# Safe Maintenance of Airfield Electrical Systems for Small Airports

**April 9, 2026**

**2 – 3:30 PM EDT**

NATIONAL ACADEMIES Sciences Engineering Medicine

TRB TRANSPORTATION RESEARCH BOARD

ACRP AIRPORT COOPERATIVE RESEARCH PROGRAM

# Today's Learning Objectives

1. Use ACRP WebResource 20 guidance to address the unique safety, staffing, and resource constraints of small airports

1. Locate and utilize the key actionable tools within the resource, such as the Task Decision Matrix and the Lockout/Tagout procedures, to ensure staff is working under electrically safe work conditions

1. Leverage the website's content to define electrical staff skill sets, identify appropriate training opportunities, and implement structured troubleshooting and preventative maintenance procedures

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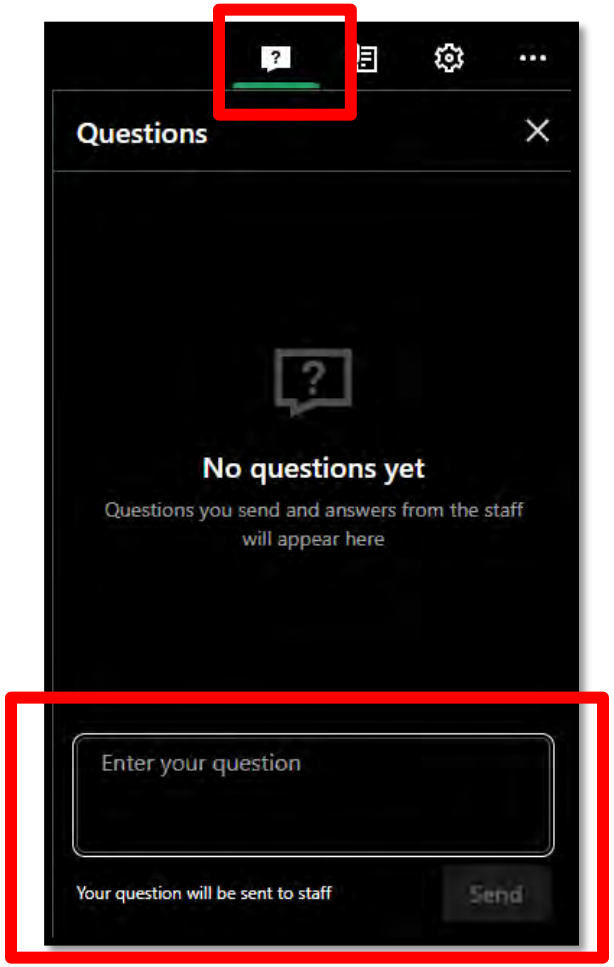
# Questions and Answers

**Please type your questions into your webinar control panel**

**We will read your questions out loud, and answer as many as time allows**

**#TRBwebinar**



# Grayson Langlais, C.M.
## *The Aviation Planning Group*

- Aviation Planner
- Contributed to airport master plans, airport layout plans, state aviation system plans, and Part 77 analyses.
- Professional experience includes commercial airports of all sizes, busy general aviation airfields, hospital heliports, seaplane bases, and on-airport vertiports.
- Academic research included a defended thesis titled "Integration of Advanced Air Mobility Corridors into the National Airspace System."

# Today's Speakers

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Littleton, CO

# Safe Maintenance of Airfield Electrical Systems for Small Airports

## Objectives

The objective of this research was to **provide guidance** and **best practices for safely maintaining airfield electrical systems** that are **accessible and practical** for small-hub, non-hub, reliever, and GA airports.

The guidance included

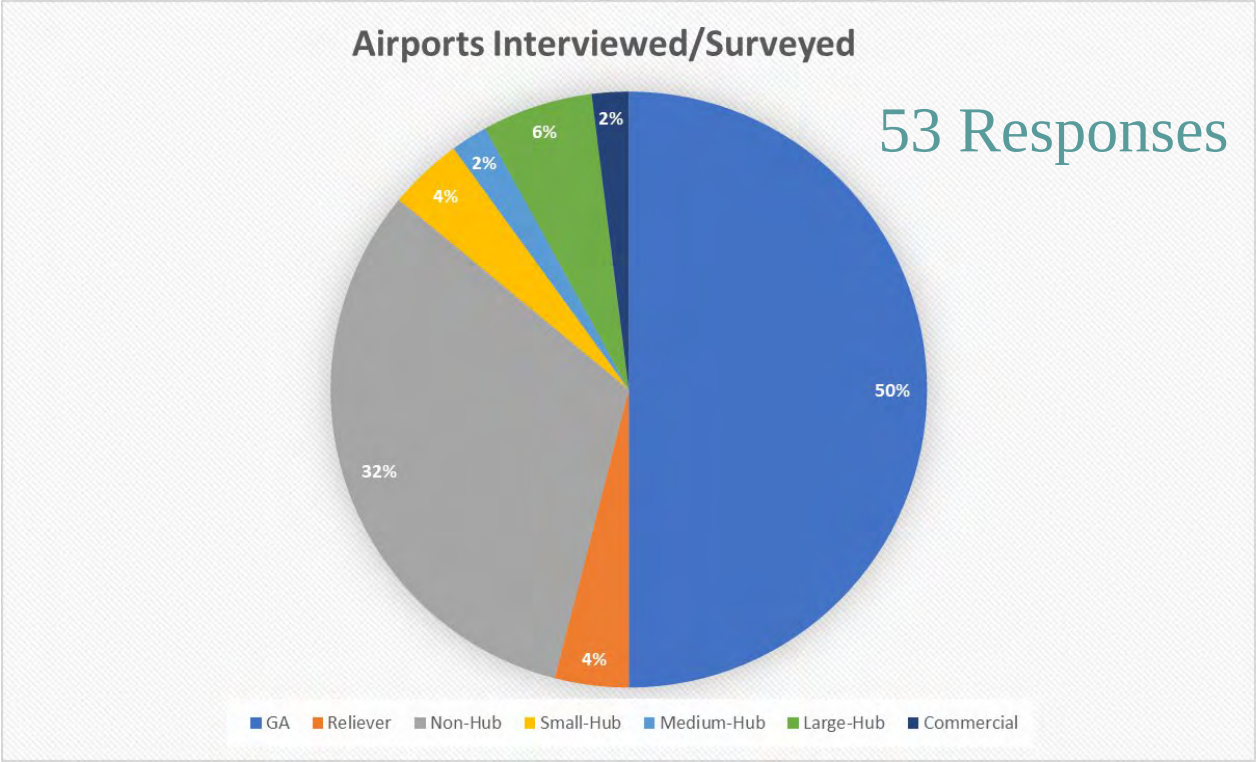
- tools;
- compile means and methods for recognizing hazards and mitigating risks; and
- provide curriculum outlines and job aids that sponsors can use to ensure that individuals are better equipped to perform tasks assigned.

# Research Approach

## Literature Review

- FAA
- ACRP
- AAAE
- Airport in-house training

## Airport Interviews/Surveys

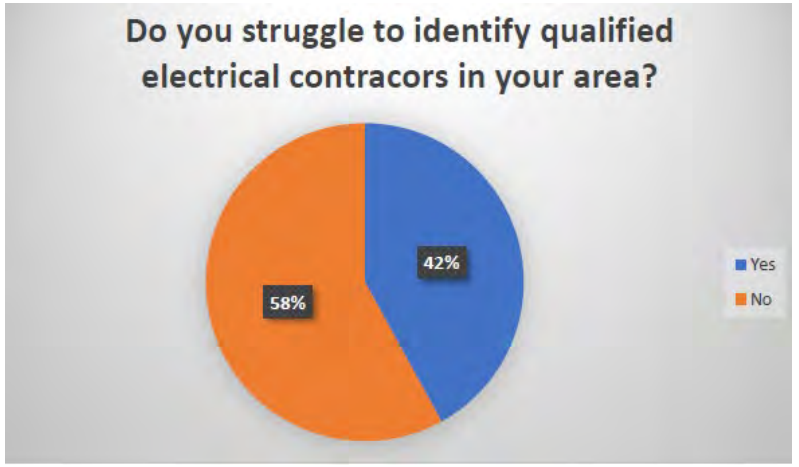


# Interview Survey Results

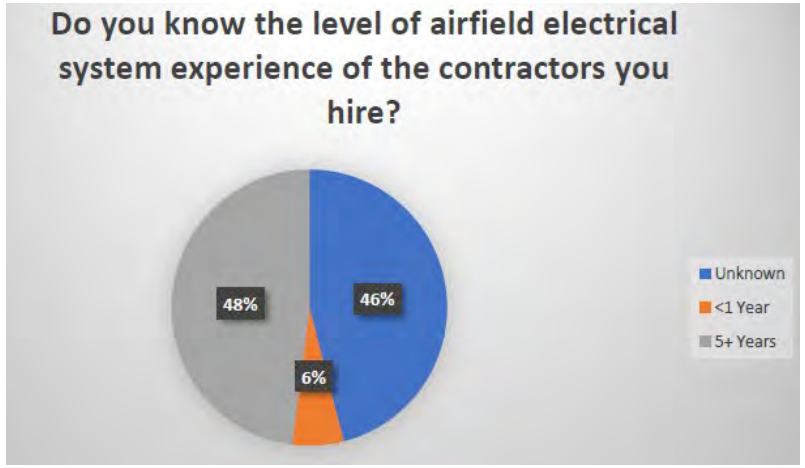
## Commonalities

- Most airports surveyed had 10 or less airfield circuits (small systems)
- Most airports surveyed perform their own electrical system maintenance.
- Most airports surveyed don’t have licensed electricians on staff.
- Most have electrical maintenance staff possessing 5 years or more experience.
- About 50% of airports provide electrical training. Most being informal on the job training.
- The majority of surveyed airports are unaware of available training curriculums.
- 65% thought their training was insufficient.
- **Lack of Awareness, budget, available time/limited resources are common reasons for lack of training.**

# Contractor Related Questions





# WebResource 20 Tools

- Decision Matrix
- Compiled Videos and Other Training Resources
- Contractor RFQ
- Maintenance Checklists
- Component Descriptions
- Terminology

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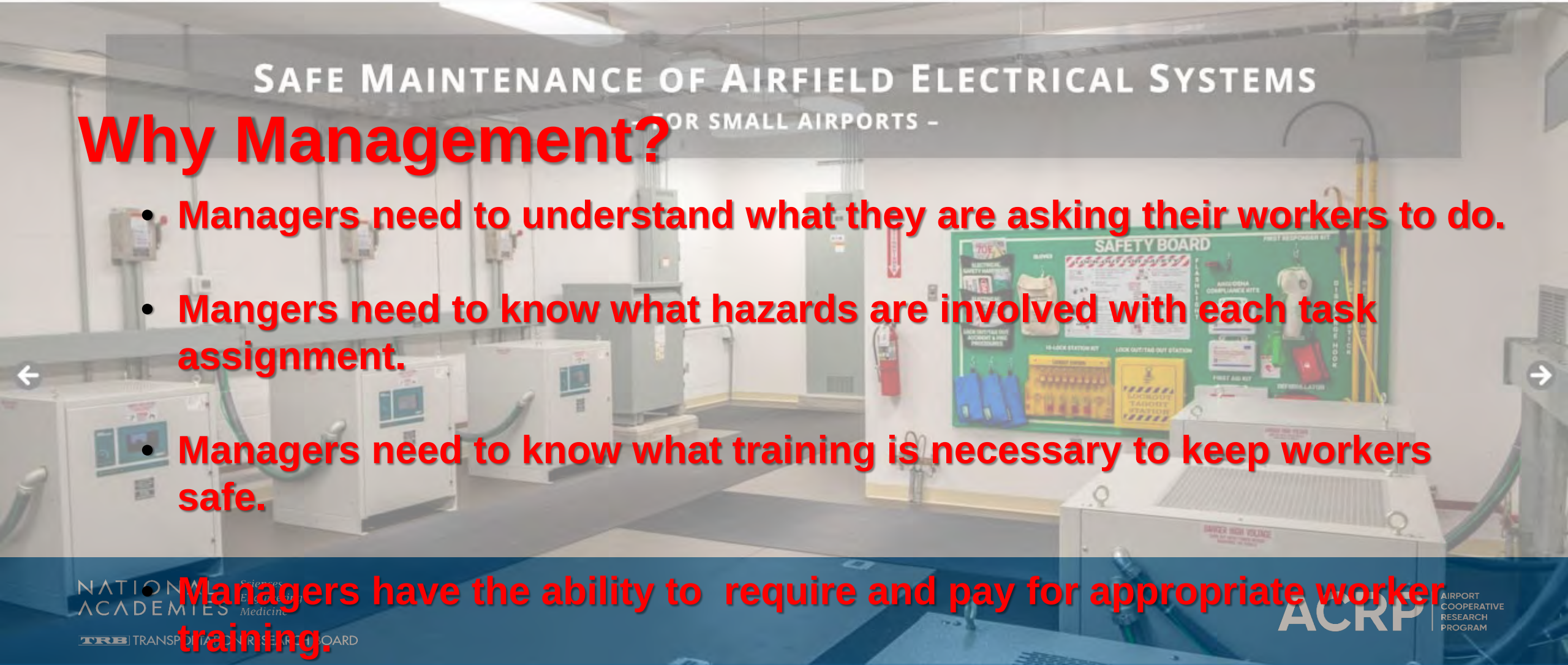


# Why Management?

- Managers need to understand what they are asking their workers to do.
- Mangers need to know what hazards are involved with each task assignment.
- Managers need to know what training is necessary to keep workers safe.
- Managers have the ability to require and pay for appropriate worker training.

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- Airfield Lighting Safety and Maintenance
- General Hazards and Risks
- Safe and Electrically Unsafe Work Conditions
- Task Decision Matrix

## General Hazards and Risks

While airport lighting systems pose a number of unique hazards and challenges, the electrical hazards involved hold out the same dangers of injury or death. There are four general electrical hazards of concern while working with airport lighting systems: electric shock, arc flash, arc blast, and fire.

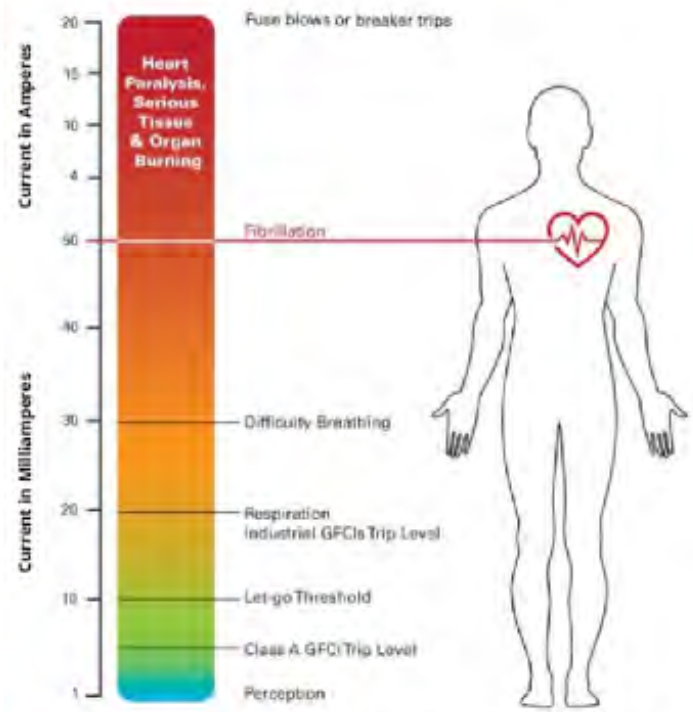
### ELECTRIC SHOCK*

To eliminate the hazards of electric shock, it is important to know the following:

- The source of the hazard
- How the exposure could occur
- How severe the shock would be to the human body
- What action is necessary

To mitigate exposure to electric shock, one should consider:

- Can the circuit be de-energized?
- If not, what must be done to minimize the hazard?
- What personal protective equipment (PPE) will minimize the exposure?




