap to the future

- Insert LED technology into legacy lighting systems that addresses improving reliability and maintainability
  - ➢ Possible to reduce the lifecycle cost of Visual Glide Slope Indicator (VGSI) by at least 50 percent

# REILs Initiative

## Service Description

- The REIL is a non-precision visual aid that provides rapid and positive identification of the approach end of a particular runway to the pilot.
- REILs are required for current and future NAS operations
- Approx. 400 REILS are beyond their 20 year life-cycle; over 200 REILs are >30 years old



## Roadmap to the future

- Transition from zenon flashtubes to LED Technology
- Insert LED technology into legacy lighting systems to improve reliability and maintainability
- Current program is replacing REILs to at a rate of ~10/year

# RVR Initiative

## Service Description

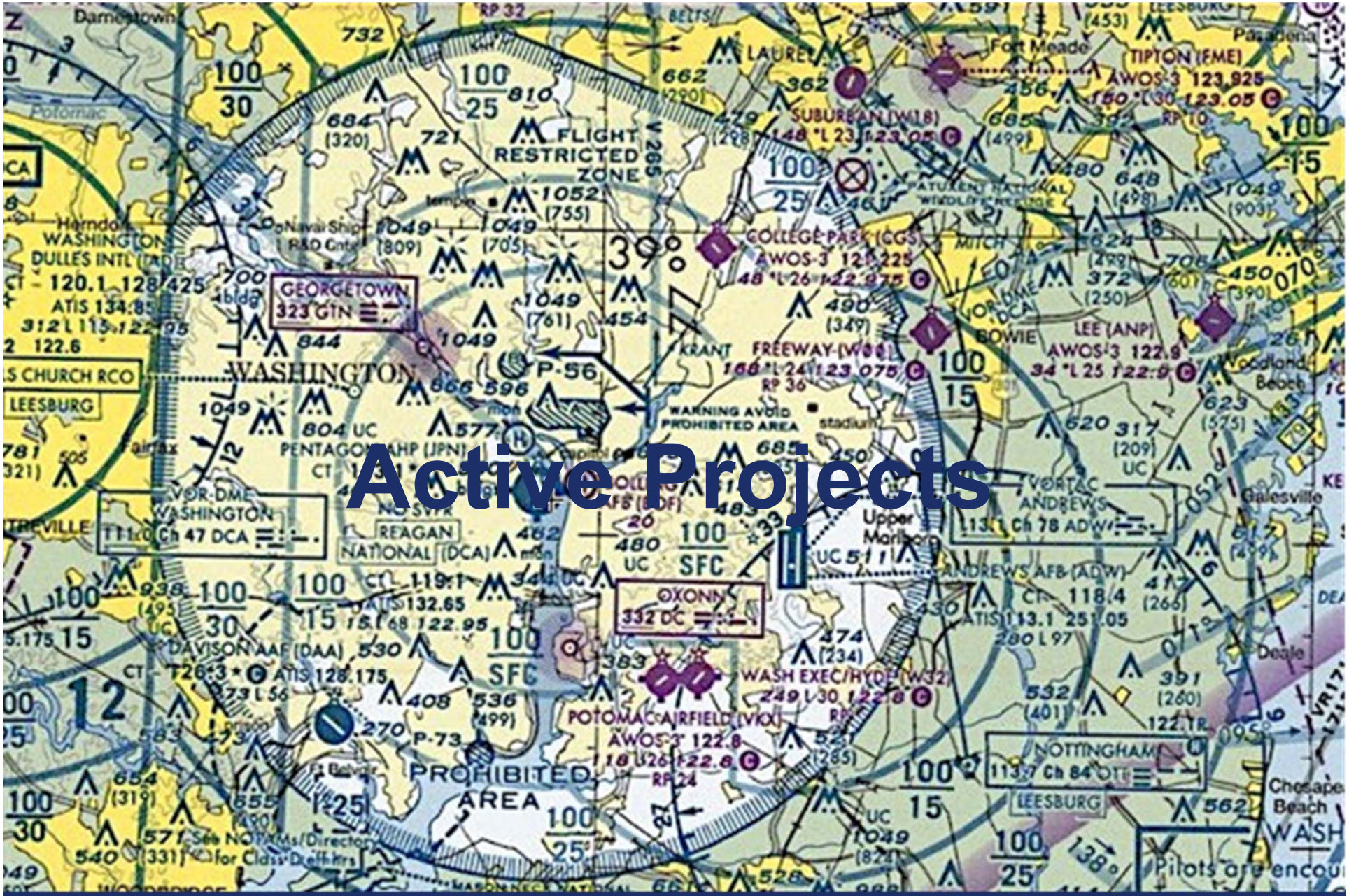
- Runway Visual Range (RVR) provides air traffic controllers with a measure of the distance a pilot can expect to see the runway
- RVR becomes critical when visibility is less than a mile
- RVR information is required for departure and Category (CAT) II, III, and many CAT I precision approaches

