Airfield Lighting Maintenance

Keeping the Lights On

ARKANSAS AIRPORT OPERATORS ASSOCIATION

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GARVER

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Airport Lighting

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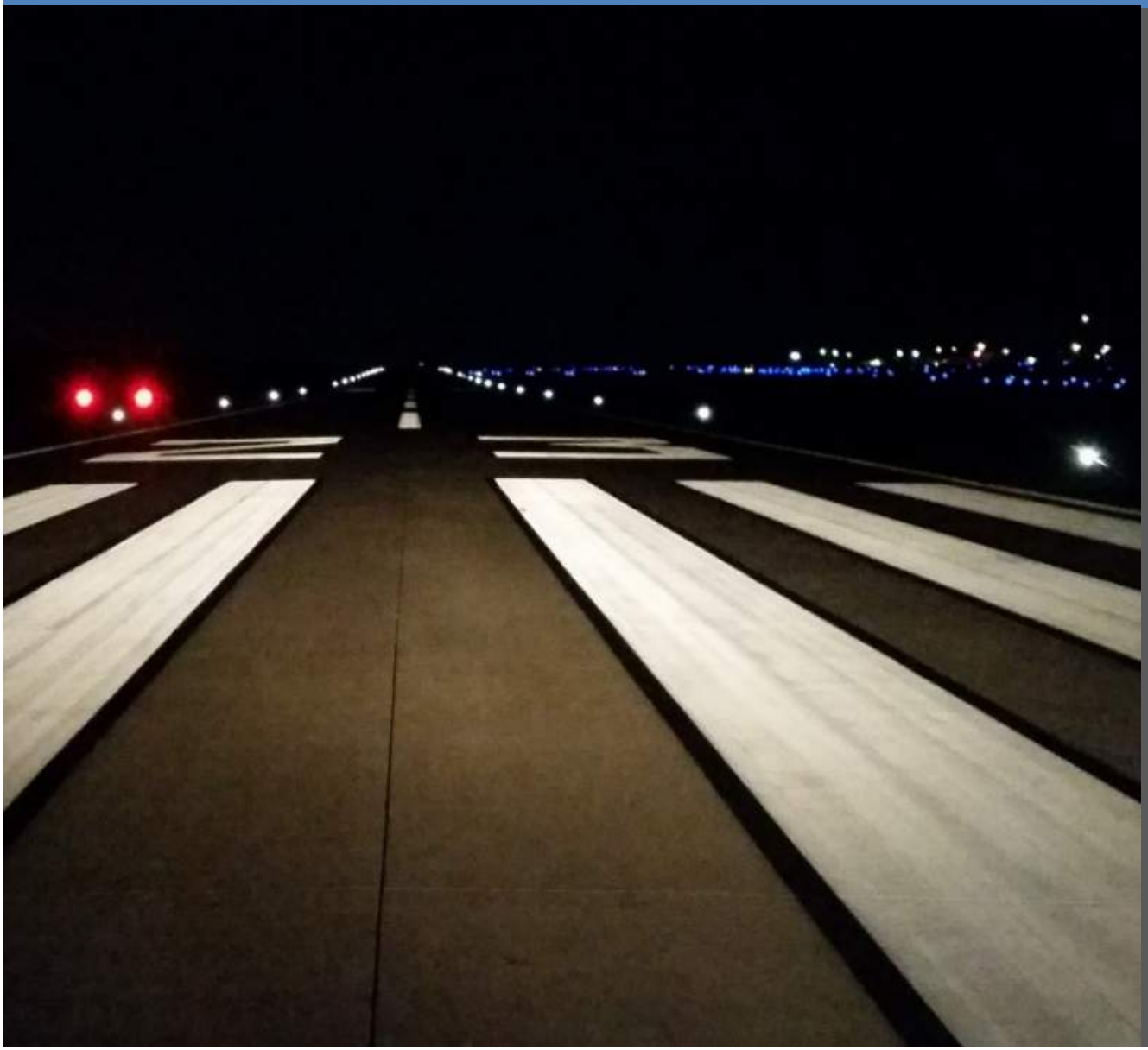


Obviously…

Lighting is very important to any airport.