*The effects of different current levels flowing through the human body (source: Littelfuse)*

*Duluth International Airport. *Airfield Lighting Electrical Safety Program*, July 24, 2007.

## ARC FLASH*

Arc flash is defined as follows:

> When an electric current passes through air between ungrounded conductors or between ungrounded conductors and grounded conductors, the temperatures can reach 35,000°F. Exposure to these extreme temperatures both burns the skin directly and causes ignition of clothing, which adds to the burn injury. The majority of hospital admissions due to electrical accidents are from arc-flash burns, not from shocks. Each year more than 2,000 people are admitted to burn centers with severe arc-flash burns. Arc flashes can and do kill at distances in excess of 10'.

The degree of arc flash potential should be determined by a qualified electrical engineer and posted, along with PPE requirements, on the cabinet of all electrical equipment as recommended by the Occupational Safety and Health Ad[illegible] (OSHA) and the National Fire Protection Association (NFPA) 70E.

Understanding Arc Flash

*National Fire Protection Association. *NFPA 70E: Standard for Electrical Safety in the Workplace®*. Annex K.


*Potential arc flash hazard warning sign*

## ARC BLAST*

An arc blast occurs when the tremendous temperatures of the arc cause the explosive expansion of both the surrounding air and the metal in the arc path. For example, copper expands by a factor of 67,000 times when it turns from a solid to a vapor. The dangers associated with this expansion include high pressure, sound, and shrapnel. The high pressure can easily exceed hundreds or even thousands of pounds per square foot, knocking workers off ladders, rupturing eardrums, and collapsing lungs. The noise can exceed 160 dB. Finally, material and molten metal is expelled away from the arc at speeds exceeding 700 mph, fast enough for the shrapnel to penetrate the body.

The degree of arc blast potential should be determined by a qualified electrical engineer and posted along with PPE requirements on the cabinet of all electrical equipment as recommended by OSHA and NFPA 70-E.

WORKPLACE SAFETY AWARENESS COUNCIL

# Understanding "Arc Flash"

Simply put, an arc flash is a phenomenon where a flashover of electric current leaves its intended path and travels through the air from one conductor to another, or to ground. The results are often violent and when a human is in close proximity to the arc flash, serious injury and even death can occur.

Arc flash can be caused by many things including:

- Dust
- Dropping tools
- Accidental touching
- Condensation
- Material failure
- Corrosion
- Faulty Installation

Three factors determine the severity of an arc flash injury:

- Proximity of the worker to the hazard
- Temperature
- Time for circuit to break

Because of the violent nature of an arc flash exposure when an employee is injured, the injury is serious – even resulting in death. It's not uncommon for an injured employee to never regain their past quality of life. Extended medical care is often required, sometimes costing in excess of $1,000,000.

**Typical Results from an Arc Flash**

- Burns (Non FR clothing can burn onto skin)
- Fire (could spread rapidly through building)
- Flying objects (often molten metal)
- Blast pressure (upwards of 2,000 lbs. / sq.ft)
- Sound Blast (noise can reach 140 dB – loud as a gun)
- Heat (upwards of 35,000 degrees F)

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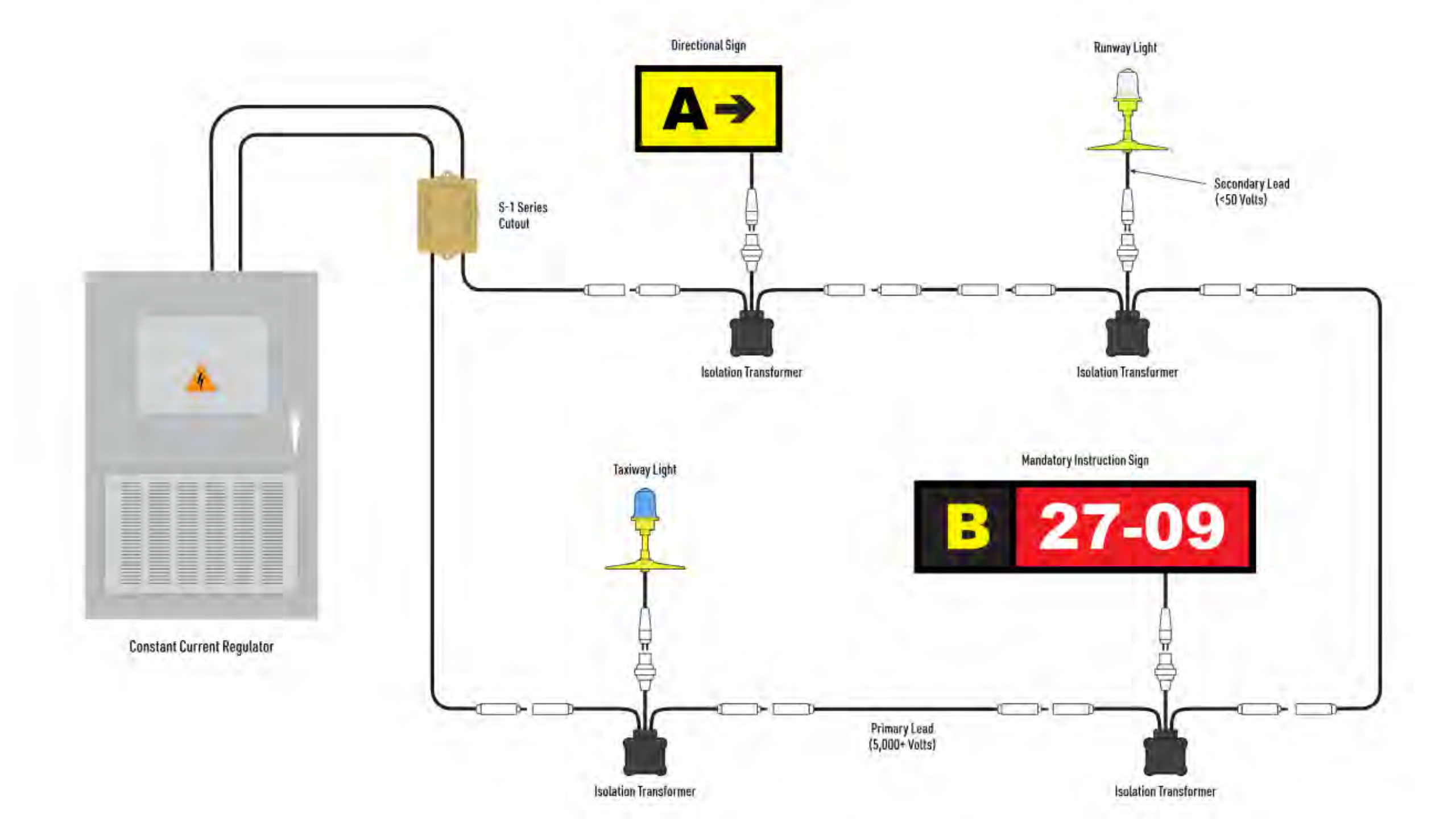
Directional Sign
A
Runway Light
S-1 Series
Cutout
Secondary Lead
(<50 Volts)
Isolation Transformer
Isolation Transformer
Constant Current Regulator
Taxiway Light
Mandatory Instruction Sign
B
27-09
Primary Lead
(5,000+ Volts)
Isolation Transformer
Isolation Transformer

## GENERAL HAZARDS & RISKS

The hazards associated with the airport lighting system, while unique, remain the same as other electrical hazards when discussing how they could injure and kill.

**Electrical hazards include:**

- Electric shock – the primary hazard
- Arc flash and arc blast – typically most hazardous when working on the 208v–480v line voltage side of the constant current regulator or on any other non-series circuit, such as motor control centers, switchgear, and electrical distribution panels
- Fire

Learn more about General Hazards and Risks

Watch the first seven minutes of this video to learn about the hazards of airfield lighting.

## TASK DECISION MATRIX

The Task Decision Matrix illustrates the levels of necessary training and work experience necessary for tasks with different levels of complexity.

View the Task Decision Matrix

- Is the employee properly trained?
- Does the employee wear proper personal protective equipment (PPE) and understand the appropriate PPE based on each task?
- How many hours of experience does the employee have?
- How was the risk mitigated?
- Document all employee training and exposure.

If an accident or injury occurs, these questions will likely be asked, so it is important to document the scene, PPE used, and all circumstances.

Qualified Worker Task Checklist

Qualified Worker

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# Electrically Safe and Electrically Unsafe Work Conditions

## IMPORTANCE OF "ELECTRICALLY SAFE WORK CONDITION"

One of the most important decisions an airport manager can make regarding their electrical safety program is whether any electrical work will be allowed beyond an "Electrically Safe Work Condition."

**Electrically Safe Work Condition:**

> A state in which the conductor or circuit part to be worked on or near has been disconnected from the energized part, locked/tagged in accordance with established standards, tested to ensure the absence of voltage, and, if necessary, grounded. Achieving an electrically safe work condition is the underlying principle of all electrical work.*

*Duluth International Airport. *Airfield Lighting Electrical Safety Program*, July 24, 2007.

With an electrically safe work condition, the hazard level, training requirements, personal protective equipment (PPE) requirements, and documentation are minimized, and an electrical safety program will be simplified. If work needs to be done beyond an electrically safe work condition, the safety program will need to be intensified and more skilled employees will be necessary; far more risk will be taken on.

**Working beyond an electrically safe work condition will require:**

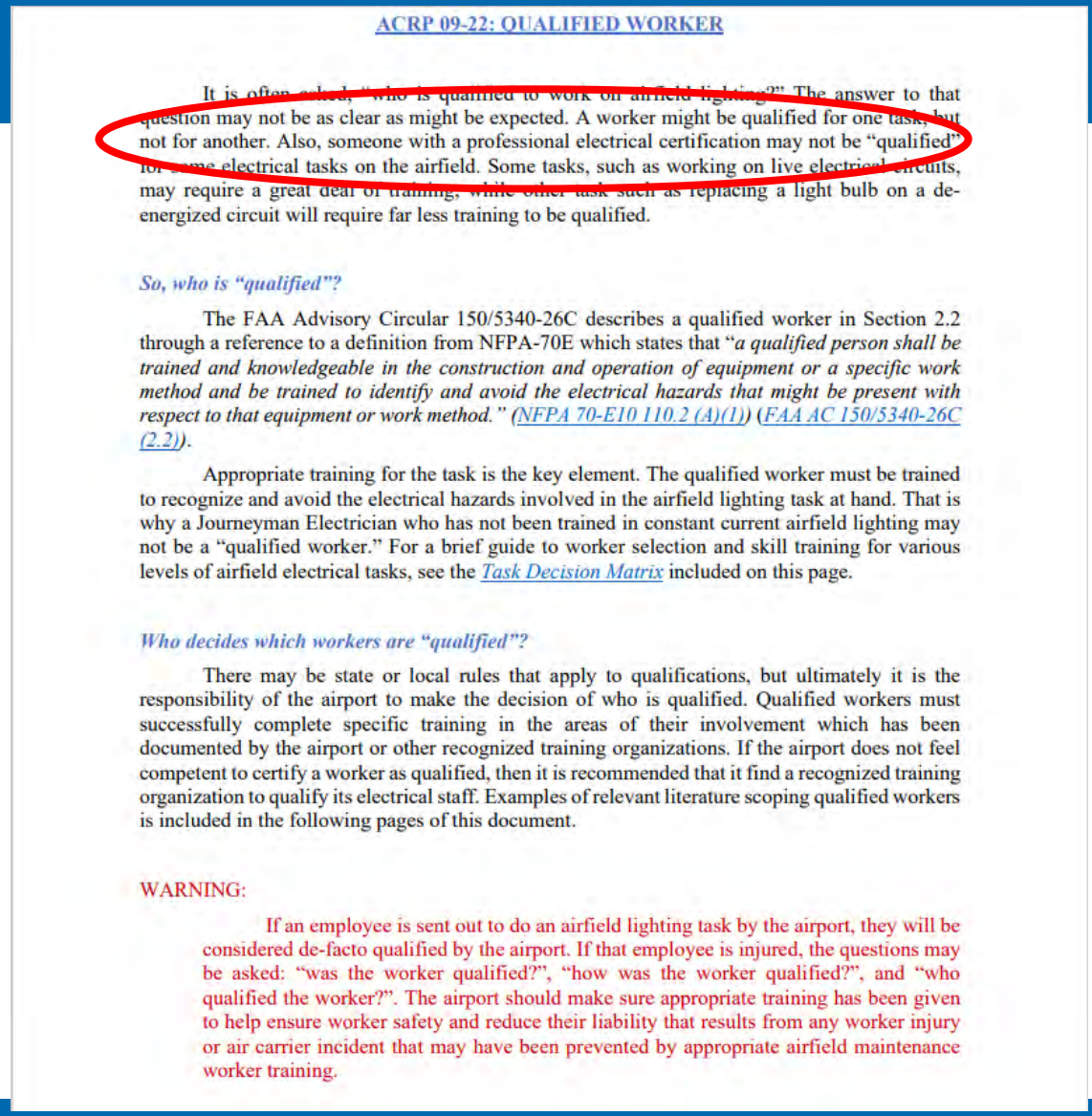
- Establishing boundaries around live parts

Qualified Worker Task Checklist

Qualified Worker

# So, who is “qualified”?

A worker might be qualified for one task, but not for another. Also, someone with a professional electrical certification may not be “qualified” for some electrical tasks on the airfield.



ACRP 09-22: QUALIFIED WORKER

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*So, who is “qualified”?*

The FAA Advisory Circular 150/5340-26C describes a qualified worker in Section 2.2 through a reference to a definition from NFPA-70E which states that “*a qualified person shall be trained and knowledgeable in the construction and operation of equipment or a specific work method and be trained to identify and avoid the electrical hazards that might be present with respect to that equipment or work method.*” (NFPA 70-E10 110.2 (A)(1)) (FAA AC 150/5340-26C (2.2)).

Appropriate training for the task is the key element. The qualified worker must be trained to recognize and avoid the electrical hazards involved in the airfield lighting task at hand. That is why a Journeyman Electrician who has not been trained in constant current airfield lighting may not be a “qualified worker.” For a brief guide to worker selection and skill training for various levels of airfield electrical tasks, see the Task Decision Matrix included on this page.

*Who decides which workers are “qualified”?*

There may be state or local rules that apply to qualifications, but ultimately it is the responsibility of the airport to make the decision of who is qualified. Qualified workers must successfully complete specific training in the areas of their involvement which has been documented by the airport or other recognized training organizations. If the airport does not feel competent to certify a worker as qualified, then it is recommended that it find a recognized training organization to qualify its electrical staff. Examples of relevant literature scoping qualified workers is included in the following pages of this document.

WARNING:

If an employee is sent out to do an airfield lighting task by the airport, they will be considered de-facto qualified by the airport. If that employee is injured, the questions may be asked: “was the worker qualified?”, “how was the worker qualified?”, and “who qualified the worker?”. The airport should make sure appropriate training has been given to help ensure worker safety and reduce their liability that results from any worker injury or air carrier incident that may have been prevented by appropriate airfield maintenance worker training.