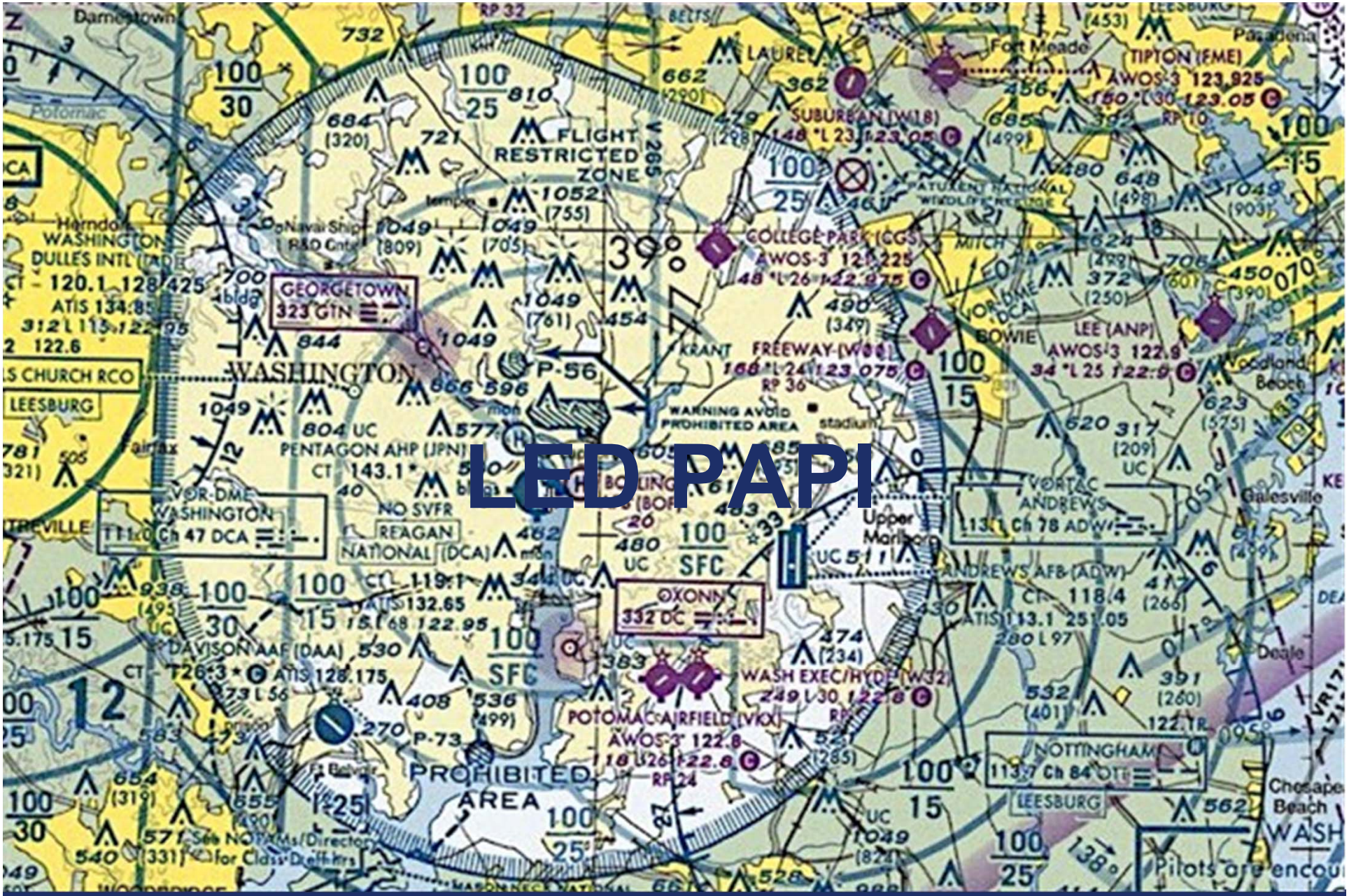

## Roadmap to the Future

- RVRs are required for the current and future NAS operations to:
  - Replace aging transmissometers and non-PC-based systems
  - Support future precision approach requirements

# Lighting Systems Future Initiatives

- **ALSF-2/MALSR**: Conduct Analysis on the feasibility of reducing the footprints of these lighting systems
- Redesign **MALSR** system based on LED technology
- Redesign **ALSF-2** system based on LED technology

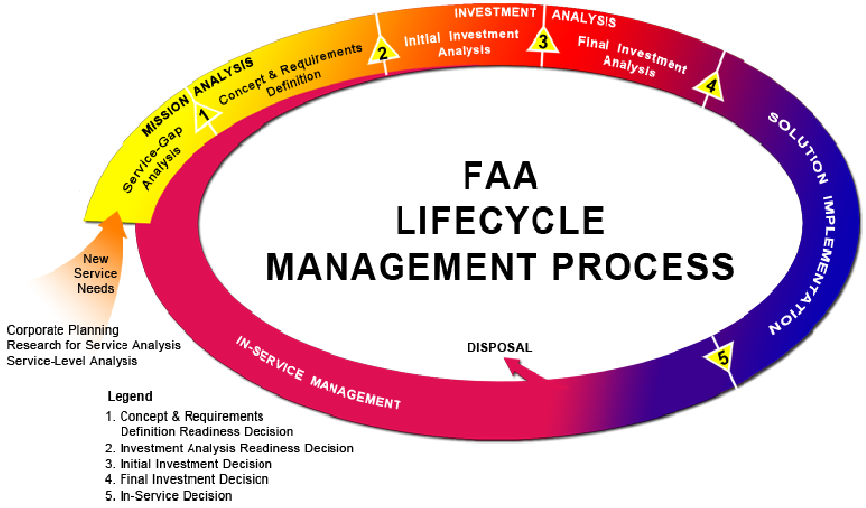

Active Projects


LED PAPI
WASHINGTON
PENTAGON AHP (JPN)
REAGAN NATIONAL (DCA)
DAVISON AAF (DAA)
POTOMAC AIRFIELD (VKX)
ANDREWS AFB (ADW)
PROHIBITED AREA
FLIGHT RESTRICTED ZONE
FREEWAY (W88)
WASH EXEC/HYDE (W32)
NOTTINGHAM
LEESBURG
COLLEGE PARK (CGS)
LEE (ANP)
TIPTON (FME)
SUBURBAN (W18)
GEORGETOWN
OXON
VOR/DME WASHINGTON
VORTAC ANDREWS
WARNING AVOID PROHIBITED AREA

# LED PAPI Project

- Objective: The primary objective is to fully deploy LED PAPI by using the System Development, Deployment and Implementation phases of FAA's Acquisition Management Systems (FAMS) process.

