Introductory to Airfield Lighting Maintenance

Steven Bellamy and Ronnie Jones
Raleigh Durham International Airport

The Purpose of this Presentation

1. To introduce airfield lighting maintenance.
2. To collaborate and exchange information.

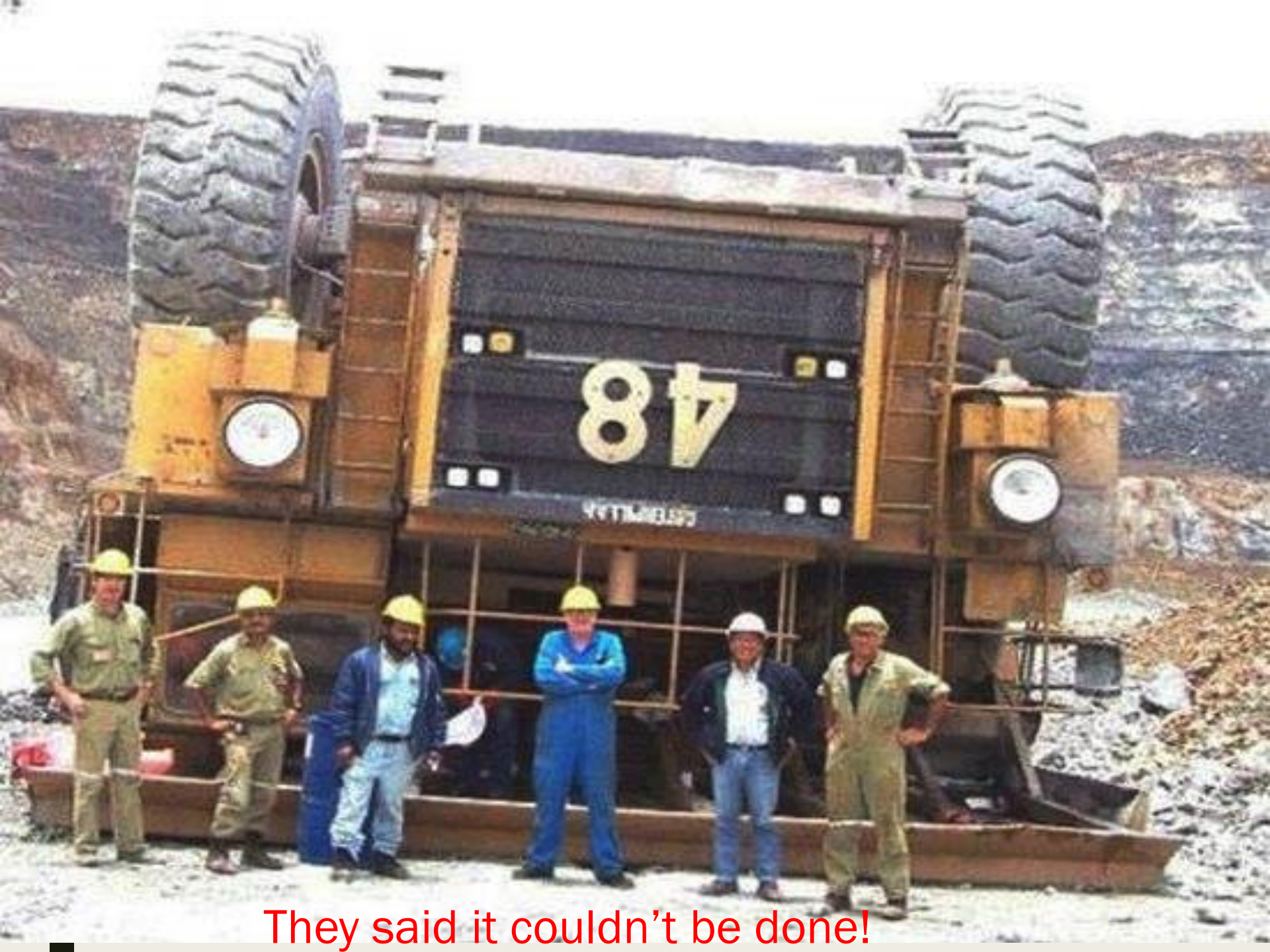
The Classroom Training Will Cover the Following

1. **SAFETY**
2. Series Circuit
3. Constant Current Regulators (CCR)
4. Trouble Shooting
5. Airfield cable splicing

Airfield Lighting Maintenance

1. Can be defined as maintaining the airfield lights!
2. Maintaining the airfield lights means that each component should perform as designed or be ready to perform when requested.
    a. Make sure the lights are not only on, but serviceable (not to dim/not to bright.)
    b. The CCRs are doing what they are assigned to do.