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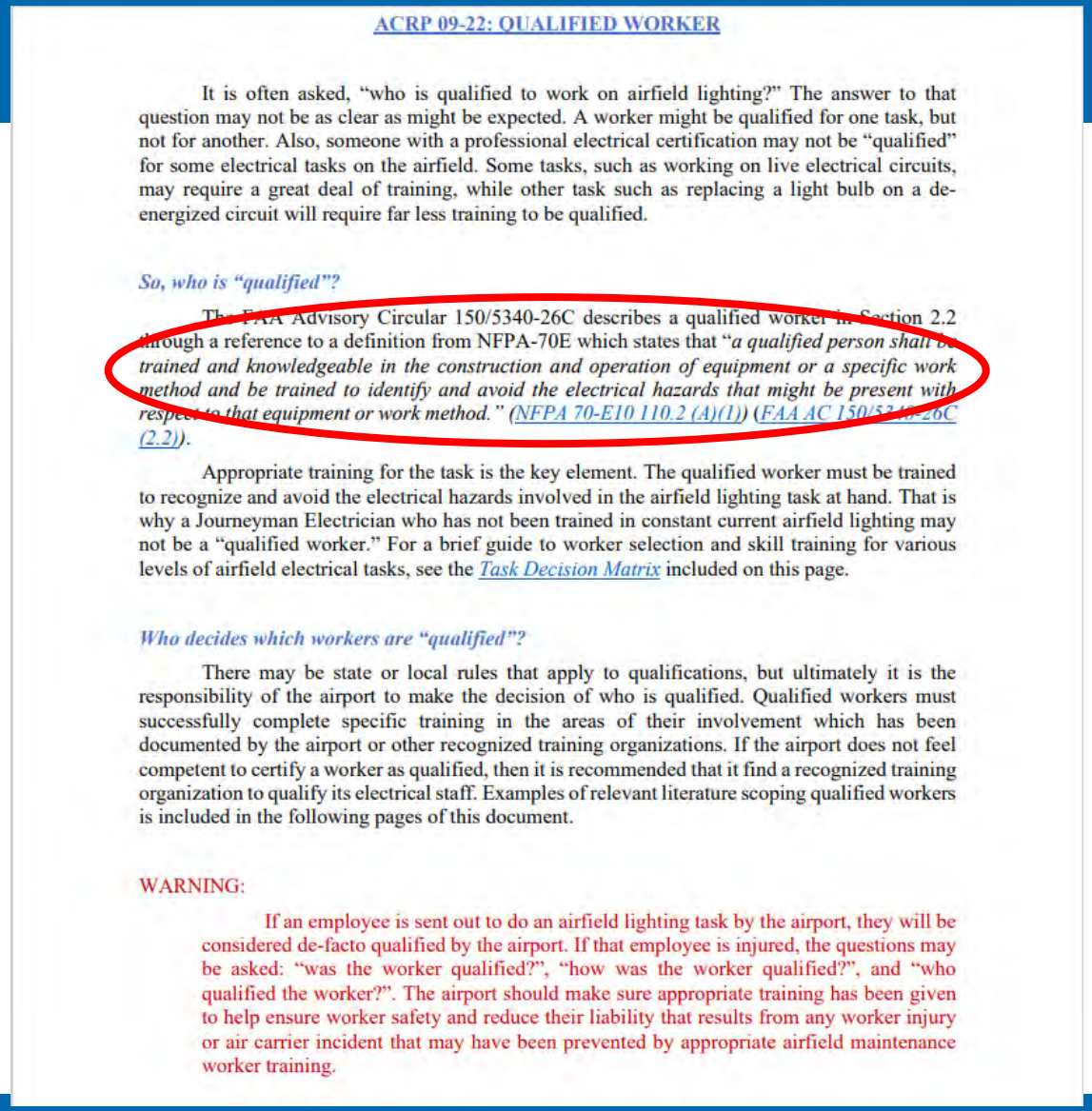

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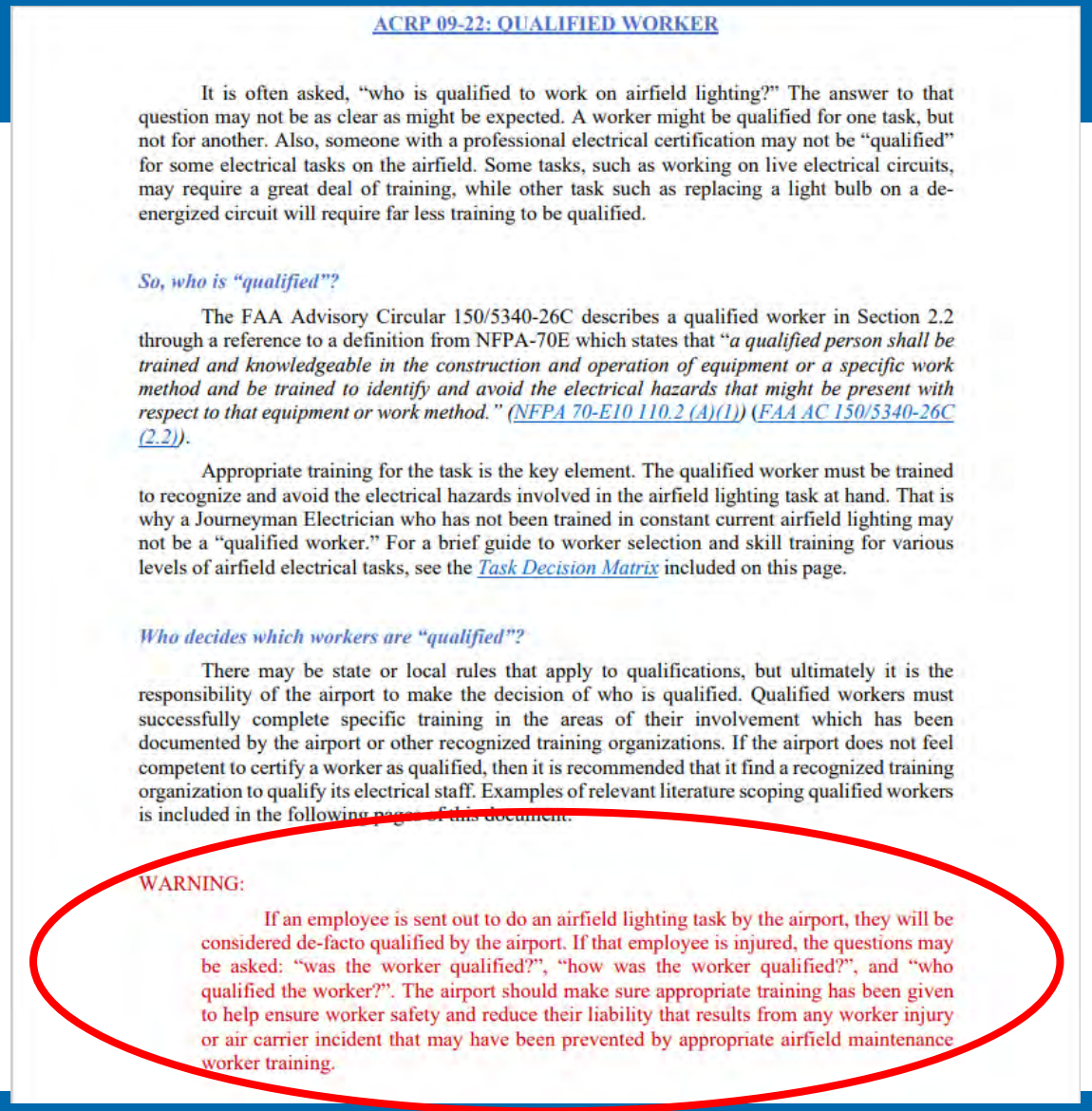

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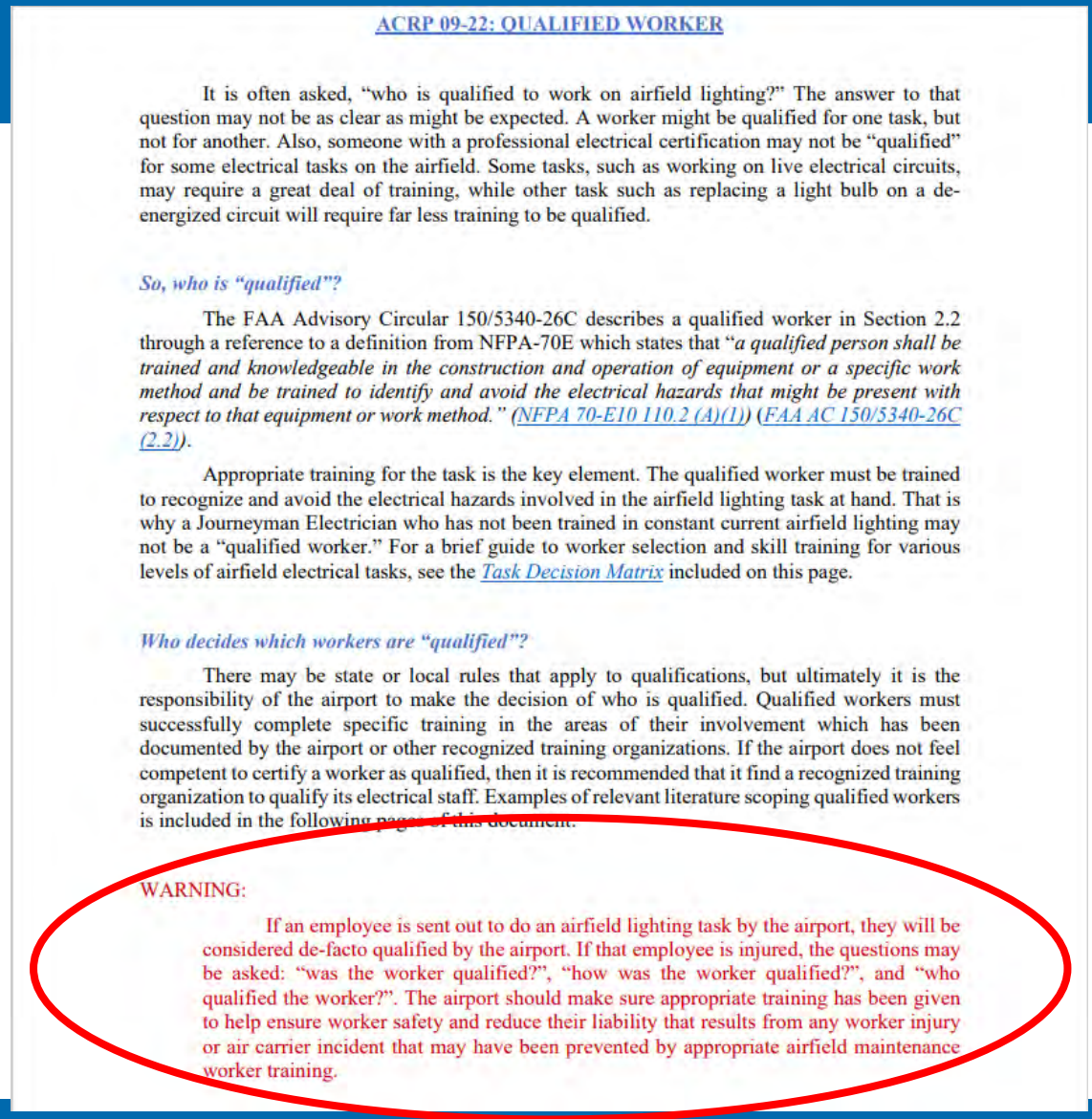
# WARNING

## If someone is injured the questions may be asked:

**Was the worker qualified?**

**How was the worker qualified?**

**Who qualified the worker?**



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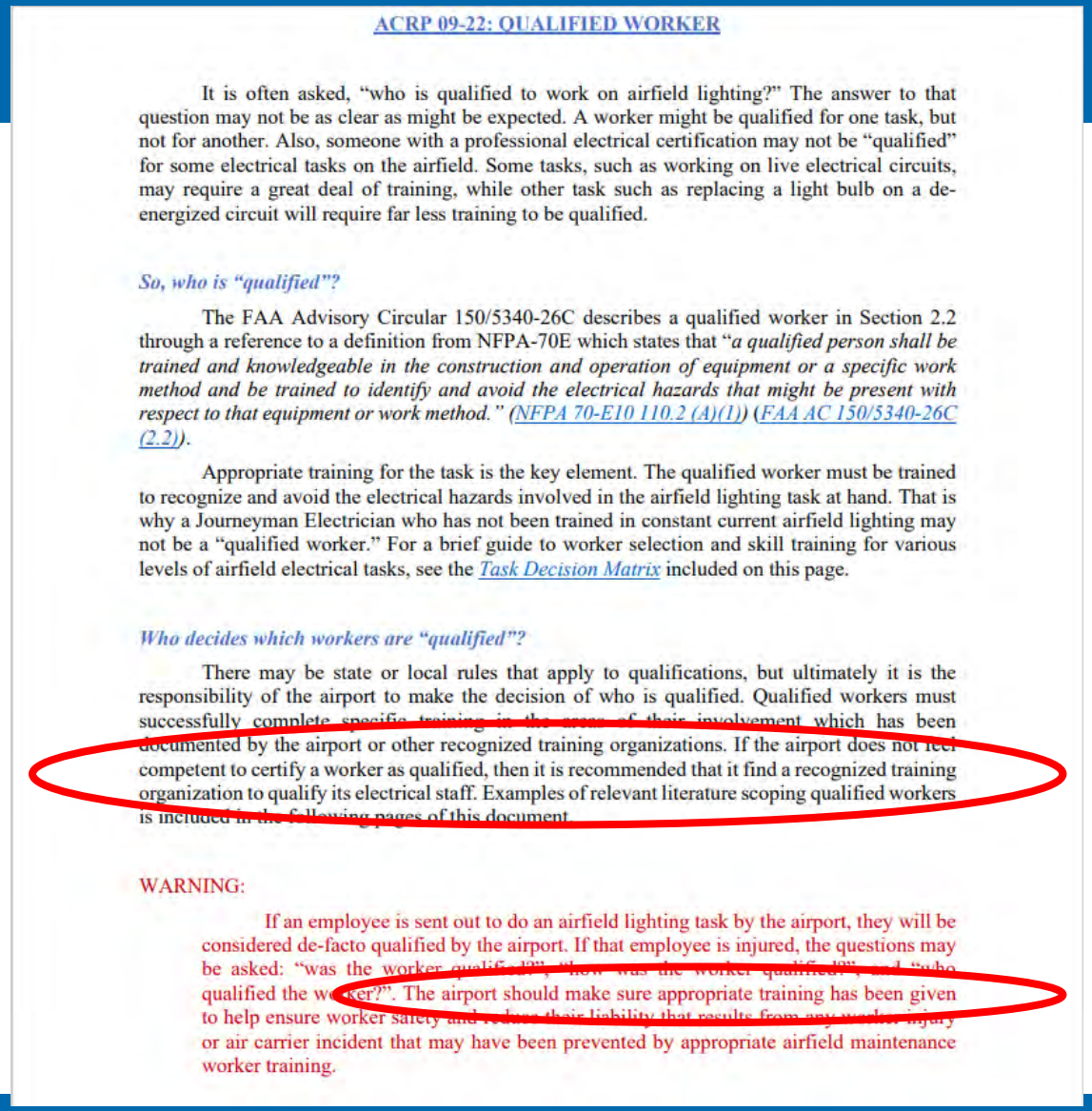
# The airport should make sure appropriate training has been given.

