



# **USMC Expeditionary Airfield Lighting Update LED Approach and Runway Lighting Systems**

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**NAVAIR Lakehurst, NJ**

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## Reasons for Change



- **Obsolescence**
  - Unique incandescent fixtures
  - Antiquated manufacturing processes
  - Mechanical flash timers
  - Xenon flash tubes



*"Legacy" Runway Edge Light*

- ***USMC Requirement to Support Deployed CAT-I Operations***
  - Portable ASR/PAR system (ATNAVICS)
- ***Non-standard Approach Light Configurations***
  - Could not support IFR flight operations during OEF/OIF



## Program Objectives



- ***Priority = Approach Lighting Systems***
  - Refurbished Legacy runway lights could support for short term
  - Leverage COTS technologies and processes as much as possible
  - Develop power and control infrastructure
  - Apply any “lessons learned” to future runway lights
  - “System” to include complete MALSR, REIL and CCR



***“Legacy” Approach & Strobe Barrette***

- ***USMC Challenges***
  - Visible and covert capability
  - Weather-proof and “lightweight” CCR
- ***USMC Advantages***
  - No requirement for “backwards compatibility”
    - Power, control or fixture form factor
  - Trained on constant-current circuits



## Approach Light System (ALS) Design Approach



- ***MALSR Threshold & Steady Burner Fixtures***
  - Base light engine on existing L-862(L) technologies
  - Add near-wave IR emitter
- ***MALSR SFL - REIL***
  - Base light engine on existing L-849(L) technologies
  - Add near-wave IR emitter
- ***CCR***
  - Base performance on existing L-828 technologies
  - *Fixture Centric* approach
    - Intensity & Mode commanded by signal sent by CCR
    - *Amplitude Shift Key (ASK)* chosen



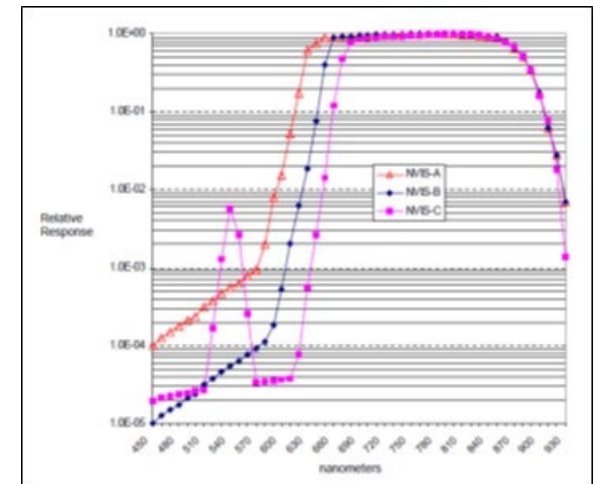
# Night Vision Device Compatibility Design Approach



- ***“Entire Airfield” Strategy to Address Intensities***
  - Approach > Runway > Taxiway
- ***Specification Evolution***
  - Historic Navy shipboard data
  - Unit of Measure = NVIS Radiant Intensity ( $\text{NRI}_B$ ) (SAE-ARP-5825)
    - USMC flies both Class B & C NVGs
  - IR  $\lambda$  towards high end of linear response to reduce power requirement
  - “Risk Mitigation” testing
    - Fixed observers at Lakehurst Test runway
  - “Order of Magnitude” dimming profile
    - High  $\approx 1 \times 10^{-1}$  W/sr
    - Med  $\approx 1 \times 10^{-2}$  W/sr
    - Low  $\approx 1 \times 10^{-3}$  W/sr
- ***Control Provided Combined IR + VIS Output***



Risk Mitigation test fixture



from MIL-STD-3009



## ALS Components

### MALSR Threshold and Steady-Burn



- ***MALSR Threshold and Steady-Burn Fixture***
  - *Identical except for Light Engine (LED color)*
  - *Automatic heater gasket on window*
  - *Center IR LED*
  - *~ 30-W per fixture*





## ALS Components REIL / MALSR-SFL



- **REIL / MALSR-SFL Fixture**
  - *Flash synchronization regulated by CCR output waveform*
  - *REIL or SFL function (internal DIP switch setting)*
  - *Automatic heater gasket on window*
  - *Center IR LED*
  - *~ 150-W per fixture*