CONSTRUCTION
SAFETY FIRST
workplace
ha2ards
nanotechnology
DANGER
caution
PROTECTION
equipment
Work Safety
RISK
gloves
HEALTH
INJURY
safety procedures
accident
regulations
WORKING CONDITIONS
helmet
CONSTRUCTION SITE
SOLUTION

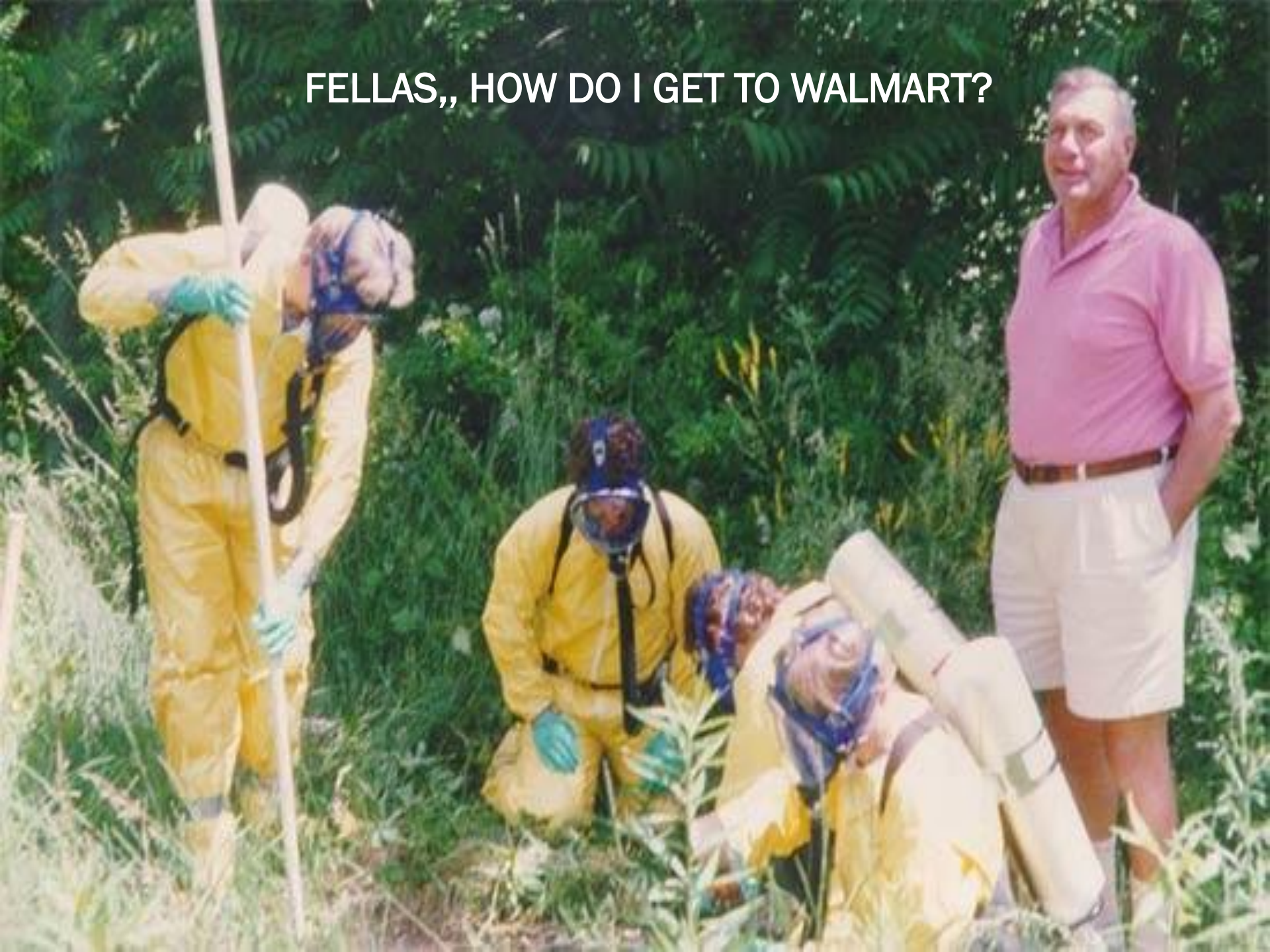


They said it couldn't be done!

Lunch break


Just hanging out


1 TO MANY BRICKS!


FELLAS,, HOW DO I GET TO WALMART?

Joe’s onsite muffler repair


DANGER
HIGH
VOLTAGE
401
THIS IS NOT A “BUN WARMER!”
POSTED AT
theCHIVE.com


NOT “UL” APPROVED!