## If the Airport does not feel confident to certify a worker as qualified, then it is recommended that it find a recognized training organization to qualify its electrical



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# A Tool for Airport Managers and Decision-Makers


## Task Decision Matrix

The task decision matrix below is a tool for airport managers and decision-makers to utilize when evaluating the appropriate training or qualifications needed for work on certain airfield electrical projects. In the absence of staff experience as described, the matrix provides options for training which may be used to up-skill airport electrical workers. Task complexity begins in Tier 1 at the bottom of the matrix with relatively simple tasks. Task complexity and associated training and experience needed to conduct various procedures increases in conjunction with higher tiers.

If there is any uncertainty about a task and appropriate electrical experience needed to conduct a procedure, managers should always exercise caution and consult the component manufacturer or a suitably qualified professional.

## TIER 4

### Tasks:

- Complex regulator calibration / troubleshooting
- Regulator major repairs
- New installation
- Airfield Lighting Control and Monitoring System computer controls and programming
- Proprietary equipment installation and repairs

### Training:

Tier 4 is someone who is specifically trained to work on lighting equipment and controls by the lighting manufacturer or a contractor under the guidance of the manufacturer.

Note: These technicians often are not journeyman electricians and may be restricted in their ability to work outside of the manufacturer's equipment such as feed wiring.

Example: Installing a new regulator may require a factory technician for control set up and a Journeyman Electrician to make power connections, etc.

## TIER 3

### Tasks:

- Regulator calibration / troubleshooting
- Regulator major repairs
- 120v-600v National Electrical Code regulated work
- New construction and installation
- Primary feed wiring from the regulator core to the power company transformer

### Suggested Training:

- Journeyman electrician or equivalent (Note: A licensed electrician is not necessarily a "qualified worker" for airfield lighting)
- Basic series circuit theory
- Complete safety understanding
- De-energization/verification competency
- Lock-out/Tag-out (LOTO)
- Distinguish exposed live parts from other parts

### Training Possibilities:

- All possibilities of Tier 2 (below)
- Federal journeyman electrician apprenticeship program

### Training Documentation:

- Must have a list of airfield lighting tasks which trainee has been verified as "qualified" by an outside instructor or experienced airport staff member
- Must have demonstrated the skills and knowledge of each task and any hazards involved
- Journeyman electrician license

## TIER 2

### Tasks:

- S1 cut-out use
- Circuit meggering (insulation resistance testing)
- Circuit ohming (circuit resistance testing)
- Identifying a fault
- Identifying a failed transformer
- Identifying an open
- Proper splicing technique
- Regulator calibration/ troubleshooting
- Regulator minor repairs

### Suggested Training:

- Basic series circuit theory
- Complete safety understanding
- Understanding of tools and meters
- De-energization/verification competency
- LOTO
- Understanding of component installation process
- Distinguish exposed live parts from other parts

### Training Possibilities:

- All possibilities of Tier 1 (below)
- Airfield lighting manufacturer training seminars
- Accredited airfield lighting course
- L-823 splicing certification course

### Training Documentation:

- Must have a list of tasks which trainee has been verified as "qualified" by an outside instructor or experienced airport staff member
- Must have demonstrated the skills and knowledge of each task and any hazards involved

## TIER 1

### Tasks:

- Regulator operation
- Alarm recognition
- Re-lamping and elevated fixture replacement
- Frangible replacement
- Bolt torquing

### Suggested Training:

- Basic safety understanding
- Basic series circuit theory
- De-energizing of circuit
- Verification of de-energization
- LOTO

### Training Possibilities:

- Alaska Department of Transportation airfield lighting safety video
- Advisory Circular 150-5340-26C
- Hands-on de-energization/ verification training with experienced staff/instructor
- LOTO instruction with airport staff

### Training Documentation:

- Must have a list of tasks which trainee has been verified as "qualified" by an outside instructor or experienced airport staff member

## TIER 1

### Tasks:

- Regulator operation
- Alarm recognition
- Re-lamping and elevated fixture replacement
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- Basic safety understanding
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- Circuit meggering (insulation resistance testing)
- Circuit ohming (circuit resistance testing)
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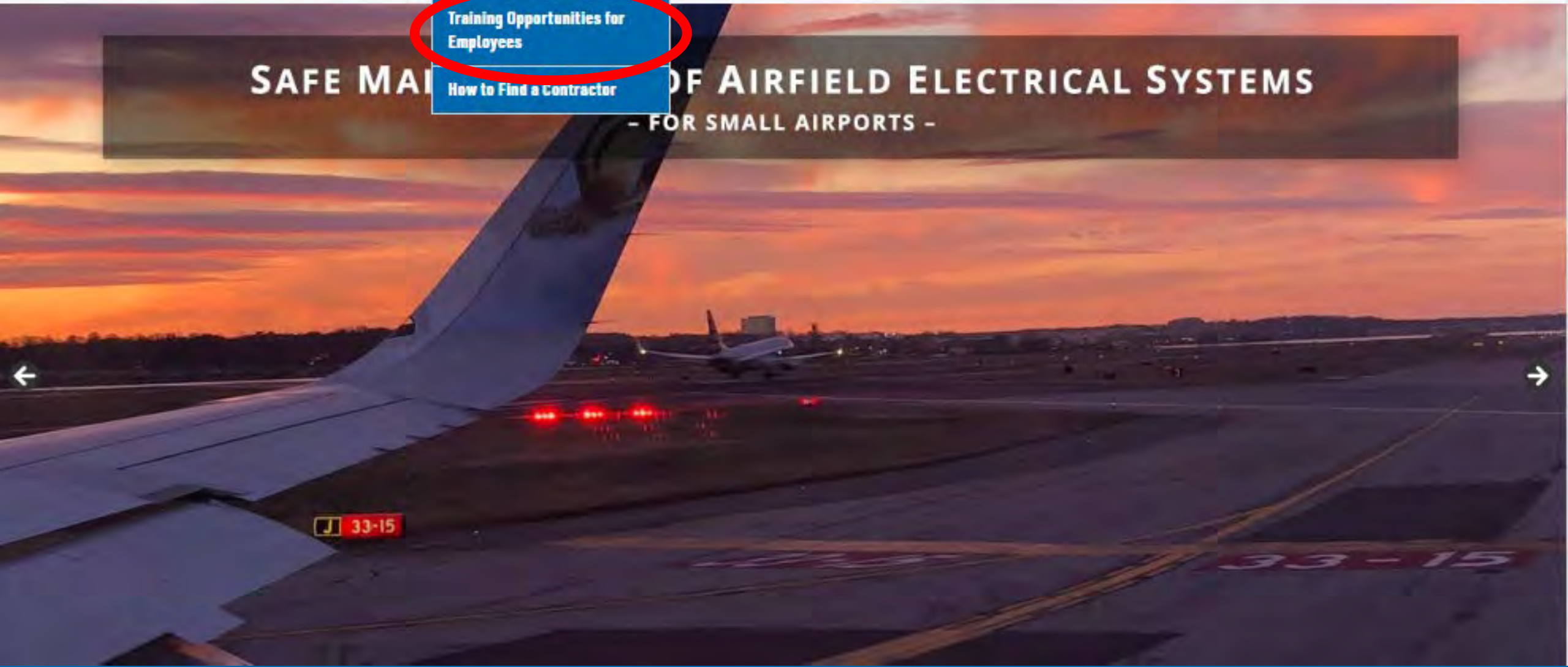
- Task Decision Matrix
- Training Opportunities for Employees
- How to Find a Contractor



# SAFE MAINTENANCE OF AIRFIELD ELECTRICAL SYSTEMS

– FOR SMALL AIRPORTS –

## Training Opportunities for Employees

### IN-PERSON INSTRUCTION

The Association of American Airport Executives (AAAE) offers training in the online self-study and live classroom format. Those who complete the training earn the Airport Certified Employee (ACE)—Airfield Lighting Maintenance designation. More information can be found here.

It is highly recommended that each airport check with their electrical equipment manufacturer or on-call aviation engineers involved in lighting projects, as some firms will offer training services to customer airports.

For example, ADB Safegate offers in-person field maintenance seminars at airports consisting of two days of hands-on classroom training. Further ADB Safegate resources for in-person and online delivery are available here. Flash Technology also offers in-person courses to airports for up to 15 attendees. OCEM Airfield Technology offers similar classroom training. Honeywell has training

Eaton Crouse Hinds Airfield Lighting Course List

AAAE Airport Certified Employee Programs

Airside Solutions In-Person Airfield Electrical Maintenance Training

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- Emergency Response
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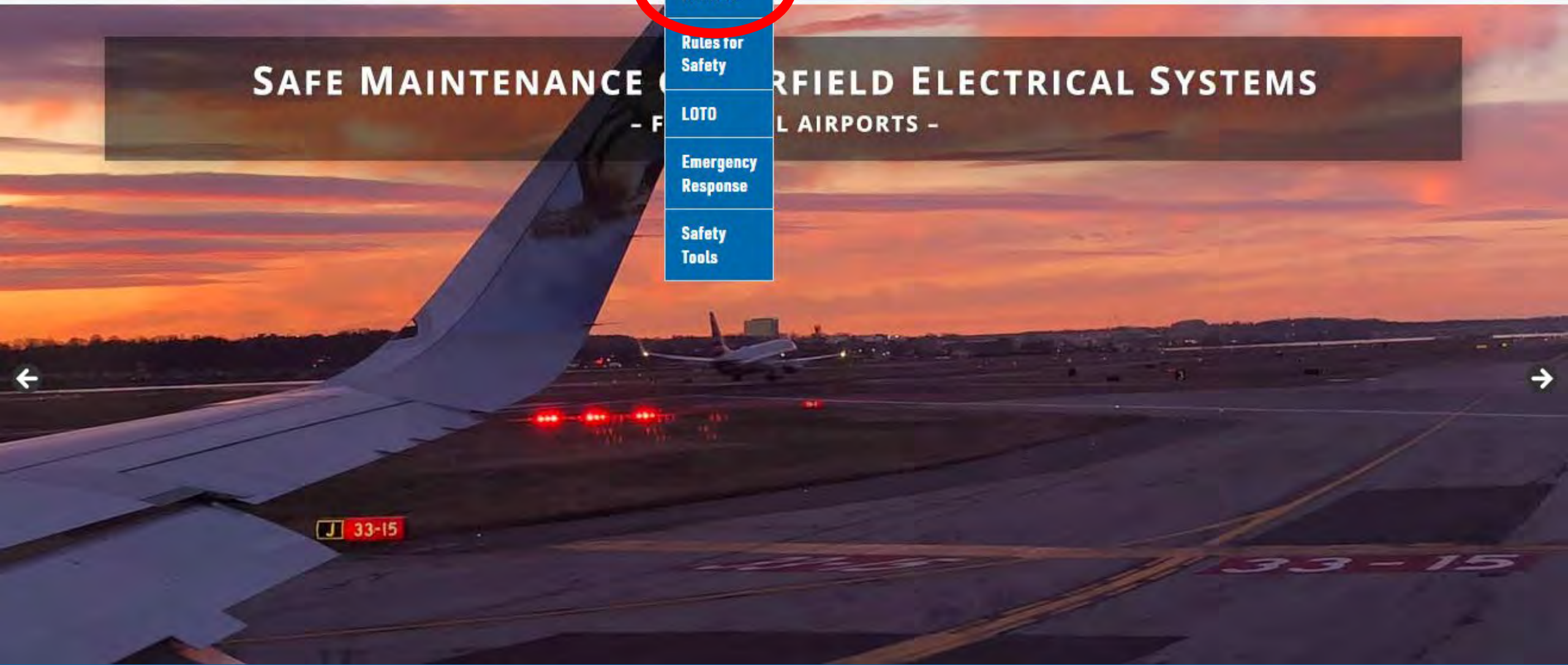

# SAFE MAINTENANCE OF AIRFIELD ELECTRICAL SYSTEMS

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## Unique Hazards

Airfield series constant current lighting circuits are inherently dangerous. Much of the danger stems from their unique functionality and design. Airfield lighting circuits are engineered to keep the lights working while aircraft are on critical landing and take-off operations, so they are designed to continue working through serious problems like ground faults and even components on fire. They are extremely resistant to nuisance trips and unexpected shutdowns. Because of this there is no personnel protection integrated into the system such as might be found on parallel wiring systems. This means if a worker becomes energized by an airfield lighting circuit it will not shut down and will continue to run the lights—even if it is through the worker's body.

Another reason airfield lighting circuits are inherently dangerous is their unique design, which is very different from standard parallel lighting systems used in homes and businesses. It is so unique that unless specifically trained in series constant current theory, most licensed electricians do not understand this system well enough to work on it safely. It is imperative that anyone who works on airfield series constant current lighting systems is properly trained to understand and avoid all electrical hazards involved with maintaining these systems.

AC 150/5340-26C, Maintenance of Airport Visual Aid Facilities, Chapter 2, provides detailed information regarding airfield lighting safety and is a good resource for anyone working with this system.

# Chapter 2. Safety.

## 2.0 General.

This chapter provides information that will aid airport owners/operators in establishing an effective safety program. Safety is the responsibility of everyone and must be practiced in every maintenance activity that is performed. Any additional local operational procedures and OSHA requirements should also be followed. The safety program established at each airport should include preventive safety precautions used when servicing the equipment and first-aid procedures for use in the event of an injury.

We are all surrounded by various hazards every day such as the careless driver using a cell phone that we see on our way to work. Safety is everyone's responsibility and our own responsibility. We cannot delegate our safety responsibilities to others. It is our responsibility to set the safety example for others. Safe work practices is a learned attitude and skill we should be passing on to our fellow workers and our family.

Safety is no accident. Know and comply with your company's safety program and lockout/tagout procedure. Use and store personal protective equipment (PPE) properly. Verify that your test equipment functions properly. Become familiar and knowledgeable with National Fire Protection Association (NFPA) 70E, Standard for Electrical Safety in the Workplace. Should a conflict between your local safety plan and this document occur, we recommend adherence to the stricter (safer) requirement.