## ALS Components CCR & Power Distribution System



- **4kW Ferro-Resonant CCR w/ QUADCON-based Distribution System**
  - *De-rated to 3.33kW to allow headroom for ASK operation (fixed 5.5-A)*
  - *Selectable output to support bi-directional runway ("A" or "B" loop)*
  - *Environmentally sealed*
  - *Wired remote*
  - *< 300-lb*





## ALS Testing



- ***Developmental Testing***
  - **FAA-E-2980 and AC150/5345-51-derived photometrics**
  - **MIL-STD-810 “qualification” criteria**
    - **Passed with minor corrections**
- ***Integration Testing***
  - **Marine Corps Air Ground Combat Center, Twentynine Palms, CA**
    - **8000-ft AM2 Matting runway with taxiways and parking ramps**
  - **Installed prior to “Integrated Training Exercise (ITX)” SEP 2019**
  - **Complete system installation (MALSR r/w 10; REIL r/w 28)**
  - **Limited fixed-wing flights**
    - **No ATC Services**
  - **“NVG operations are VFR only”**
    - **Consideration for the future**
  - **System has remained installed**
    - **Largely VFR operations, but system continues to receive positive feedback**



## Runway Lighting System (RLS) Design Approach



- ***Lessons Learned from ALS***
  - ASK-controlled infrastructure works
  - Simultaneous IR & visible unnecessary
  - Further dimming of IR output desirable
- ***Runway Edge and Threshold/End Light Fixtures***
  - Meet L-862(L) & L-862E(L) performance
  - “Overt NVD” to allow “*under the goggles*” viewing (“<B1” intensity)
  - Maintain a low-profile fixture
    - Eliminate frangible couplings
    - Allow installation near Arresting Gear
- ***4kW CCR***
  - Single design to accommodate both 5-step and 3-step configurations
    - No increase to message byte size
  - Installs in existing space within Power Distribution QUADCON
    - 4 total: (1) for approaches; (2) for inter-leaved runway; (1) spare



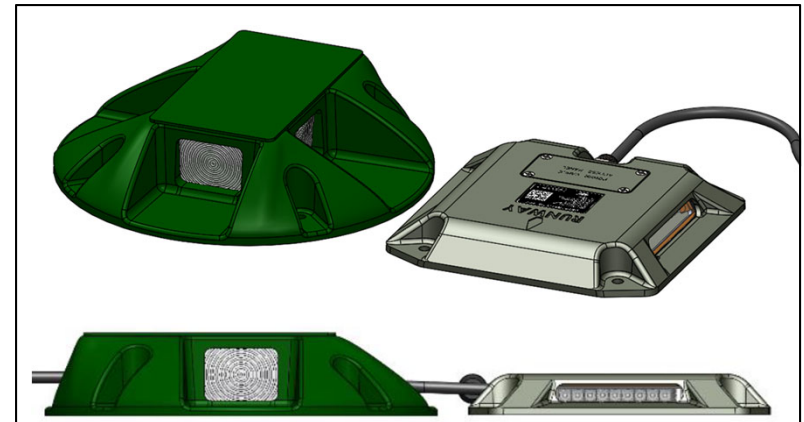
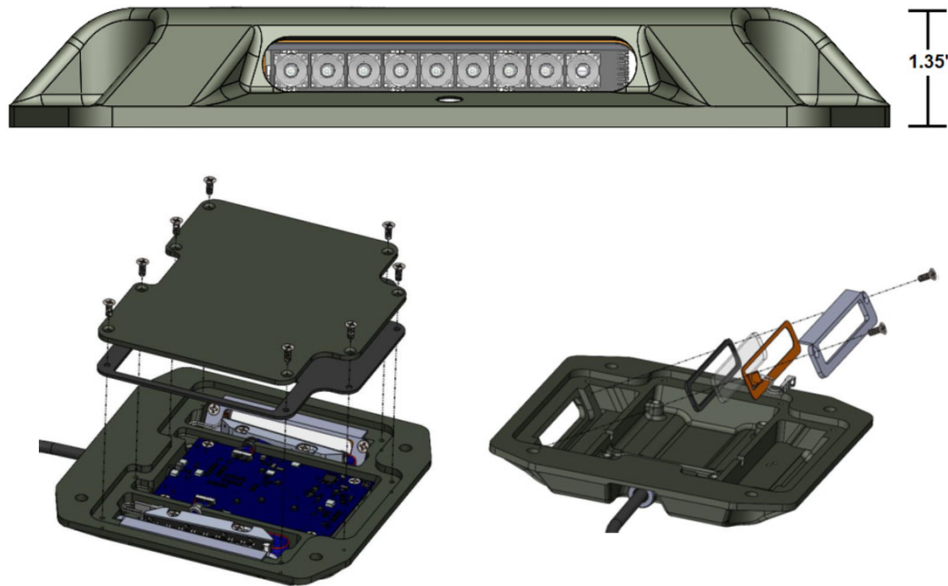
## RLS Components Runway Edge & Threshold/End Light