  - Project Activities
    - Preliminary Design Review
    - Critical Design Review
    - Design Qualification Test
    - Operational Test
    - Configuration Audits
    - Product Baseline
    - In-Service



# LED PAPI Project

- **Extensive Safety Review**
  - Conducted several Safety Risk Panel meetings to identify potential hazard conditions involving visual guidance indicators

- **Additional Flight Evaluations**
  - Conducted video recording of LED PAPI, incandescent PAPI and Visual Approach Slope Indicator at key-site Vero Beach, FL (VRB) - September 2014
  - Conducted Flight Demonstration at Vero Beach, FL with Flight Standards to resolve brightness perception - December 2014
  - Conducted another Flight Demonstration at Vero Beach, FL - June 2015

# Flight Demonstration

- **Objective:**
  - To resolve any questions about brightness perceptions of a LED's PAPI systems
  - Confirm accurate glide slope guidance
  - Capture any effects caused by haze or fog
  - Confirm the LED PAPI does not contribute to the loss of a pilot's situational awareness or cause any distractions
  - Comparison of LED PAPI and Incandescent PAPI
- **Observation:**
  - Global Brightness
  - Global Blooming
  - Brightness Directional Stability
  - Color
  - Color Stability
  - Transitioning/Trending

Vero Beach LED PAPI Video September 2014 V3.mov

# Flight Demonstration (December 2014) Results

## Lighting Acceptability Rating Scale (LARS)

| | Global Brightness | Global Blooming | Brightness Directional Stability | Color | Color Stability | Transitioning /Trending |
|---|---|---|---|---|---|---|
| Day | 2 | 2 | 3 | 1 | 1 | 2 |
| Twilight | 2 | 2 | 3 | 1 | 1 | 2 |
| Night | 3 | 3 | 3 | 1 | 1 | 2 |
| Dawn | 2 | 2 | 3 | 1 | 1 | 2 |

1 - Excellent, highly desirable
2 - Good, negligible deficiencies
3 - Fair, some mildly unpleasant deficiencies
4 - Minor but annoying deficiencies
5 – Moderately objectionable deficiencies

6 – Very objectionable but tolerable deficiencies
7 - Major deficiencies
8 - Major deficiencies
9 - Major deficiencies
10 – Major deficiencies

# Flight Demonstration (December 2014) Results

- **Summary/Recommendations**
  - LED PAPI is satisfactory under the conditions we saw during this demonstration
  - The transitioning or trending information was good
  - The best feature of the LED PAPI is its sharp, vivid colors
  - The white was excellent and a major improvement over the incandescent
  - The brightness was not overwhelming nor did lead to a loss of situational awareness
  - The increased brightness was more noticeable at night
  - More data points on this system in its entire operational environment will be very beneficial going forward

# Flight Demonstration (June 2015) Results

## Lighting Acceptability Rating Scale (LARS)

| | Global Brightness | Global Blooming | Brightness Directional Stability | Color | Color Stability | Transitioning /Trending |
|---|---|---|---|---|---|---|
| Day | 1 | | | 1 | | 1 |
| Twilight | 1 | | | 1 | | 1 |
| Night | 1 | | | 1 | | 1 |
| Dawn | N/A | | | N/A | | N/A |

1 - Excellent, highly desirable
2 - Good, negligible deficiencies
3 - Fair, some mildly unpleasant deficiencies
4 - Minor but annoying deficiencies
5 – Moderately objectionable deficiencies

6 – Very objectionable but tolerable deficiencies
7 - Major deficiencies
8 - Major deficiencies
9 - Major deficiencies
10 – Major deficiencies

# Flight Demonstration (June 2015) Results

- Comments

Rwy 4 (LED)

- (Day) Excellent Visibility/Brightness from 5 miles
- (Dusk) Excellent Visibility/Brightness from 5 miles, excellent transition
- (Night) Did not wash out runway, noticeable at 20nm and 5500 ft.