Airfield Electrical System

The smallest airfield lighting system typically has:

- Pavement edge lights
- Approach lights
- Guidance signs
- Wind cones
- Obstruction lights
- Beacons

Airfield Electrical System

The smallest airfield lighting system typically has:

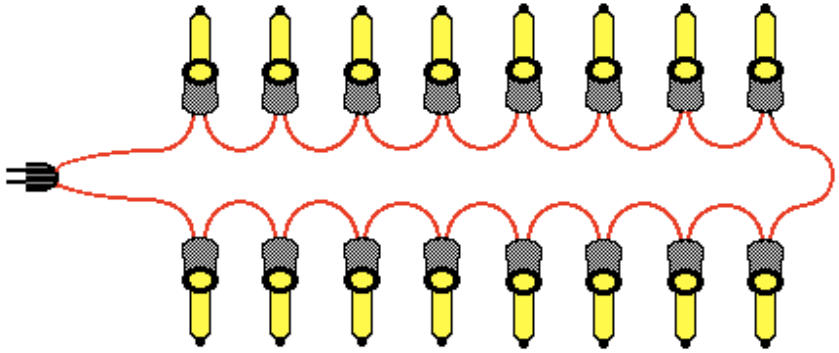
- Electrical vault, transclosure, or room
- Miles of cabling
- Hundreds of field made connections
- Regulators and controls
- Many lamps or LEDs and drivers
- Electrical panels

Airfield Electrical System

Airfield Electrical System

Airfield Electrical System

Similar to the old style of Christmas lights, most airfield electrical systems use a *series circuit*.



Series Circuits

A failure within the circuit can cause the entire system to fail.

Each light has an isolation transformer which maintains the circuit when a light bulb fails or the light fixture is run down.

Airfield Electrical System

As electrical systems age, sudden system failure becomes more of possibility with each passing day.

System Failure

Troubleshooting and repair takes time.

Can your airport afford a sudden system failure?

How might that affect your tenants?

How might that affect the safety of the airport?

Has your airport experienced a partial or complete lighting failure?

Conduit vs. Direct Buried

- Cable installed in conduit
  - Advantages:
    - Longevity
    - Ease of maintenance work
    - Easier quality assurance on installation
  - Disadvantages:
    - Additional installation cost
    - Inflexibility with small configuration changes

- Cable directly buried in earth
  - Advantages:
    - Lower installation cost
    - Potential flexibility with small configuration changes
  - Disadvantages:
    - Challenging recourse for poorly installed systems
    - Difficult to perform some routine maintenance

Airfield Electrical System

- Degradation in the integrity of airfield cable insulation can be a primary reason for airfield circuit failure.
- Weakened or failed insulation creates faults or “leaks” in the cable.
- Initial Megger readings should exceed 500 megohms for a well installed system (now required in FAA technical specifications).

Airfield Electrical System

- Degradation is expected to be around 10-20% per year.
- Test system regularly to identify trends that a circuit may soon fail.
- Regulators with monitoring and on-board testing can assist with this.
- ALCMS can perform tests on an automated schedule and log results.