**THINK SAFETY FIRST!**

## 2.1 Common Causes of Accidents.

Some common causes of accidents are listed below:

**a.** Working on equipment without adequate coordination with equipment users.

**b.** Working on equipment without sufficient training or experience.

**c.** Failure to follow instructions in equipment manuals

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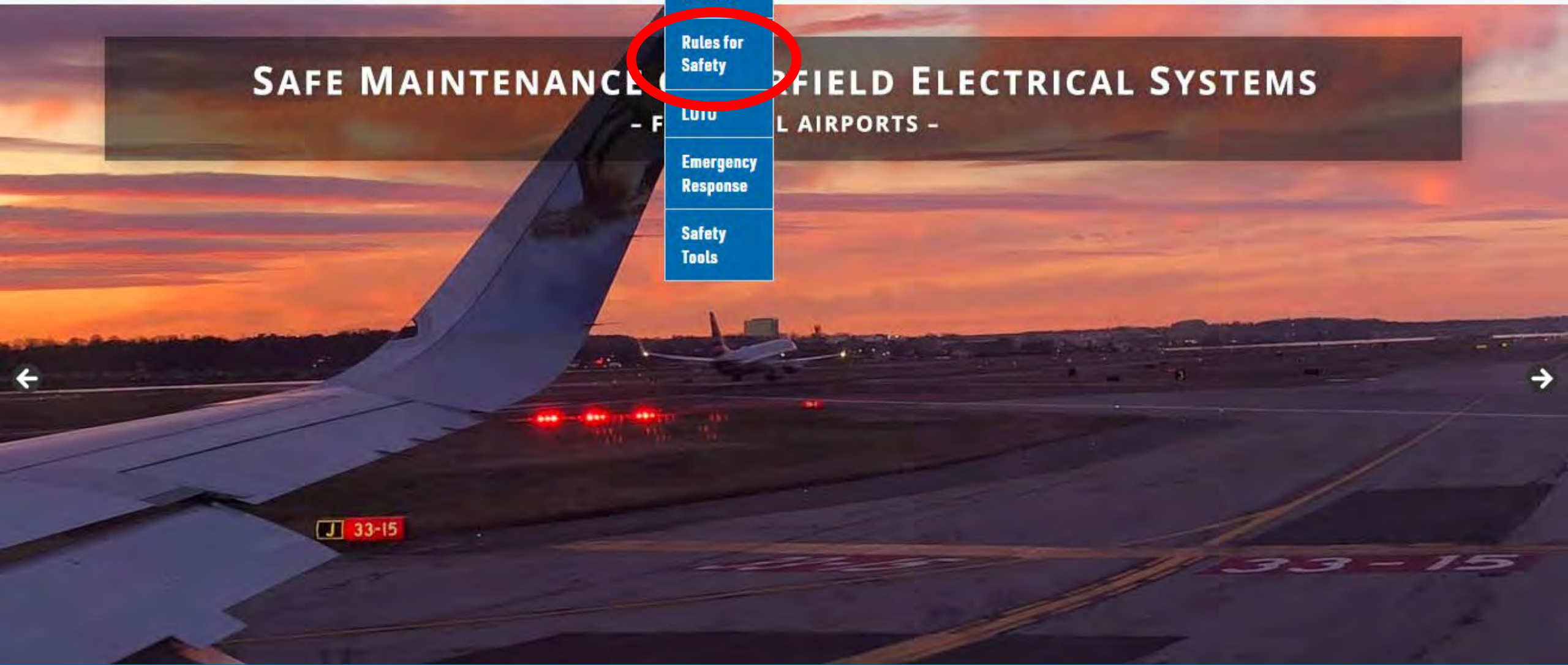

Explanation of Dangers

## Rules for Safety

It is very important that airfield series circuits be de-energized and verified prior to working on them. Even simple tasks such as re-lamping or removing fixtures with the circuit energized can be extremely hazardous because of unseen dangers. One such danger is a fault between the primary and secondary windings of the isolation transformer feeding the light, which exposes the worker to the full voltage present on the primary wiring. See AC 150/5340-26C 2.4.3.a-b for a detailed description of how this happens.

Another hazard is the high open-circuit voltage present at the secondary of the isolation transformer. Airfield lights work on low voltage from the secondary of the isolation transformer; however, when the light is removed or burns out, the transformer secondary is "opened," which can cause the transformer to produce as much as 200 volts to the lamp connection point.

Breaking a live connection on an airfield series circuit creates an "open circuit" and is a dangerous and potentially deadly situation. When the live connection is broken, the circuit amperage drops. In an attempt to bring the amperage back up to the proper level, the constant current regulator instantaneously sends the voltage to its maximum level, which can reach nearly 10,000 volts. At that voltage it is very possible that it will drive the circuit through the worker's body which will most likely be fatal.

Lastly, beware of induced voltages on wires that run in the same conduit as energized wires. Circuits with pulsing loads such as runway guard lights or strobes are especially prone to inducing voltages on other conductors.

**Working on airfield series lighting circuits does not necessarily have to be hazardous if the proper safety practices and procedures are followed:**

1. Strictly and habitually follow the safety rules listed under "Basic safety rules to remember when working with airport lighting circuits."
2. Require that all maintenance workers, especially new employees, are properly trained in electrical safety and are familiar with the particular system of your airport. New workers should shadow experienced workers until they are qualified and competent with the system.

**Basic safety rules to remember when working with airport lighting circuits:**

- **ALWAYS** assume that the circuit is energized until proven otherwise.
- **ALWAYS** check for current with a True RMS clamp-on ammeter prior to opening any series circuit primary connection or removing the S1 cut-out.
- **NEVER** attempt to measure voltage in an airfield series lighting circuit using ordinary voltmeters.
- **NEVER** under any circumstances open or break a live airfield series circuit.
- **NEVER** enter a manhole or handle cables or transformers in light bases while there is current present.

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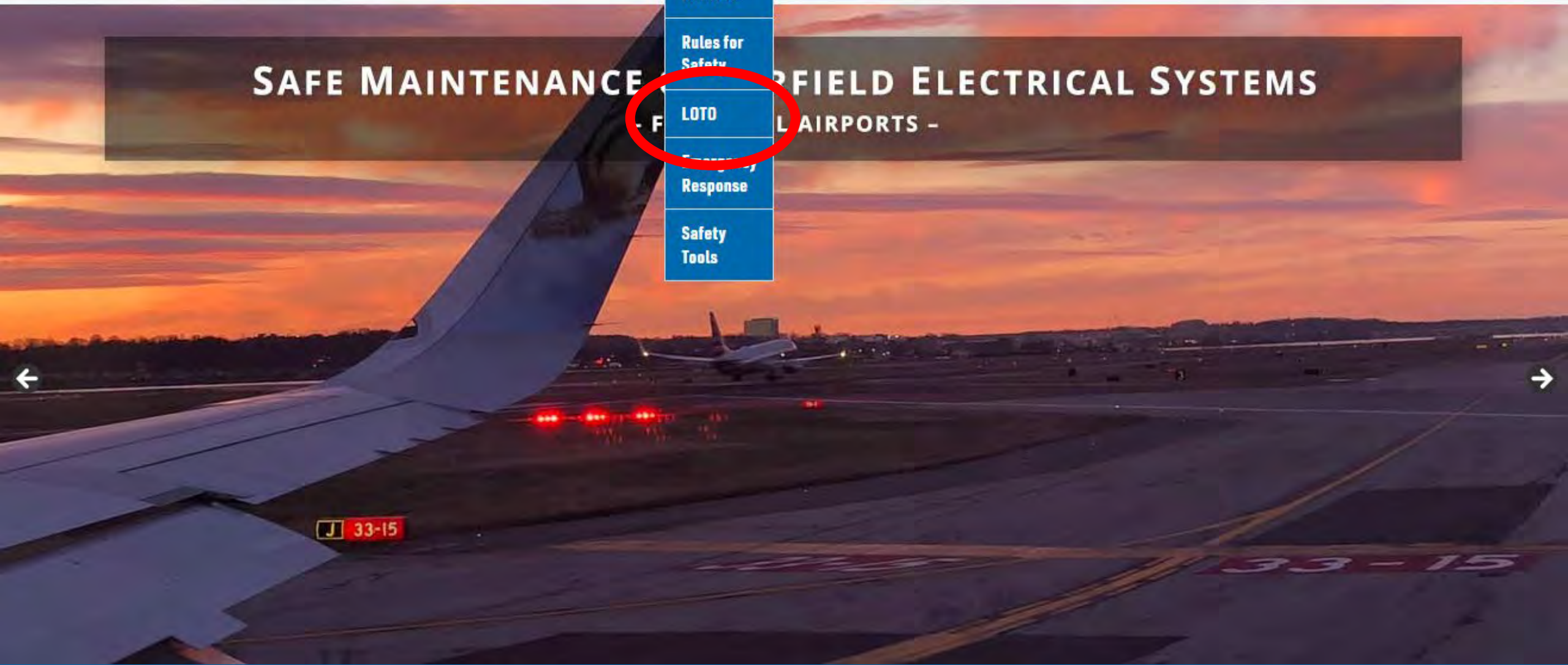

# Lock-Out/Tag-Out

## LOCK-OUT/TAG-OUT VERIFICATION

In order to establish an Electrically Safe Work Condition, every airport must establish a Lock-Out/Tag-Out (LOTO) program for its airfield lighting. The following procedures are necessary to establish a LOTO program:

1. Every employee that works with the lighting system must be trained in the LOTO procedures.
2. Each employee working with the system must place his own personal lock on the circuit disconnecting means. A personal lock is one with its own single unique key that can only be opened by the owner of the lock. Common locks with multiple keys are not acceptable as a personal LOTO lock.
3. No circuit should be considered locked-out until it is verified by attempting to energize the circuit by all means.
4. Most airfield lights are off during daylight hours. Simply locking it out and testing with an ammeter during daylight hours will obviously show no energy present, so this method does not verify LOTO. A pilot using the radio lighting control, air traffic control, or another electrician could turn the lights on at any time, day or night. Turning all circuits on and verifying the lights you intend to work on are dead is the only sure way to verify proper LOTO.
5. A LOTO log should be kept in the airfield lighting vault. Anyone involved in the LOTO should sign the logbook. This record can be used by other workers or operations to verify who is working on the circuit in the event the locks need to be removed.
6. The airport's LOTO program should be audited and reviewed at least annually.

This linked video includes training material from the Alaska Department of Transportation and Public Facilities which details troubleshooting of electrical systems. Skip to 0:41 in the video to begin where the LOTO concept is explained.


*Example of a lock-out device [photo credit: Ted Stevens Anchorage International Airport (TSAIA)]*

*LOTO logs are important (photo credit: TSAIA)*

LOTO Circuit Control Log (Sample)

LOTO Policy (Sample)

# LOTO
# CIRCUIT CONTROL LOG

**Project:**_____

The individuals listed below **CONFIRM** that the following electrical circuit(s) is/are **DE-ENERGIZED and have applied approved LOCKOUT DEVICES to the circuit(s). Verification of de-energization must take place at the work location as indicated in the Lockout/Tagout (LOTO) procedures found within this binder.** Signatures below indicate an understanding of LOTO procedures.

| Circuit #(s) |
| --- |
| |

| Company/Agency | Name of Employee | Signature | Lock I.D. # |
| --- | --- | --- | --- |
| | | | |
| | | | |
| | | | |

Contractor LOTO:

CONTRACTOR REPRESENTATIVE CONFIRMS DE-ENERGIZATION at FIELD LOCATION:
Contractor Representative Signature_____Date:_____

---

The individuals listed below **CONFIRM** that the following electrical circuit is **ENERGIZED and have REMOVED their LOCKOUT DEVICES from this circuit.** Signatures below verify that all precautions (as indicated in the Airport's written LOTO procedures) have been taken prior to energization:

| Circuit #(s) |
| --- |
| |

| Company/Agency | Name of Employee | Signature | Lock I.D. # |
| --- | --- | --- | --- |
| | | | |
| | | | |
| | | | |

**Date:** _____ **Time:** _____

# Lock-Out/Tag-Out

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In order to establish an Electrically Safe Work Condition, every airport must establish a Lock-Out/Tag-Out (LOTO) program for its airfield lighting. The following procedures are necessary to establish a LOTO program:

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*Example of a lock-out device [photo credit: Ted Stevens Anchorage International Airport (TSAIA)]*

*LOTO logs are important (photo credit: TSAIA)*

LOTO Circuit Control Log (Sample)

LOTO Policy (Sample)

# Electrical Lockout / Tagout

**PURPOSE:**
Lockout/Tagout (LOTO) is a primary method used within Airfield Maintenance (AFM) operations to protect personnel from electrical hazards during service and maintenance. The policy and procedure described below establishes minimum requirements needed to ensure circuits and components are isolated from hazardous electrical energy where the unexpected release of this energy could cause injury or death in accordance with 29 CFR 1910.147

**POLICY:**
The procedures listed below are to be used by all AFM personnel and associated contractors engaged in electrical maintenance, repair, or inspection of circuits that operate at 50 volts (to ground) or greater. These circuits are to be de-energized and locked out to prevent accidental energization during service. All personnel who perform work on affected circuits will be present to participate in Lockout/Tagout procedures (except in the case of Group Lockout as described in paragraph "E"). All personnel performing Lockout/ Tagout must be qualified electricians with a thorough understanding of the Lockout/ Tagout procedures described below.

**STANDARD PROCEDURE:**
**A. Location of Lockout / Tagout Devices**
Lockout / Tagout devices will be available at the regulator vault and at the Field Maintenance Electrical (FME) shop. In addition, a LOTO kit will be available in each of the FME work trucks. All Job locks (see "H" definitions) and Personal Locks for FME personnel will be provided by AFM. There will be no spare keys for personal locks. "Job Locks" will be keyed alike and keys made available only to FME employees. If the key to a lock is lost or unserviceable while the lock is on a cabinet/breaker, etc., all procedures for forcibly removing lockout devices will be followed as listed in paragraph "D". In the event a lock is to be cut off, personnel must inform the electric shop foreman so a new lock can be purchased.

**B(1). Application of Controls and Lockout / Tagout Devices**
The established procedure of applying energy controls includes the specific actions that must be implemented in sequence. When a circuit is going to be de-energized, the following steps will be followed by the authorized employee(s):

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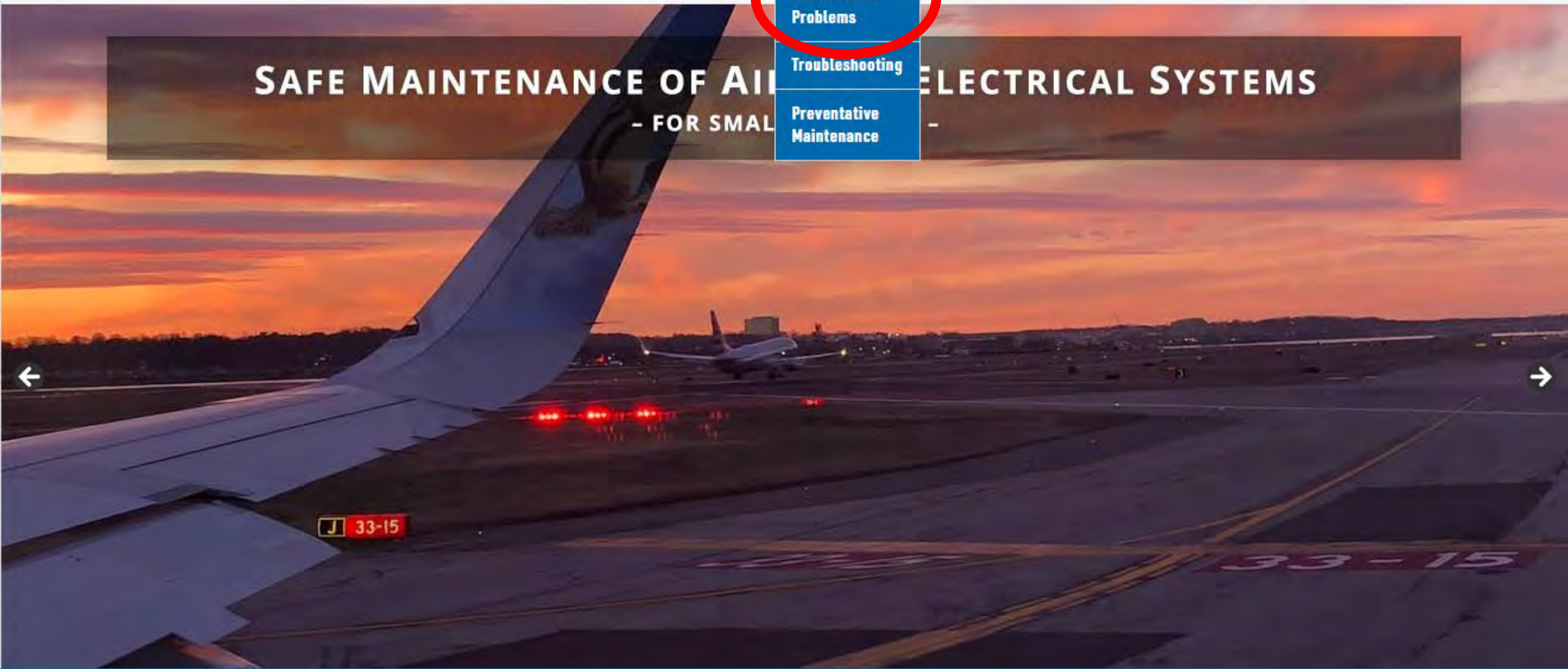
- Common Maintenance Problems
- Troubleshooting
- Preventative Maintenance