- **“Flapjack” Fixture**
  - Interchangeable LED modules
    - Straight or “toed” mounting
    - 9-LED Array, 8 vis + 1 IR
  - Automatic heater gasket on window
  - ~50-W per fixture



“Legacy” Threshold fixture vs. “Flapjack”



“Legacy Pancake” fixture vs. “Flapjack”



## RLS Testing



- **Developmental Testing**
  - AC 150/5345-46 photometrics
  - MIL-STD-810 “qualification” criteria
    - Passed with minor corrections
  - Arresting Gear interface evaluation
    - Confirmed requirement for “Cable Cover”



*Trafficking evaluation*



*Arresting Gear Purchase Tape evaluation*

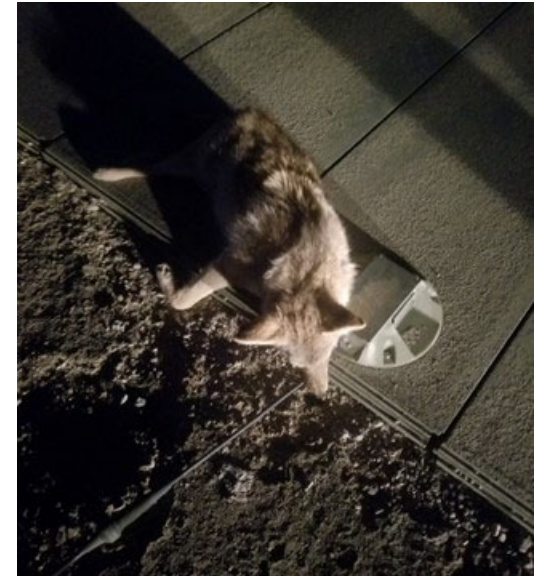
- **Integration Testing**
  - Expected late 2022/early 2023
    - To be installed with ALS at Twentynine Palms



## Unique Challenges to EAF - 1



- **Wildlife Damage to Secondary Cables**
  - Above-ground installation
  - Incidents have ACCELERATED in recent years



- **#1 Maintenance concern**
- **Solutions or Advice?**

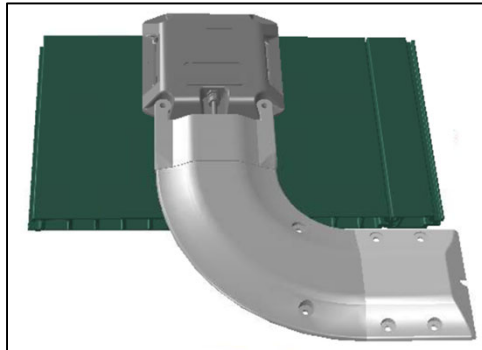




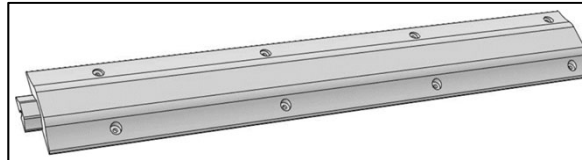
## Unique Challenges to EAF - 2



- **Interface with Portable Arresting Gear**
  - Difficult to replicate “Legacy” fixture
  - Cable Cover concept



*AM2 Mat concept*



*“Bare Base” concept*



*“Legacy Flush-Deck” fixture*



*Purchase Tape traversing Cable Cover*



*Tape Connector striking fixture*



## Unique Challenges to EAF - 3



- ***Portable Frangible Towers***
  - Unique 1980's design based on FAA D-6155 drawing series
  - Out-of-date drawing package



NAVAIR Public Release 2022-236, Distribution Statement A: "Approved for public release; distribution is unlimited."  
IESALC Government Contacts 2023 Spring Meeting



## Acknowledgements & Thanks



- ***NAVAIR Lakehurst Photometrics and Laser Labs***
- ***Naval Flight Information Group (NAVFIG)***
- ***Federal Aviation Administration***
  - **Flight Safety R&D**
  - **Lighting Systems**
  - **Flight Operations**
- ***Marines of MWSS-271, -371 and -374***



***MWSS-371 Marines installing REIL***