Airfield Electrical System

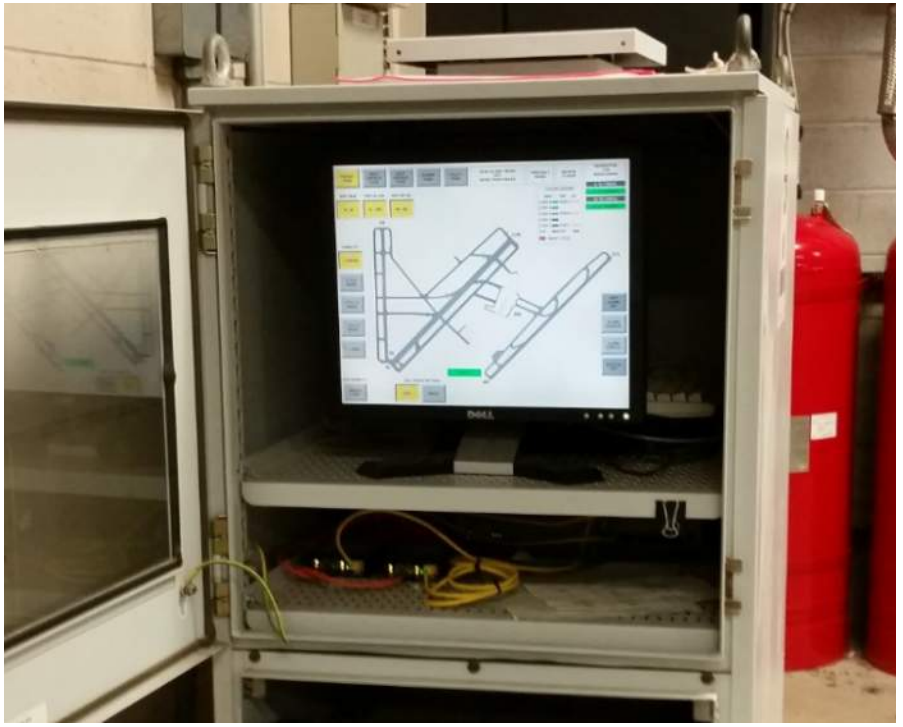
Benefits of regulator monitoring:

- Allows display of regulator performance metrics (megger, voltage, current)
- Eliminates need of separate tools and instruments to determine these values
- Approximately 10-15% increase in acquisition and installation cost for regulator monitoring capabilities

Airfield Electrical System

Benefits of computerized monitoring system (ALCMS) integration:

- Can check megger values on a pre-set schedule
- Provides data logging capability
- Can allow remote users access to data via secured network
- Provides touchscreen interface
- Allows user interaction with airfield equipment without exposing to danger



Case Study

Newport, AR (M19):

- There are two active runways; only one is lit.
- Connecting taxiways are lit.

Newport (M19)

A former Army Airfield base built during World War II.

26 aircraft are based on the field.

Daily fuel sales are common.

Case Study

- Engineer was contacted because a section of the taxiway lighting had failed.
- Lamp replacement did not solve the problem.

Lights Out

Sections of lights being out or dim almost always means cable damage.

Case Study

Site investigation revealed:

- Several damaged transformers
- Many electrical shorts/opens
- Unburied high voltage cable with exposed copper

Buried vs. Conduit

Newport's electrical conductors were buried in the earth.

Case Study

Also revealed in the site investigation:

- The system was not installed in accordance with FAA Advisory Circular requirements.
- The runway circuit was showing signs of nearing failure.

Weak Points

As systems age, they develop multiple weak points.

Poor installation will always expedite failure.

Case Study

- As a result of the investigation, the engineer and the airport worked to develop a series of projects to replace their airfield lighting.

Case Study

- Generally speaking, if the majority of an airport's lights are working, no one thinks anything is wrong.

- Under the surface, there may be many points of imminent failure.

Electrical Inspections

When developing an airport's Capital Improvements Program (CIP), it is best to include an electrical inspection by qualified electrical personnel.

Electrical Inspections

Regular inspections by qualified personnel can identify potential problems before they interrupt your operations.

Electrical Inspections

Qualified Person

"One who has demonstrated skills and knowledge related to the construction and operation of electrical equipment and installations and has received safety training to identify and avoid the hazards involved."

- NFPA 70E Standard for Electrical Safety in the Workplace

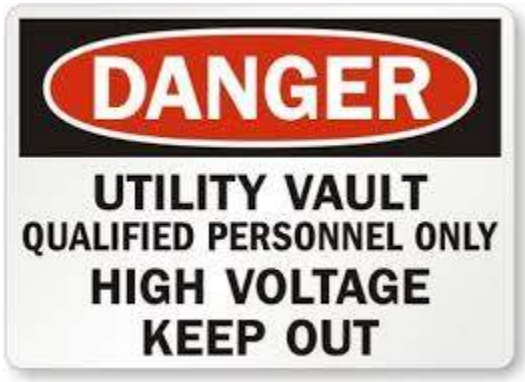
Electrical Inspections

Just because the contractor is a "good" contractor, that does not mean they are qualified.