Rwy 12R (Incandescent)

- (Day) Hard to discern for 2 miles
- (Dusk) Good brightness/intensity noticed at 5nm, good transition
- (Night) Same as dusk except lights seem to wash out runway.

# LED PAPI Project

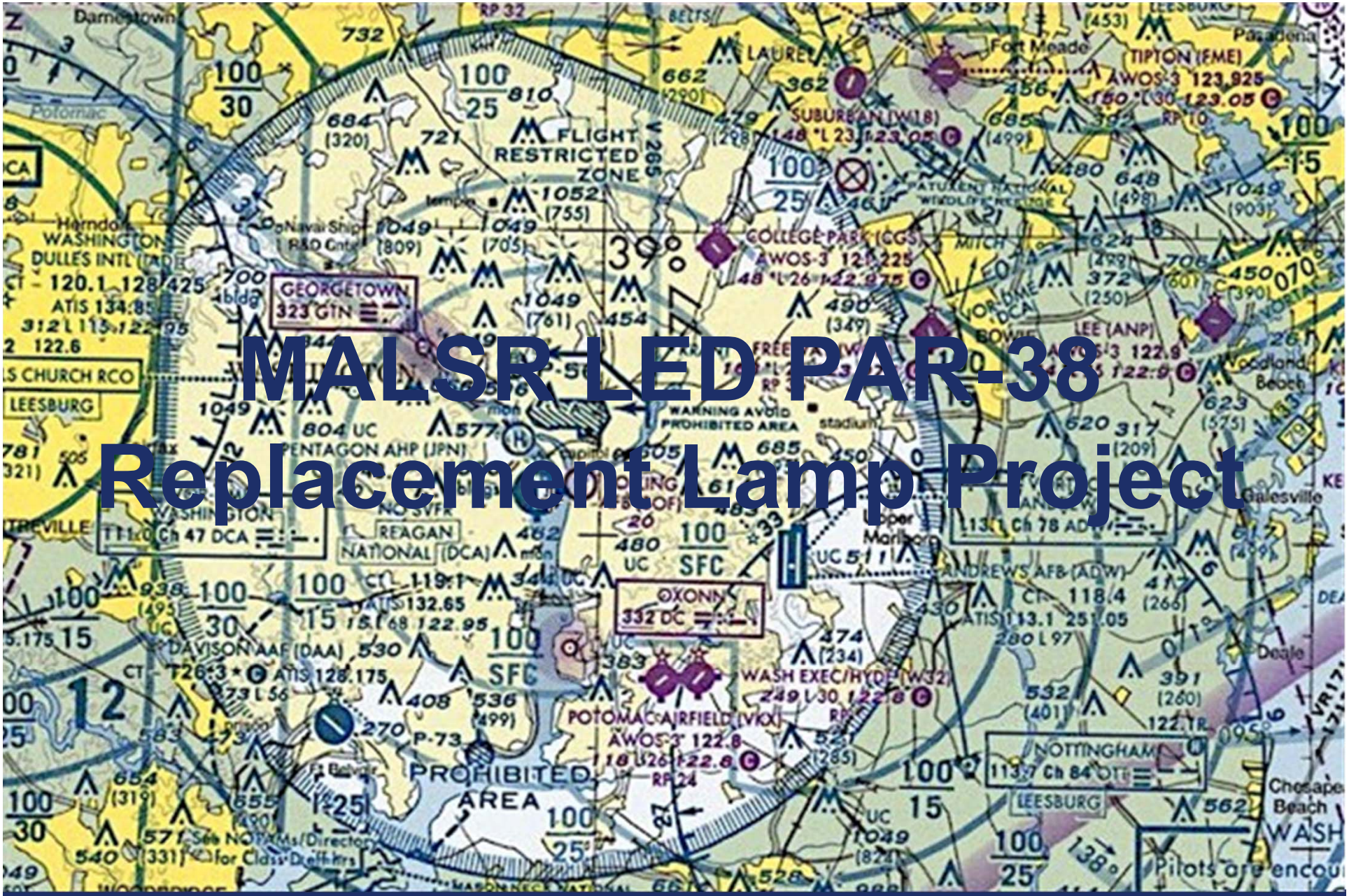
## Planned Activities

- Complete LED PAPI standard installation drawings – June 2016
- Establish System Baseline – June 2016
- Obtain In-Service Decision – September 2016
- Commission key site at Vero Beach Municipal Airport (VRB) in Vero Beach, FL – September 2016

# LED PAPI Project

## Planned Activities

- Implementation Activities
  - Rochester International Airport Runway 22, Rochester, NY
  - Flagstaff Pulliam Airport Runway 03, Flagstaff, AZ
  - Valley International Airport Runway 35L, Harlingen, TX


MALSR LED PAR-38
Replacement Lamp Project

# MALSR LED PAR-38 Replacement Lamp Project

- **Objective:** Determine the I/R requirements for a PAR-38 LED replacement lamp. This will includes a feasibility study, developing requirements and evaluating the concept by prototyping, testing and conducting operational capabilities demonstrations.
  - **Phase I:**
    - Feasibility Study
      - To determine if integrating IR into a LED Par 38 and Par 56 fixtures is achievable.
  - **Phase II:**
    - Prototype Development
    - Confidence Testing
    - Pre-Flight Testing
    - Operational Capability Demonstration (OCD) with EFVS-equipped aircraft
  - **Phase III:**
    - Production

# Test Activities

## Confidence Test

- Validate “numbers” to ensure we are in the same ballpark and that technologies are compatible under simulated low-visibility conditions
- Photometric and EVS testing