I got your back partner.


Taking it to the next level


DON’T GET IN OVER YOUR HEAD!!!


CLEAN YOUR EQUIPMENT DAILY

Airfield Lighting Maintenance SAFETY Tips

1. Wear proper **P**ersonal **P**rotective **E**quipment.
    a. High voltage class 2 gloves and protectors
    b. SAFETY eye wear
    c. Ear plugs
    d. Working gloves
    e. Proper reflective clothing
    f. SAFETY shoes


ELECTRICITY
CAN TURN YOU
OFF
TAKE CARE
WHEN WORKING WITH IT

Airfield Lighting Maintenance **SAFETY** Tips

2. Never

Never,

NEVER……..

perform work on electrical energized equipment or wiring except when measuring voltage and current. Never, never, never break a live circuit or attempt to replace a airfield fixture with the circuit still energized.

Airfield Lighting Maintenance SAFETY Tips

3. Common causes of Accidents
    a. Working on equipment without adequate coordination with equipment users.
    b. Working on equipment without sufficient experience on that equipment.
    c. Failure to follow instructions in equipment manuals.
    d. Using unsafe equipment, SAFETY devices, and working at unsafe speeds.

Airfield Lighting Maintenance SAFETY Tips

4. Coordinate work with Operations and tower personnel
5. Inspect and test all meters before using
6. Never assume anything. Check it out first
7. Radios working
8. SAFETY will be mentioned throughout this presentation

Questions before we move into Series Circuits


DANGER
AUTHORIZED
PERSONNEL
ONLY
PATENT PENDING
Master Lock
S10301


LOCKOUT TAG OUT KIT
DO NOT OPERATE
DANGER
DANGER
DO NOT OPERATE
DANGER

Series Circuit

Laws of series circuits important to our discussion:

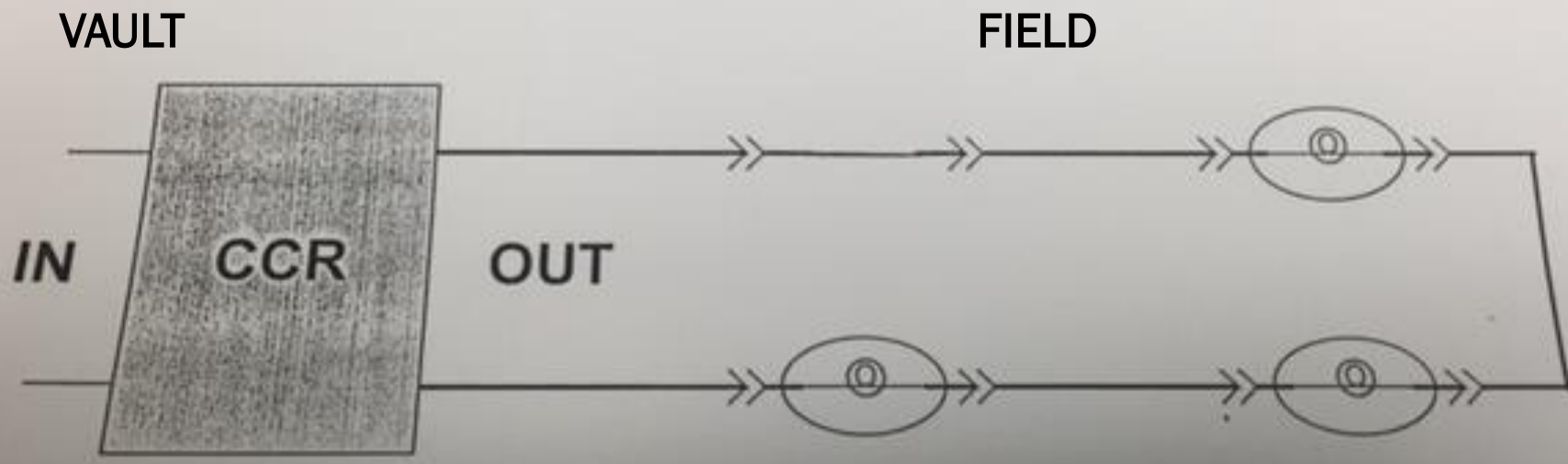
Rule 1- The total current (amps) in a series circuit is equal to the current in any other part of the circuit.