For example…

Electrical Inspections

Only persons who are qualified in airfield electrical systems should handle any item connected to the system.



Training

Consider the benefits of training your maintenance and operational staff.

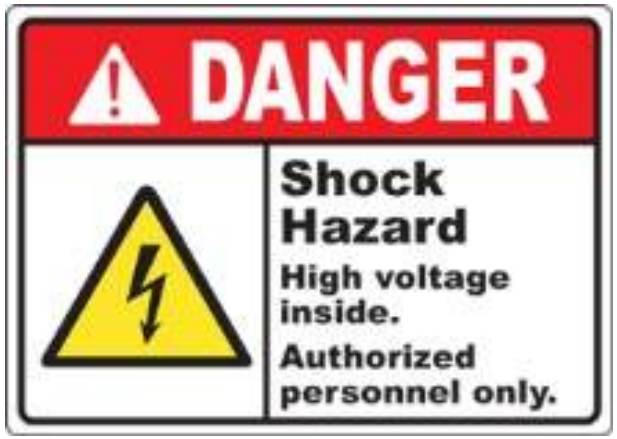
Caution

Airfield lighting systems operate at high voltages which can reach nearly 5,000 volts! NFPA 70E requires unqualified persons come no closer than 5 feet to exposed live parts.

No part of the system should be touched when it is energized.

Components that look normal could have hidden hazards.

For example, cables may have broken or cracked insulation.

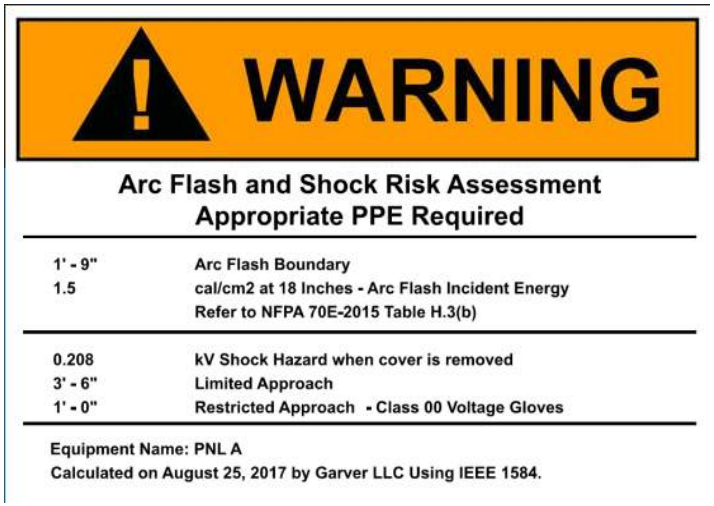


Caution

AC 150/5340-26C, Maintenance of Airport Visual Aid Facilities, Par. 2.5.1.1:

"Each piece of equipment operating at 50 volts or more and not de-energized while work is being performed, must be evaluated for arc flash hazard and shock hazards."

Required by AC 150/5340-30J, 13.2 Power Distribution



Electrical Maintenance

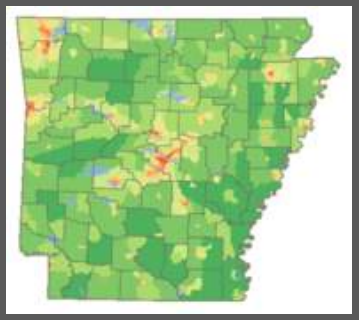
GA airports and smaller commercial airports may not have the staff to perform routine electrical maintenance.

These airports can utilize qualified contractors to assist with electrical maintenance.