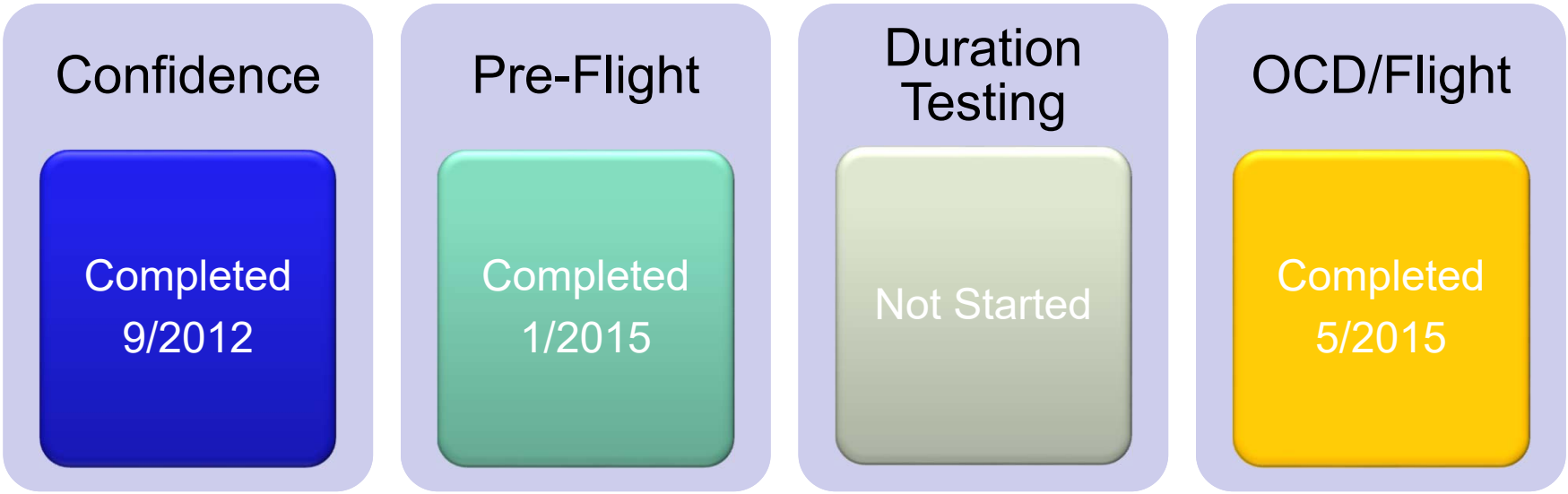
## Pre-Flight Test

- Consists of “Laboratory” and/or “Field” testing
- Accomplish the “easy” stuff before tackling the weather!
- Ensure “look-and-feel” is validated before committing to flight

## Flight Test (OCD) & Duration Testing (Volpe)

- Formal Flight Testing –chasing “relevant” wx will prove challenging
- Continue “static” weather related testing to supplement flight testing

# Milestone Schedule



# Test Highlights

- **Confidence Test**
  - Photometric requirements were met
  - EVS Cameras displayed LED Prototype images on monitor
  - LED Prototype IR were still visible through Neutral Density filters as high as 3.5 OD - equivalent to 0.0316% transmission of signal to camera
  - Test Results (Photometric, Radiometer and EVS Camera) were encouraging

# Test Highlights

| Test | Results |
|---|---|
| Photometric | Pass |
| Relative Intensity at Temperature | Pass |
| Chromaticity | Pass |
| Power Interruption | Pass |
| Voltage Variation | Pass |
| Voltage Harmonic | Pass |
| Current Harmonic | Pass |
| Power Factor | Pass |
| Grounding and Bonding | Future Validation |
| Power Line Surge | Future Validation |

| Test | Results |
|---|---|
| Environmental | Pass |
| LED Circuitry | Pass |
| Solar Radiation | Future Validation |
| Conducted Emissions (CE101) | Pass |
| Conducted Susceptibility (CS101) | Pass |
| Radiated Emissions | Future Validation |
| Radiated Susceptibility | Pass |
| Conducted Emissions (CE102) | Future Validation |
| Conducted Susceptibility (CS114) | Pass |
| Electrostatic Discharge | Pass |

# OCD (Flight Test)

- Formal Flight Testing
  - Chasing “relevant” weather will prove challenging

- Requirement Verification and data gather effort