# SAFE MAINTENANCE OF AIRFIELD ELECTRICAL SYSTEMS

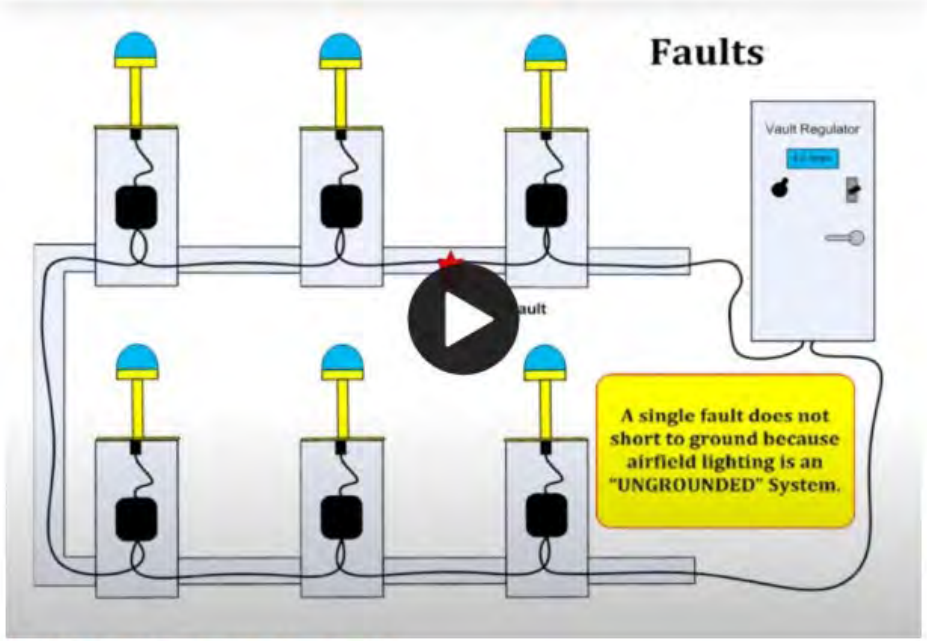
– FOR SMALL AIRPORTS –

## Common Maintenance Problems

Within any airfield electrical systems, there are some commonly arising tasks that require airfield electrical maintenance action. Below is a selection of resources from the Alaska Department of Transportation and Public Facilities and Ted Stevens Anchorage International Airport (TSAIA) that address the issues of faults, opens, transformer failure, and regulator failure.

Click on each link or icon to be redirected to the YouTube video or to download each resource.

### FAULTS (17:04–30:29)

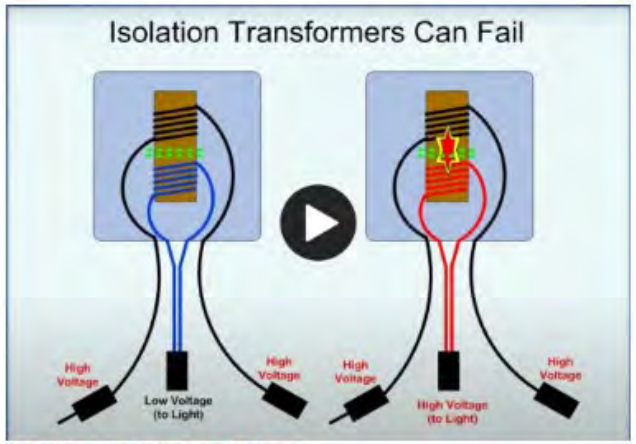



### OPEN CIRCUITS (30:31–39:27)

*Damage to lights is common (photo credit: Denver International Airport)*

OPEN CIRCUITS (30:31–39:27)


TRANSFORMER FAILURE (13:20-17:00)




REGULATOR FAILURE (.PPTX FILE)



Understand the locations of conduit before digging (photo credit: TSAIA)


Damage after a fire (photo credit: TSAIA)


Damage from ice (photo credit: TSAIA)


Testing of primary to secondary fault (photo credit: TSAIA)

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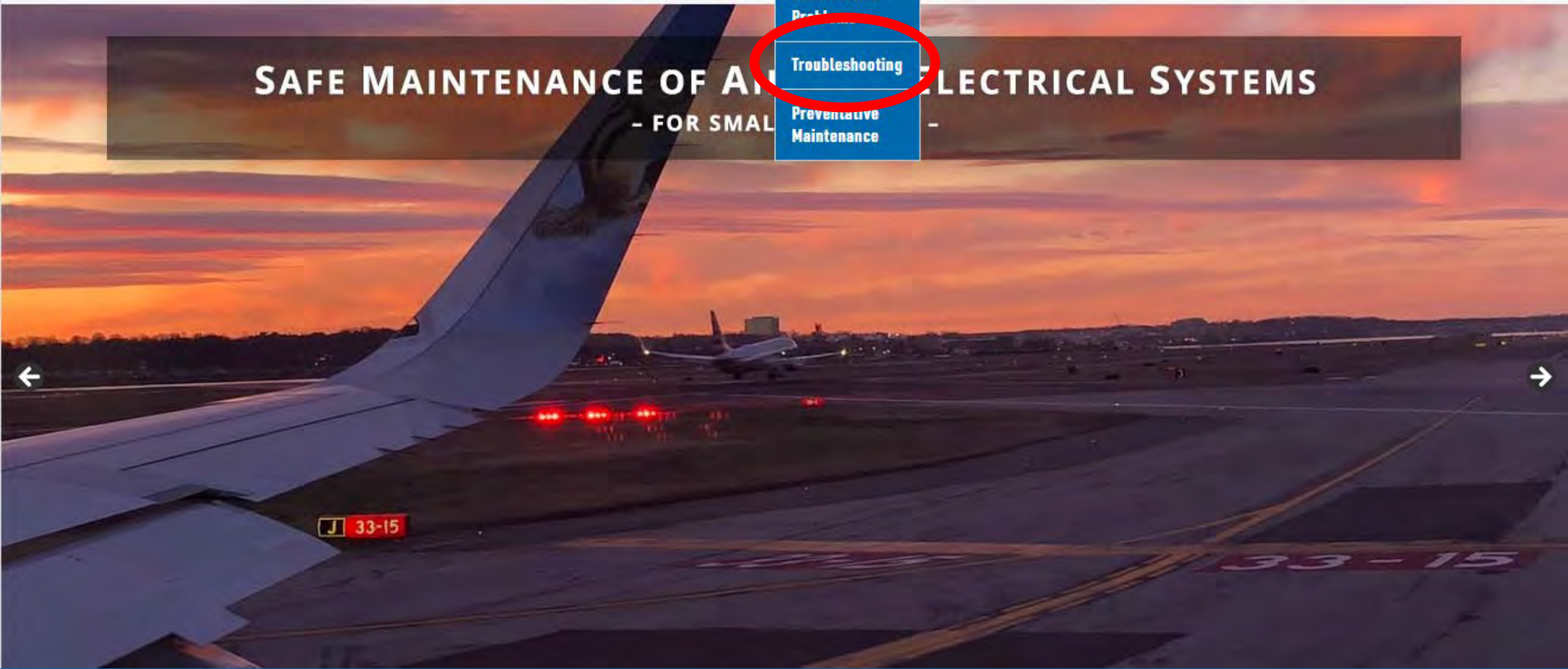

# SAFE MAINTENANCE OF AIRFIELD ELECTRICAL SYSTEMS

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## Troubleshooting

Addressing the common problems seen in airfield electrical systems may necessitate some troubleshooting to determine the source of the issue and determine the proper corrective task. Below is a selection of resources from the Alaska Department of Transportation and Public Facilities which discuss troubleshooting faults, opens, transformer failures, and regulator failures.

Click on each link or icon to be redirected to the YouTube video or to download each resource.

### FAULTS (12:07-19:30)

Tips For Faults:

- Check the **ALCMS** computer **IRMS** readings or manually Meg and record the readings regularly.
- Know how the circuit runs – Look at the Prints
- If it is a solid fault try the **Ground** **Out** cover or **Grounding Clamp**- it might give you lights out betwee fault. This makes it easy to find the fault quickly. This only works situations, but it's worth a try.
- Test Transformers before changing and discarding them.
- Look for **Testpoints** for initial tests. (where both **Feed and Return** are spliced)
- Always mark **Testpoints** by engraving TX + Circuit Number in the epoxy surrounding CL fixtures. This will help future troubleshooting.
- Make sure to put the Cut-Out back in proper position when you are finished!

### OPEN CIRCUITS (19:31-21:56)

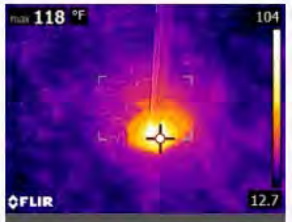
Tips:
Focus On The Open Only

- Don't get distracted by non-open circuit issues.
- Don't Meg the circuit.
- Don't waste time looking for
- Don't bother replacing trans
- Reconnect and close all test sites as you proceed.

Lights Out Troubleshooting Guide

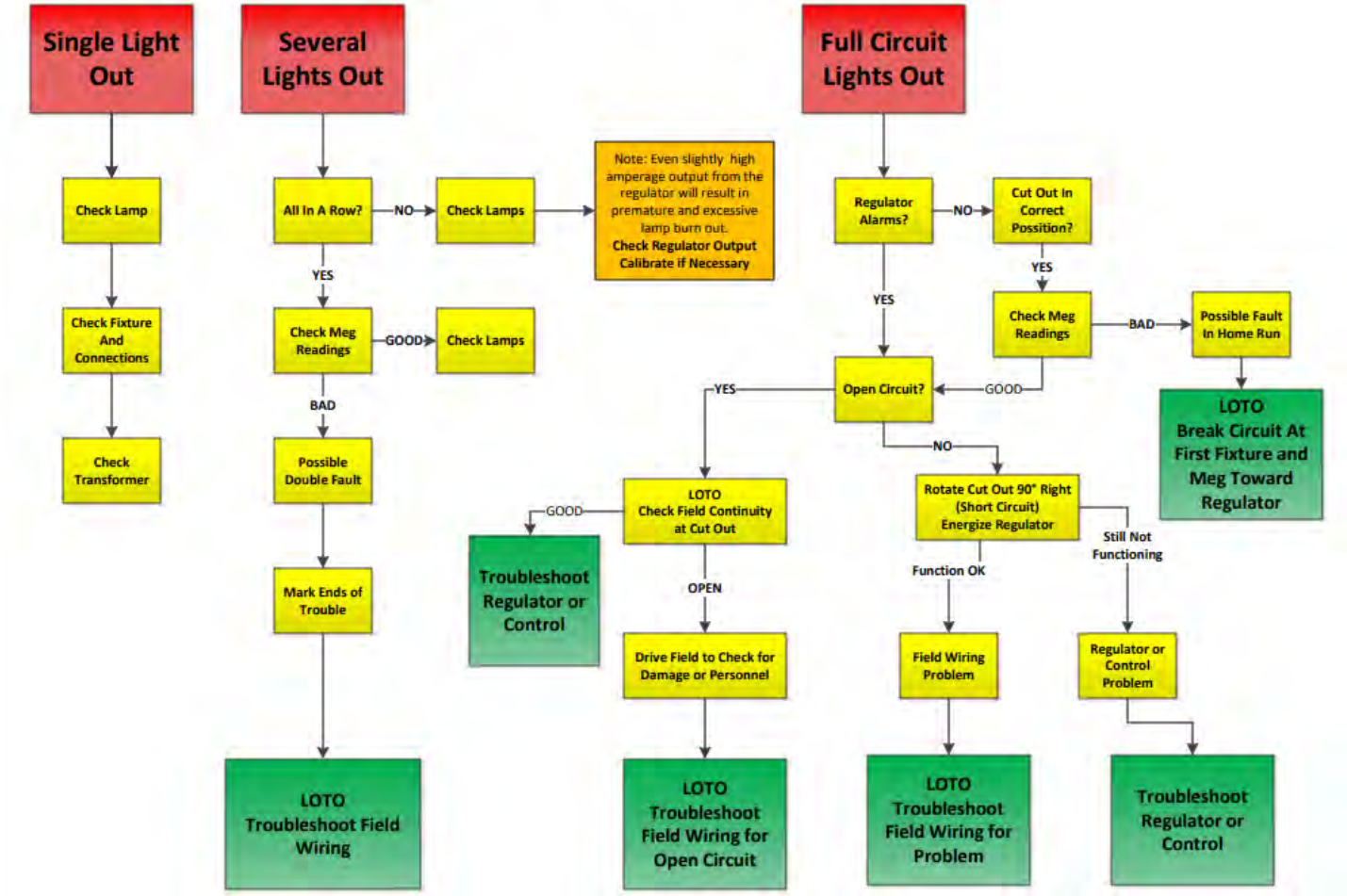
Airfield Insulation Resistance (Megger) Testing

*Melted snow/ice around a light may indicate an issue (photo credit: TSAIA)*




*Example Forward Looking Infrared (FLIR) camera image (photo credit: TSAIA)*

# Lights Out Troubleshooting



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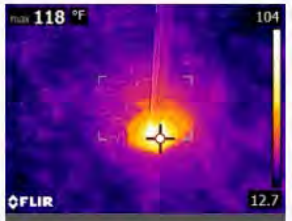
Airfield Insulation Resistance (Megger) Testing

*Melted snow/ice around a light may indicate an issue (photo credit: TSAIA)*




*Example Forward Looking Infrared (FLIR) camera image (photo credit: TSAIA)*

**Airfield Insulation Resistance (Megger) Testing**

**TSAIA Airfield Electrician Foreman**

**What is it?**

Insulation Resistance Testing, or Megger Testing, is a test of the electrical insulation in a circuit. It uses a Megohm meter which is connected between the insulated conductor and the ground. The meter charges the conductor with a high voltage and monitors any leakage to ground resulting in a "Meg Reading" value for the wiring. The reading can be 2000 + megs which is very good, or less than 1 meg which is considered very poor.

**Why Do Megger Testing?**

Electrical insulation can become damaged by overheating, ice, insects, rodents, or poor installation practices, and it can degrade due to environmental conditions such as water or chemicals. It also degrades from the electrical voltage itself, which over time breaks down the insulation. The higher the voltage, the more damaging it is to the insulation.

Airfield lighting circuits are exposed to all of the above conditions that degrade the systems integrity. The FAA AC Circular 150 -5340-26C says that it is normal to expect a 10% - 20% decrease in Meg reading values per year.