Electrical Maintenance

- Airfield electrical systems are unique to the aviation world.
- The vast majority of electrical contractors **do not** know how to work on them.
- Special training is necessary to do a thorough job.

How many *qualified* airfield electricians are in your area?



Arkansas:

Population: 3,000,000

Approximate number of airfield electricians: 50-75

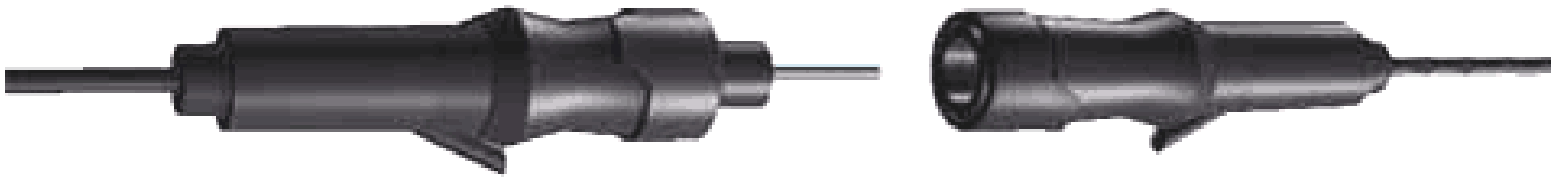
Electrical Projects

- Your electrical project doesn't need to be someone's guinea pig.
- Ask for qualifications before the work starts.
- Have installers perform demonstration connector kit installations prior to beginning work.
- The FAA construction specifications (L-108) require electrical contractors to have a minimum 3 years of continuous experience for splicing 5 kV airfield cables.

Electrical Projects

Connector Evaluation

- Connectors must be installed correctly
- Connectors have been found to commonly be critical points of failure
- Connector failure greatly impacts megger readings and system integrity



Electrical Maintenance

- The FAA publishes Advisory Circular No. 150/5340-26C *Maintenance of Airport Visual Aid Facilities*.

  The use of which is **required for AIP-funded projects.**

- The intent of this AC is to help protect your investment.

From Chapter 1 – Introduction, Applicability

"…use of this AC is mandatory for all projects funded with federal grant monies through the Airport Improvement Program (AIP) and…Passenger Facility Charges (PFC) Program."

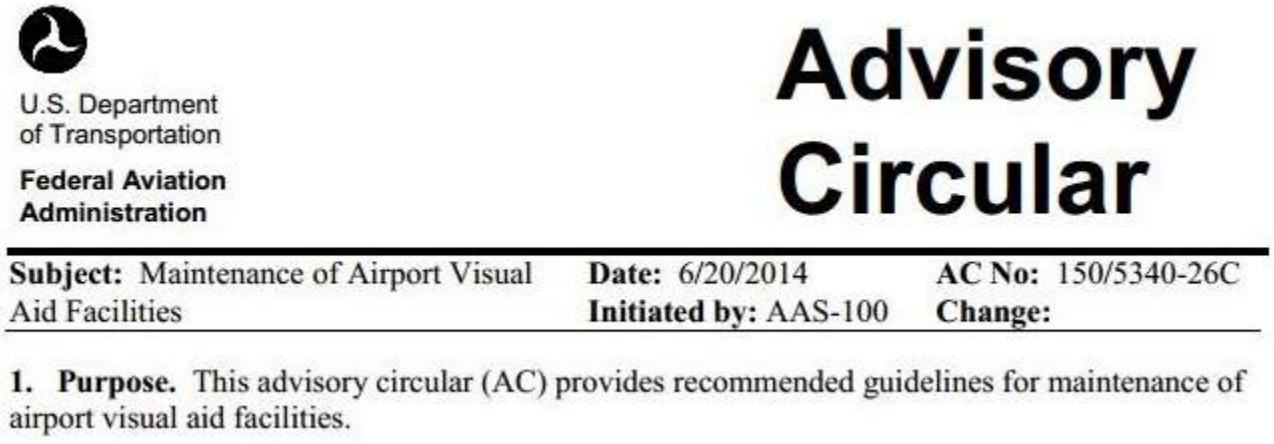
Electrical Maintenance

26C covers the following items:

- Electrical safety procedures
- Arc flash labeling
- Maintenance program for airfield and vault equipment and infrastructure
- Testing frequencies and procedures
- Troubleshooting procedures
- Lamps out tolerances

Preventative Maintenance

Chapter 5 of the maintenance AC includes a recommend Preventive Maintenance Inspection (PMI) schedule for each major item/system.