  - Current applications, standards, and specifications to demonstrate overall NAS operational capability

# OCD (Flight Test)


Incandescent MALSR 200FT AGL

# OCD (Flight Test)


LED MALSR 200FT AGL

# OCD Recommendations

- **Incorporate the brightness/luminance factor for LED lamps on Medium and Low intensities.**

- **Define and agree on operational requirements for implementing IR into LED lamps.**
  - How much IR is needed to fully image approach lights on current EFVS Heads-Up Displays (HUDs)?
  - What are the operational and performance parameters for IR?
  - Should identical levels of IR be the same for LEDs as with incandescent bulbs?

- **Use cast-iron lamp holder (FA-11506 or equivalent) for LED MALSR Systems**

# OCD Recommendations

- **Update ALS infrastructure for WJHTC experimental MALSR to make standard MALSR.**
  - Are current conduits, structures, and cabling techniques adequate for implementing newer LED MALSRs at airports.

- **Re-evaluate Electromagnetic Interference (EMI) requirements of LED lamps for use in the NAS.**

- **Further research and evaluate the validity of PRD requirements that were not successfully validated or verified through the OCD.**
  - Are the requirements for which LED prototypes did not meet still valid?
  - What changes (if any) need to be made to the requirements as written?
  - Can LED prototype lamps be further optimized to meet all requirements?

.

# OCD Recommendations

- **Evaluate green threshold LEDs for use in a full MALSR**
  - Are there any functional, performance, or operational impacts with the implementation of green LED lamps

- **Provide funding to continue all LED activities and objectives including defining a minimum IR requirement)**
  - Continue research and validation activities on all Future Verification (FV) requirements in the VRTM.