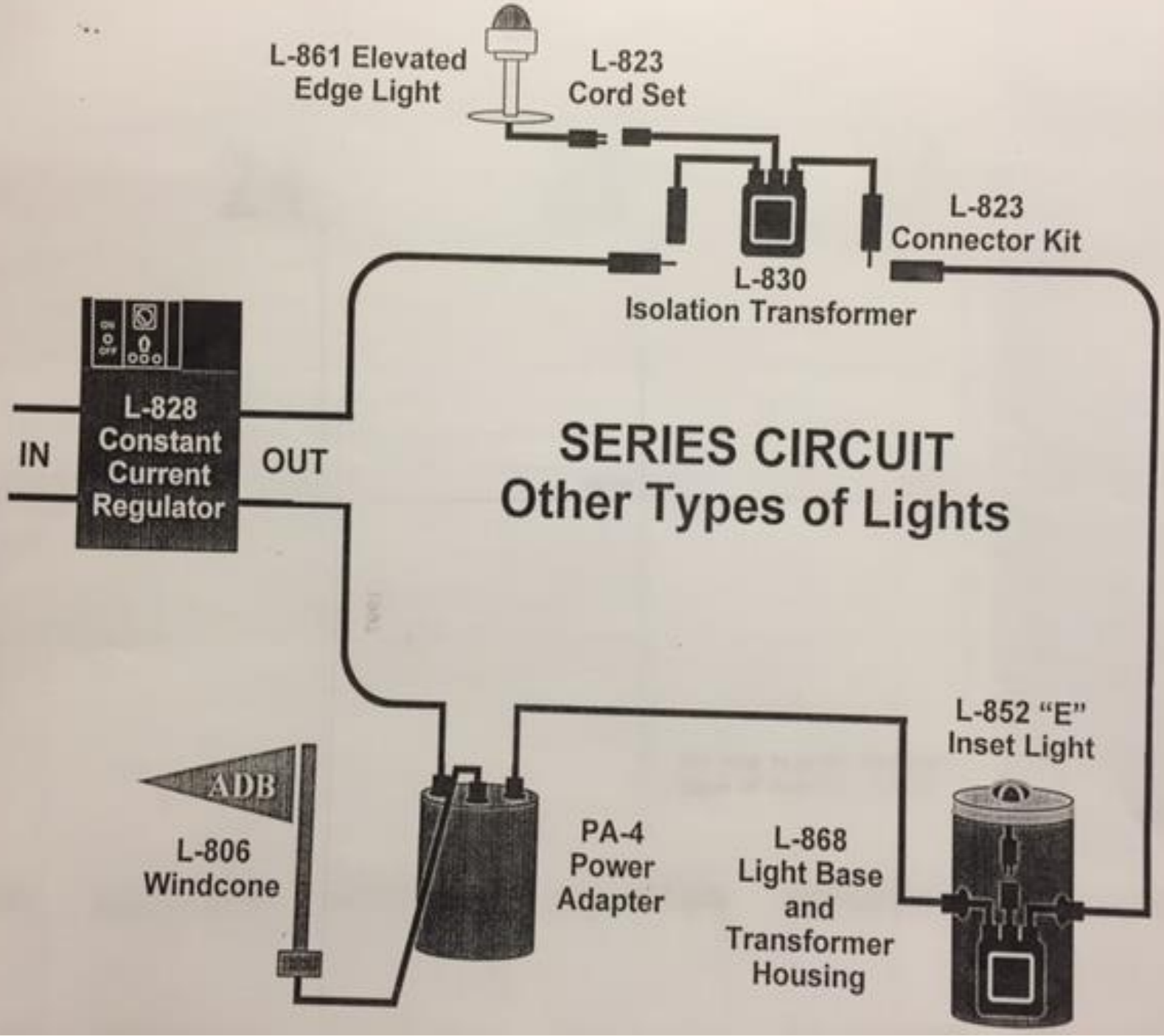
Rule 2- The total voltage is equal to the sum of the voltages across all parts of the circuit.

As you will see in the next slide the series circuit is a continuous loop from one transformer to the next. Since the amperage remains the same throughout the circuit each load or light fixture will have 6.6 amps available.

* Parallel Circuits are used on helipads and short runways if any!