**How Does This Affect the Electrical System?**

Because airfield lighting electrical systems are ungrounded, the fact that the insulation is weakening may not have any effect on the function of the circuit at all. If the copper wire has good continuity and low resistance, the electricity will continue to use it as a path and the lights will continue to function. Even a crack in the insulation exposing the copper conductor may have little or no effect on the system's function, even though the meg reading drops nearly to zero. Everything might work just fine – until it doesn't.

A single bad spot in an airfield constant current lighting circuit does not affect the circuit. Because it is an ungrounded system the electricity has nowhere to go so it remains in the wire. However, if there is more than one fault in the system, the electricity may begin to flow outside of the wire on the ground wire, conduit, or water in the area until it can jump back into the wire and resume its journey through the circuit, re-entering at the second fault. It does this because there is less resistance in the external path than there is in the circuit with lighting in it. It chooses the path of least resistance. This bypass of

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Safe Maintenance of Airfield Electrical Systems for Small Airports

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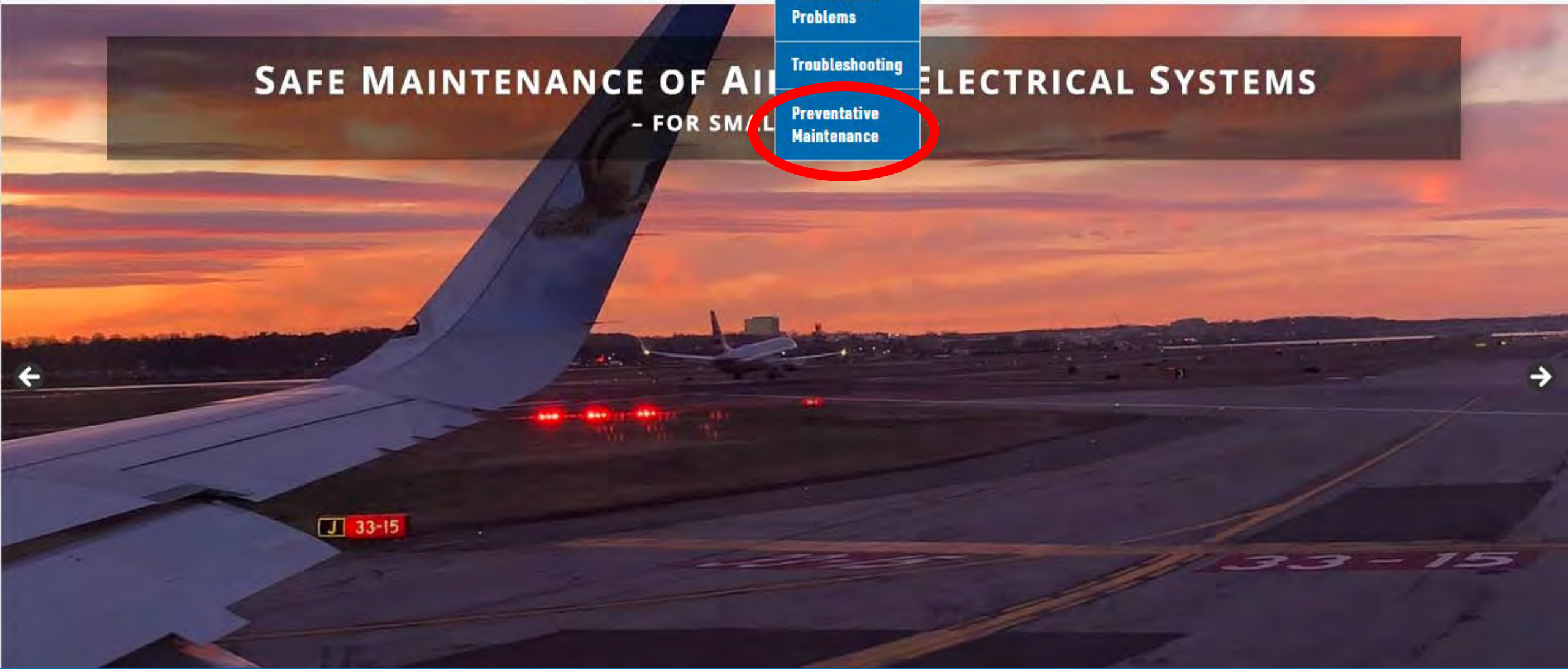
- Common Maintenance Problems
- Troubleshooting
- Preventative Maintenance



# Preventative Maintenance

FAA Advisory Circular 150/5340-26 makes recommendations about the frequency to which different airfield electrical systems should be maintained and gives details as to what each task entails.

The following are sample forms that can be used by your airport to record dates and information about when maintenance was last performed for various systems.

**Click to download sample forms:**

*Insulation Resistance Testing of Field Circuits*

*Monthly Maintenance Tasks*

*Semi-Annual Maintenance Tasks – Part 1*

*Semi-Annual Maintenance Tasks – Part 2*

*Annual Maintenance Tasks*

## Example Checklist from FAA Advisory Circular 150/5340-26

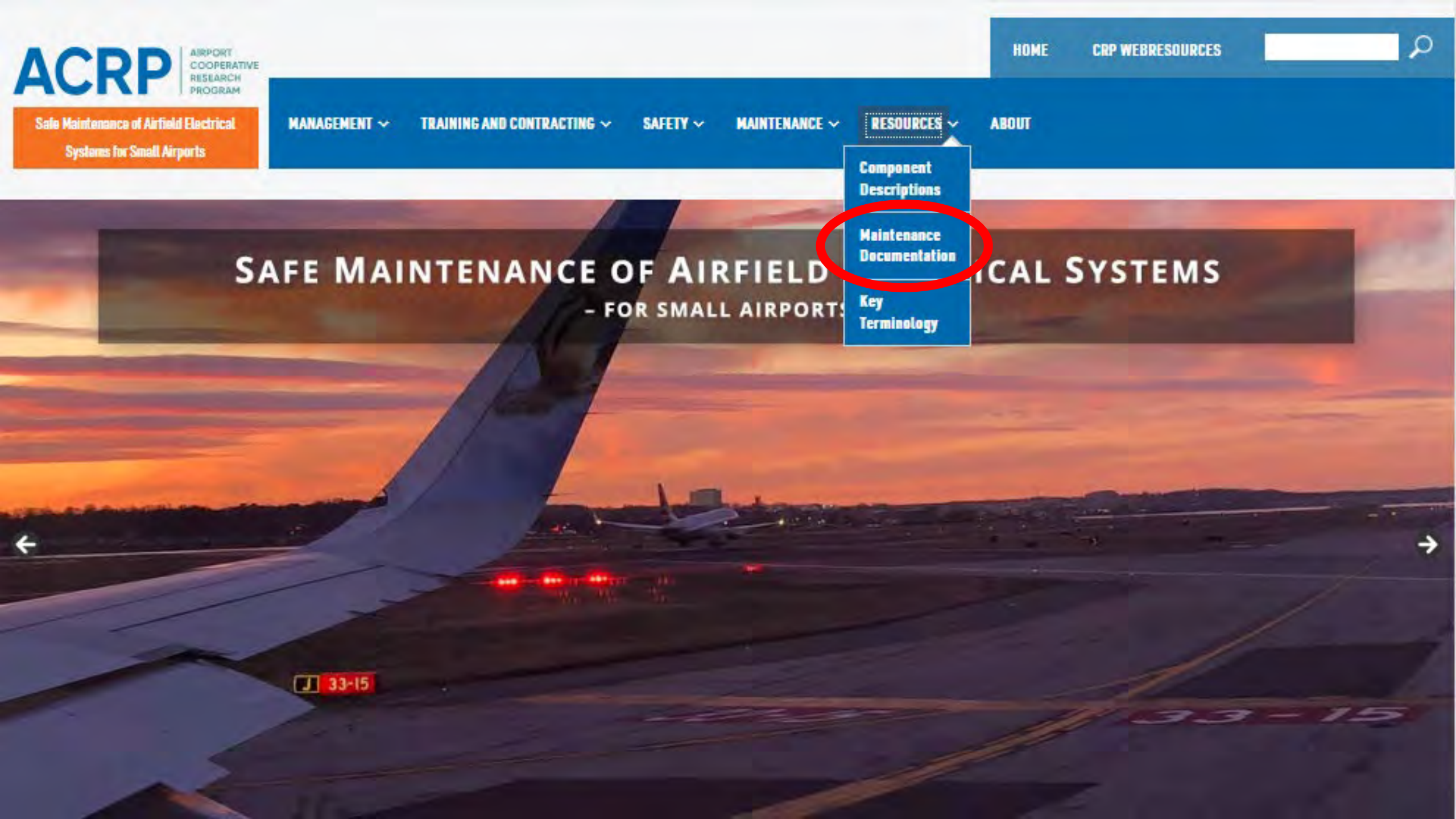
**Table 5-1. Preventive Maintenance Inspection Schedule for Airport Lighting Vaults**

| 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.

*Refer to Chapter 5 of FAA Advisory Circular 150/5340-26 for details and recommendations for each component's task list and inspection schedule.*

**Airfield Insulation Resistance (Megger) Testing**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ICAL SYSTEMS
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33-15

# SAFE MAINTENANCE OF AIRFIELD ELECTRICAL SYSTEMS

– FOR SMALL AIRPORTS –

## Maintenance Documentation

The following resources are samples of maintenance documentation that your airport may want to adopt.

- Airfield Electrical Testing Checklist (Sample)
- Insulation Resistance Testing of Field Circuits
- Monthly Maintenance Tasks
- Semi-Annual Maintenance Tasks – Part 1
- Semi-Annual Maintenance Tasks – Part 2
- Annual Maintenance Tasks
- LOTO Circuit Control Log (Sample)
- LOTO Policy (Sample)

FAA Advisory Circular 150/5340-26C has multiple tables for preventative maintenance inspection schedules, as well as other key maintenance information for documentation.

FAA Advisory Circular 150/5340-26C

**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.

*Example Checklist from FAA Advisory Circular 150/5340-26*

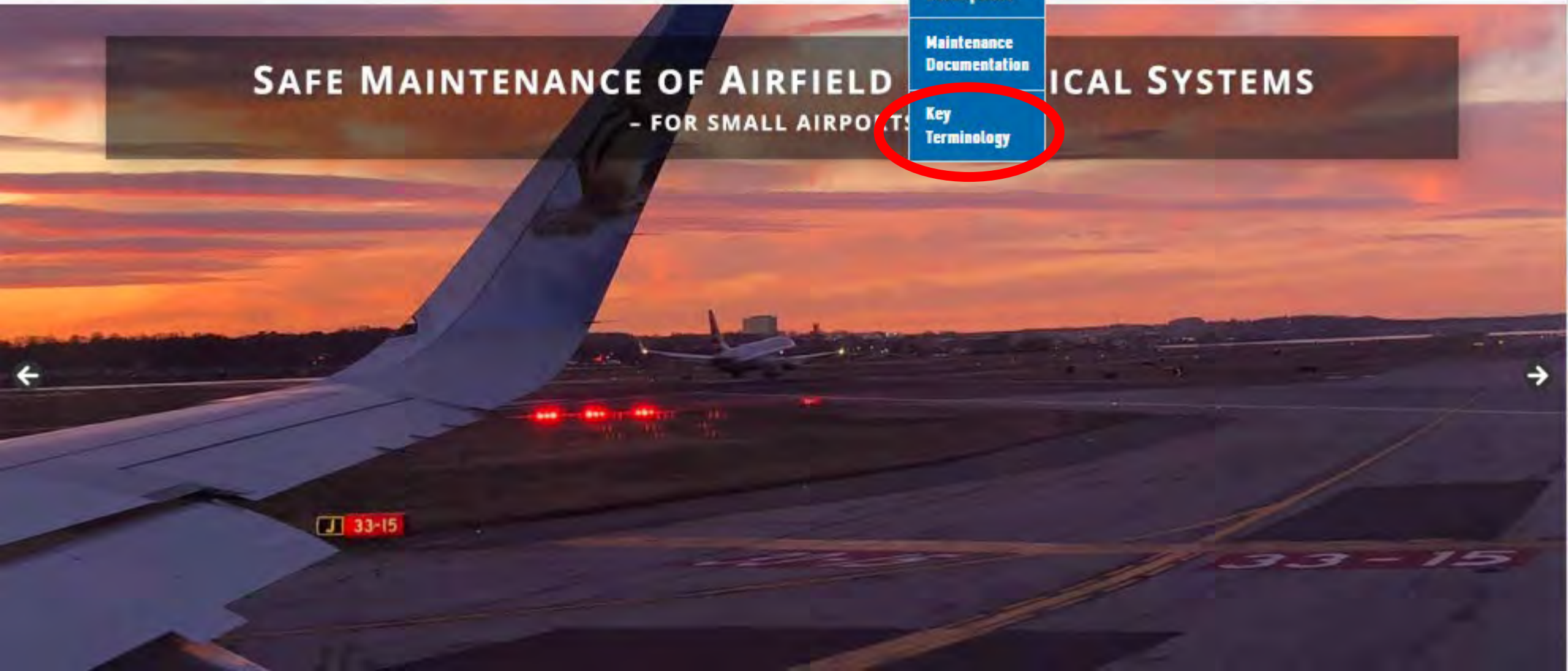
ACRP AIRPORT COOPERATIVE RESEARCH PROGRAM

Safe Maintenance of Airfield Electrical Systems for Small Airports

HOME CRP WEBRESOURCES

MANAGEMENT TRAINING AND CONTRACTING SAFETY MAINTENANCE RESOURCES ABOUT

- Component Descriptions
- Maintenance Documentation
- Key Terminology



# SAFE MAINTENANCE OF AIRFIELD ELECTRICAL SYSTEMS

– FOR SMALL AIRPORTS –

## Key Terminology

**Approach Lighting System (ALS)** – Lighting system located at the approach end of a runway consisting of a series of light bars, strobe lights, or a combination of the two, which extend outward from the runway end.

**Arc Blast** – Tremendous temperatures of the arc cause the explosive expansion of both the surrounding air and the metal in the arc path. Dangers associated with arc blast include high pressure, sound, and shrapnel.

**Arc Flash** – Electric current passes through air between ungrounded conductors or between ungrounded conductors and grounded conductors.

**Base Can** – In-ground metal enclosure that supports a lighting fixture, houses its electrical components, and facilitates future maintenance.

**Beacon** – Installed at an airport or aeronautical facility to indicate location and facility type to aircraft pilots at night. This device is mounted on top of a towering structure above other airport buildings.

**Cramp's Helipad Approach Path Indicator** – Visual aid to pilots ensuring a safe approach path. Can be installed at airports or heliports. Reinforces a 6-degree glide slope to helicopter approaches.