U.S. Department of Transportation

Federal Aviation Administration

Advisory Circular

Subject: Maintenance of Airport Visual Aid Facilities	**Date:** 6/20/2014	**AC No:** 150/5340-26C
	Initiated by: AAS-100	**Change:**

1. Purpose. This advisory circular (AC) provides recommended guidelines for maintenance of airport visual aid facilities.

Required

PMI's are required for AIP funded projects.

Chapter 5 "may be altered to suit local conditions."

Preventative Maintenance

AIRPORT LIGHTING CIRCUIT INSULATION RESISTANCE TEST RECORD

VAULT OR SUBSTATION # _____

CIRCUIT IDENTIFICATION _____

DATE	OHMS	WEATHER CONDITIONS AND COMMENTS	INITIALS

Figure 5-1. Sample Insulation Resistance Record

Preventative Maintenance

Maintenance Requirement	DAILY	WKLY	MTHLY	SMANLY	ANNLY	UNSCH
1. Check control circuits on all brightness steps	X					
2. Check condition and operation of regulator		X				
3. Check input voltage and current			X			
4. Check output current on each brightness step			X			
5. Check output load on regulator if needed				X		
6. Check relays, wiring and insulation				X		
7. Check dielectric strength of cooling oil (if used)					X	
8. Perform a short-circuit test					X	
9. Perform an open-circuit test (only on regulators with open circuit protection.					X	
10. Clean rust spots and repaint as necessary.						X

Table 5-5. Preventive Maintenance Inspection Schedule for Constant Current Regulators

Preventative Maintenance

Table 5-1. Preventive Maintenance Inspection Schedule for Airport Lighting Vaults

Maintenance Requirement	DAILY	WKLY	MTHLY	SMANY	ANNLY	UNSCH
1. Check control operation	X					
2. Check general cleanliness		X				
3. Check for moisture		X				
4. Check ventilator screens or air conditioner controls		X				
5. Inspect safety boards, safety equipment and fire extinguishers			X			
6. Check insulation resistance of all field circuits*			X			
7. Check input voltage to vault				X		
8. Check ground resistance				X		
9. Inspect and clean buses				X		
10. Check relay operation				X		
11. Check oil fuse cutouts				X		
12. Check oil switches				X		
13. Operate power transfer switches			X			
14. Check control panel or computer control equipment				X		
15. Check photoelectric switch				X		
16. Check astronomic time switch				X		
17. Check radio control of lighting equipment			X			
18. Check lightning arrestors				X		X
19. Inspect miscellaneous electrical equipment				X		
20. Test oil dielectric strength in transformers and regulators					X	
21. Paint equipment as necessary					X	X

* Weekly insulation resistance tests may be necessary for older circuits.

Preventative Maintenance

Table 5-5. Preventive Maintenance Inspection Schedule for Runway and Taxiway Elevated Edge Lights

MAINTENANCE REQUIREMENT	DAILY	WKLY	MTHLY	SMANY	ANNLY	UNSCH
1. Inspect for outages; repair as necessary	X					
2. Check cleanliness of lenses	X					
3. Perform photometric testing (HIRL) and check light alignment and orientation			X			X
4. Re-align lights as needed			X			X
5. Clean fixtures and sockets						X
6. Check light elevation				X		
7. Check for moisture in lights				X		
8. Inspect fixture for rust, deterioration					X	
9. Check lamp fitting and clean contacts					X	
10. Check gaskets					X	
11. Remove snow and/or vegetation from around lights						X

Preventative Maintenance

Work with your consultant to develop a program for your airport.