# LED PAR-38 Replacement Project Summary

- LED PAR-38 met majority of requirements in our LED Performance Requirements Document (LED-PRD-001)
  - Photometrics
  - Chromaticity

- Seven (7) flights were conducted during clear weather

- Without weather could not validate if LED's with IR is sufficient for EFVS operations during Category I weather
  - Very encouraged with results even without weather

# LED PAR-38 Replacement Project

- **Planned Activities**
  - Upgrade MALSR system at FAA Technical Center (ACY Runway 4)
  - Incorporate Brightness/Luminous Ratio of 1.6 for Medium and Low Intensity step
  - Work with LED Symposium Test Group to define testing requirements for LED approach lights
  - Plan Flight Test activities with LED Symposium Test Group


LVICC
RRCS
Other Lighting Projects
Semi-Flush
Flasher
RLMS

# Replacement Lamp Monitoring System (RLMS)

- **Objective:**
  - To replace the constant current regulators and implement lamp monitoring on the Airflow and Godfrey ALSF-2 systems.

- **Status:**
  - RLMS contract closeout – May 2016
  - Award new RLMS contract – May 2016
  - Install six (6) RLMS kits at various locations - ongoing

# Semi-Flush Flasher Light Unit (SFFLU)

- **Objective:**
  - To develop and approve a semiflush flashers light unit through the FAA's Developmental Hardware Process.

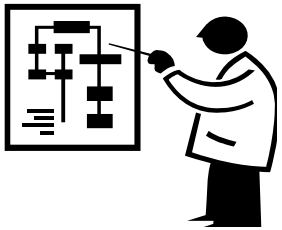
- **Status:**
  - Completed Operational Test
  - Installed SFFLU at various locations
    - Alliance, TX
    - Flagstaff, AZ
    - San Jose, CA
    - Long Beach, CA
  - Conducted the SFFLU first training course
  - Approve product baseline

# Low-Voltage Individual Control Cabinet (LVICC)

- **Objective:**
  - To develop and approve an ICC that reduces the voltage from 2000V to 400V and interfaces with semiflush flashers. LVICC is compatible with MALSR and ALSF-2 systems

- **Status:**
  - Conducted the First Training Course
  - Updated MALSR and ALSF-2 product baseline
  - Installed at various locations
    - Flagstaff, AZ
    - San Jose, CA
    - Long Beach, CA


Specification and
Procurement Opportunities



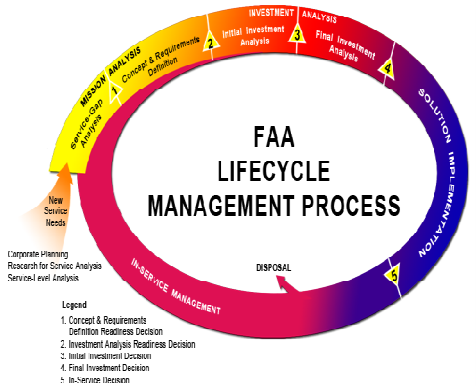
# Specification Updates

- **Radio Remote Control System**
  - Approved (March 2016)
- **REIL**
  - Anticipated Approval (March 2017)
- **MALSR**
  - Upcoming
- **In-pavement Steady-Burner**
  - Upcoming

## Reason for Changes

- Consolidation of Equipment
- Incorporated NTIA narrow bandwidth requirements
- Changes in Standards
- Changes in Testing Requirements
- LEDs
- Color Boundaries
- Photometrics
- Design vs. Performance
- Outdated Specifications

# Procurement Forecast




- Remote Radio Control System (RRCS)
- Remote Radio Control Interface Units (RRCIU)
- Runway Edge Identifier Lights (REIL)

- You should continue to monitor the FAA Contracting Opportunities Website for procurement opportunities

FAA Contracting Opportunities website: https://faaco.faa.gov/

# Questions