**Clearance Bar Lights** – Three in-pavement steady-burning yellow lights installed at holding positions on taxiways.

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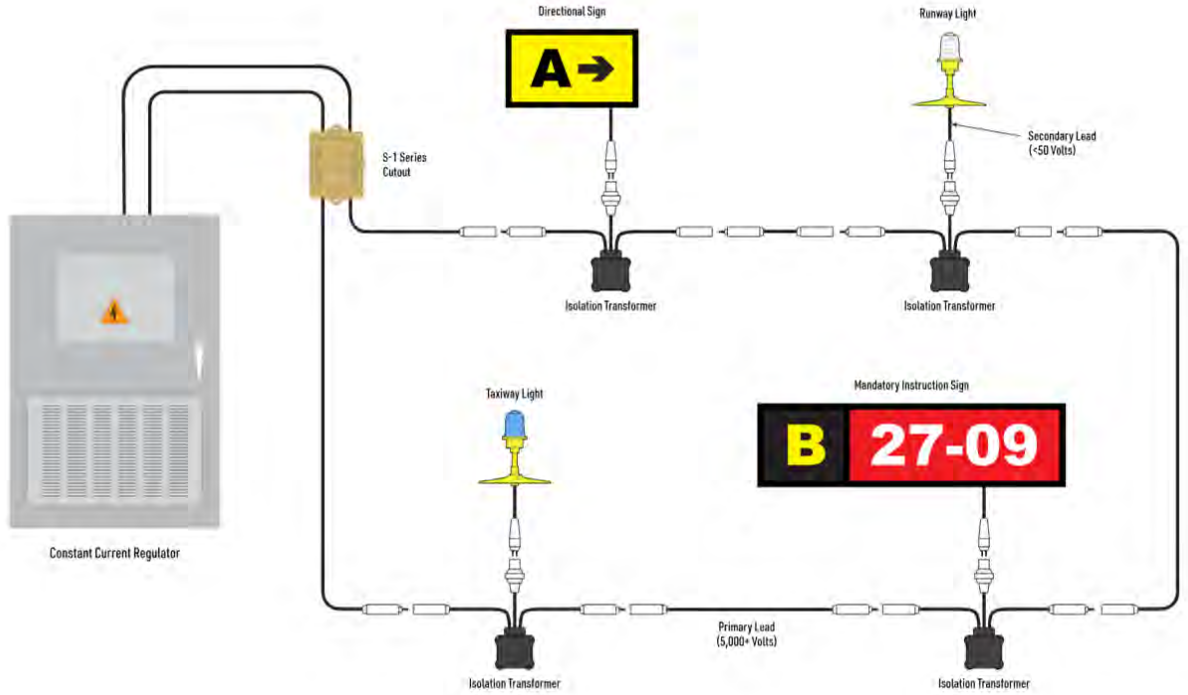
# Management

- Managers need to:
  - understand what they are asking their workers to do.
  - know what hazards are involved with each task assignment.
  - know what training is necessary to keep workers safe.
- Managers have the ability to require and pay for appropriate worker training.



# So, who is *"qualified"*?

A worker might be qualified for one task, but not for another. Also, someone with a professional electrical certification may not be "qualified" for some electrical tasks on the airfield.

## ACRP 09-22: QUALIFIED WORKER

It is often asked, "who is qualified to work on airfield lighting?" The answer to that question may not be as clear as might be expected. A worker might be qualified for one task, but not for another. Also, someone with a professional electrical certification may not be "qualified" for some electrical tasks on the airfield. Some tasks, such as working on live electrical circuits, may require a great deal of training, while other task such as replacing a light bulb on a de-energized circuit will require far less training to be qualified.

### *So, who is "qualified"?*

The FAA Advisory Circular 150/5340-26C describes a qualified worker in Section 2.2 through a reference to a definition from NFPA-70E which states that "*a qualified person shall be trained and knowledgeable in the construction and operation of equipment or a specific work method and be trained to identify and avoid the electrical hazards that might be present with respect to that equipment or work method.*" (NFPA 70-E10 110.2 (A)(1)) (FAA AC 150/5340-26C (2.2)).

Appropriate training for the task is the key element. The qualified worker must be trained to recognize and avoid the electrical hazards involved in the airfield lighting task at hand. That is why a Journeyman Electrician who has not been trained in constant current airfield lighting may not be a "qualified worker." For a brief guide to worker selection and skill training for various levels of airfield electrical tasks, see the *Task Decision Matrix* included on this page.

### *Who decides which workers are "qualified"?*

There may be state or local rules that apply to qualifications, but ultimately it is the responsibility of the airport to make the decision of who is qualified. Qualified workers must successfully complete specific training in the areas of their involvement which has been documented by the airport or other recognized training organizations. If the airport does not feel competent to certify a worker as qualified, then it is recommended that it find a recognized training organization to qualify its electrical staff. Examples of relevant literature scoping qualified workers is included in the following pages of this document.

WARNING:

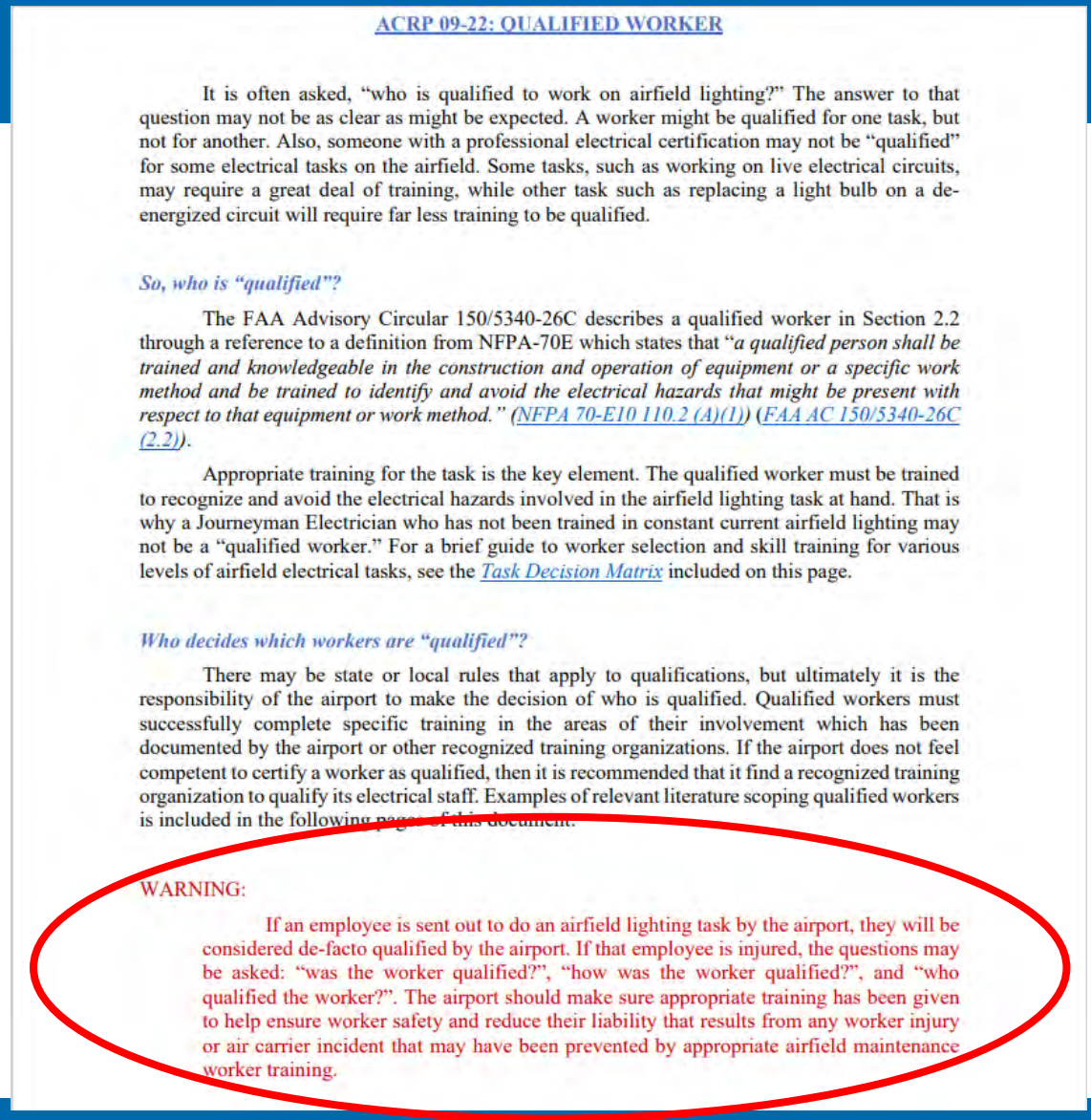
If an employee is sent out to do an airfield lighting task by the airport, they will be considered de-facto qualified by the airport. If that employee is injured, the questions may be asked: "was the worker qualified?", "how was the worker qualified?", and "who qualified the worker?". The airport should make sure appropriate training has been given to help ensure worker safety and reduce their liability that results from any worker injury or air carrier incident that may have been prevented by appropriate airfield maintenance worker training.

# If someone is injured…

## Was the worker qualified?

## How was the worker qualified?

## Who qualified the worker?



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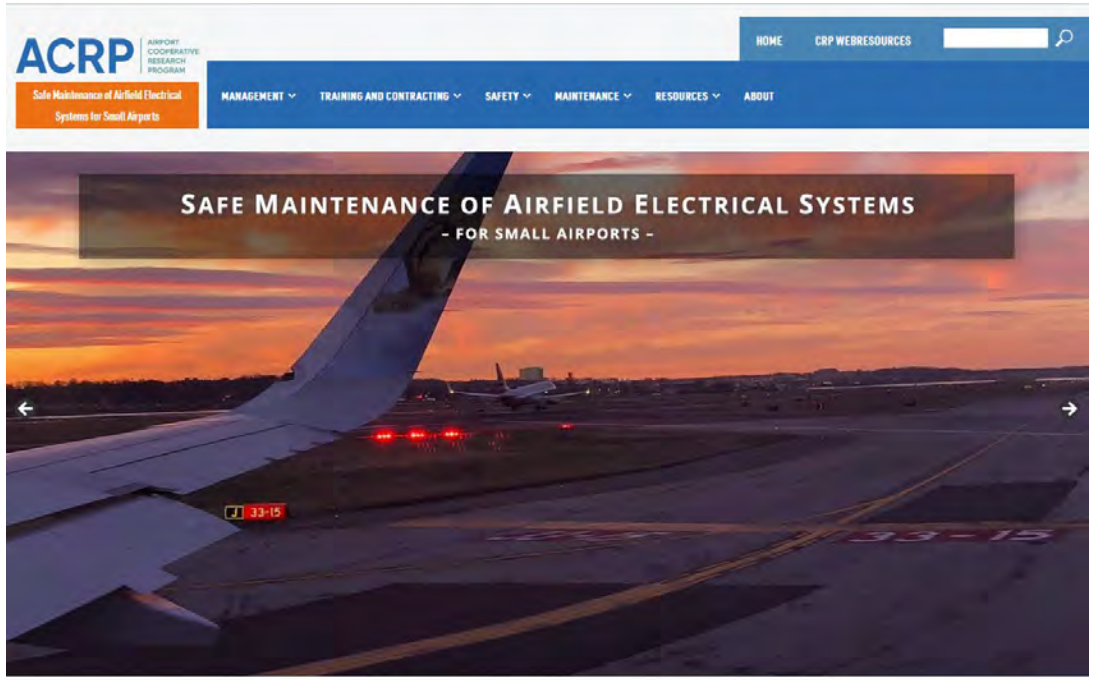
# FOR ADDITIONAL INFORMATION

## Visit: https://crp.trb.org/acrpwebresource20/




This resource is designed to provide airports with best practices for safely maintaining airfield electrical systems that are accessible and practical. The resource compiles best practices documentation into a single location to assist airport managers and staff in incorporating safety processes, training, and guidelines into their airport's standard operating procedures. The intended audience for the resource is small-hub, non-hub, reliever, and general aviation airports with a specific focus on small airports that may not have the resources of a larger airport.

The resource provides tools to assist managers to better understand their airfield's electrical system and the hazards associated with the system, and to develop

# Hands-On Training at ANC

# Web Resource 20 – From the Field

## One-Stop-Shop for Training

Airside Solutions, Inc. has transitioned from previously carrying data drives with useful materials to **directing students to Web Resource 20**. All of the information relevant to risk assessment and determining appropriate qualifications are **all in one place**.

Beyond small airports these larger airports recently found Web Resource 20 helpful:

- Boise Airport (BOI)
- Portland International Airport (PDX)
- Sacramento International Airport (SMF)
- Plus a couple of military bases

# Hands-On Training at GFK


**Leah Whitfield, C.M., ACE**
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*The Aviation Planning Group*

**Dennis "Beav" Deering, C.M., ACE**
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*Ted Stevens Anchorage International Airport*

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Grayson@theaviationplanninggroup.com
*The Aviation Planning Group*

**Gordie Winburn**
gwinburn@airsidesolutionsinc.com
*AirSide Solutions, Inc.*

# Other Events for You:

## May 19-20, 2026

**ACRP Insight Event – Exploring the Impact of Artificial Intelligence on the Airport Industry**

## June 8-11, 2026

**TRB Symposium on Aviation Innovation and Research**

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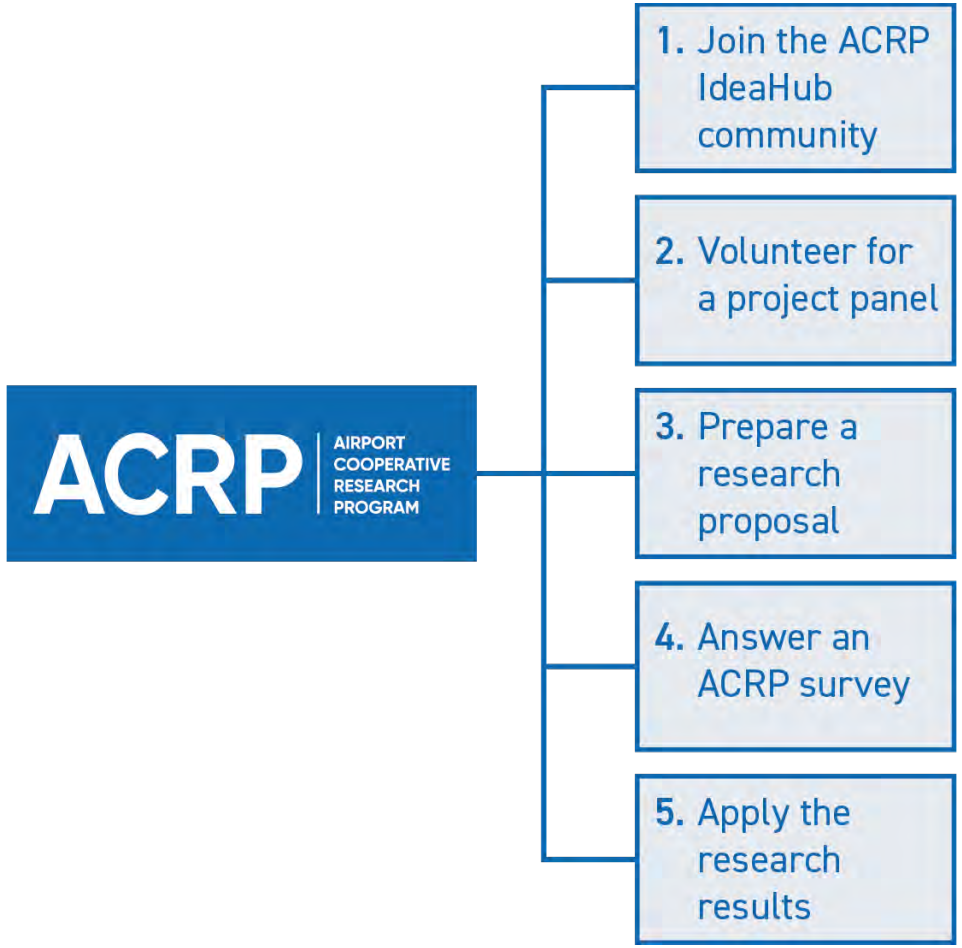


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