Your consultant can help you locate a qualified contractor to perform electrical maintenance/repairs for your airport.

Preventative Maintenance

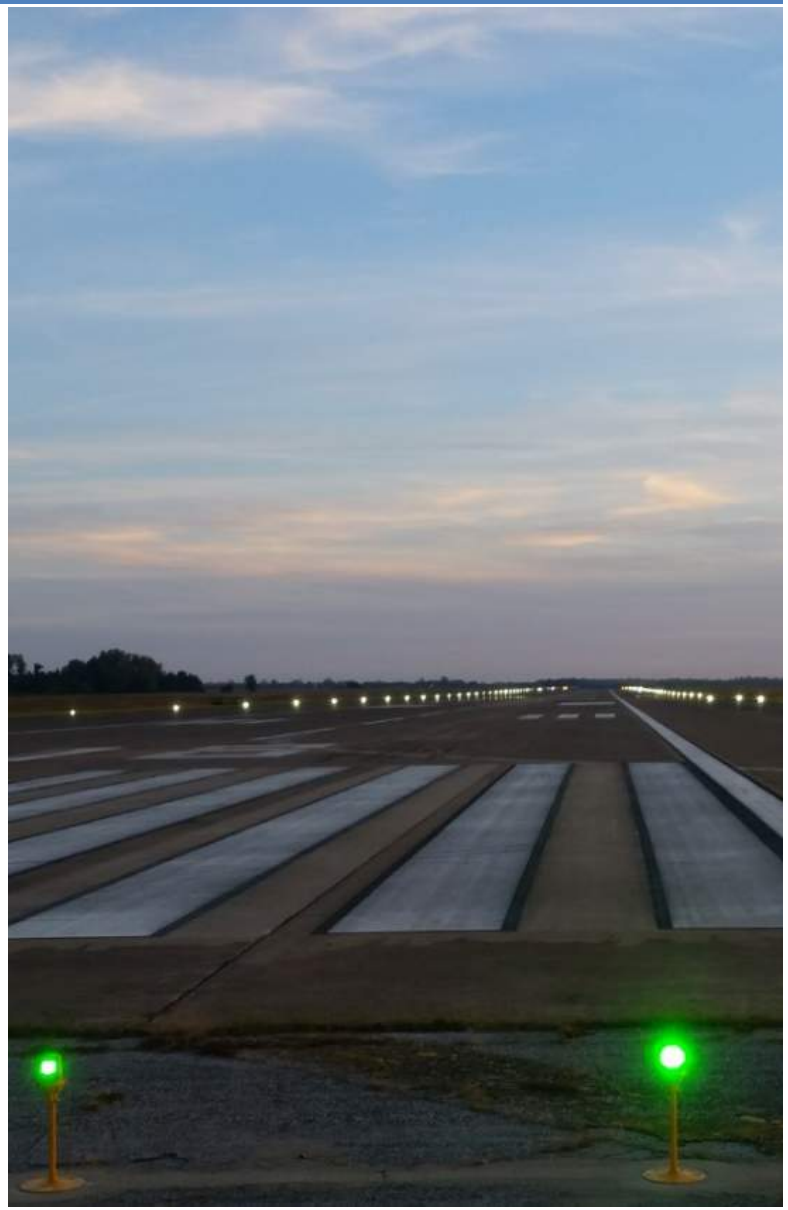
Very important:

- ✈ Tailor the maintenance program for your airports needs and complexity.

Preventative Maintenance

Correctly performed and appropriately scheduled airfield electrical maintenance can:

- Protect the airport's and funding agency's investment
- Provide a degree of safety and help protect airport personnel
- Help the airport stay in compliance with FAA and state DOT requirements



Recap

We hope we have shown:

- Your maintenance program must begin with safety first
- Diligent maintenance and inspection will help avoid surprises
- Engineers and qualified contractors can assist in identifying issues with electrical systems
- A maintenance program can work for you

Any Questions?