SERIES CIRCUIT

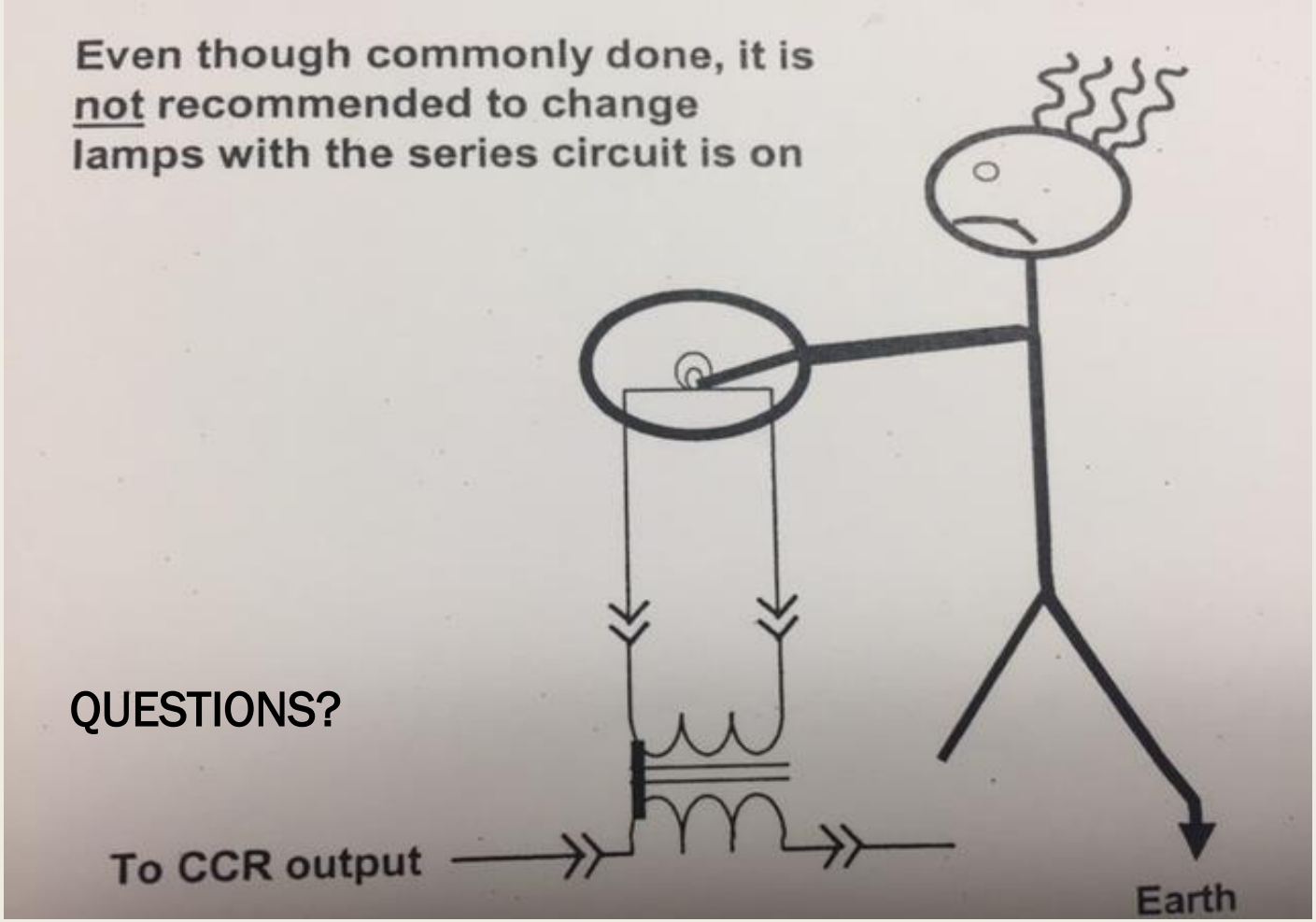



L-861 Elevated Edge Light
L-823 Cord Set
L-823 Connector Kit
L-830 Isolation Transformer
L-828 Constant Current Regulator
IN
OUT
SERIES CIRCUIT
Other Types of Lights
L-852 "E" Inset Light
ADB
L-806 Windcone
PA-4 Power Adapter
L-868 Light Base and Transformer Housing

Series Circuits Consists of 5/6 Basic Components For Airfield Lighting

1. Constant Current Regulator. (CCR)
2. 5000 KV Cable.
3. S-1 Cutout.
4. Isolation Transformer.
5. Connector Kits.
6. Lighting Device- fixtures, signs, windsock, etc.

Series Circuit



CONSTANT CURRENT REGULATOR (CCR)

CONSTANT CURRENT REGULATOR (CCR)

1. Power source for airfield lighting.
2. Provides regulated (constant) current to airfield lights.
3. Output current controls lighting intensity.
4. Located in the airfield Vault (Substation)

CCR TYPES

1. Dry type, air cooled. These have vented enclosures.
2. Oil type (wet type), oil cooled. These have cabinets with leak proof tanks.
3. Rated Sizes: 4 KW, 7.5 KW, 10 KW, 15 KW, 20 KW, 25 KW, 30 KW, 50 KW, & 70 KW.
   (1 Kilowatt = 1000 Watts)
4. Primary Supply (Input) rated in volts, 60 HZ
   208, 240, 480, and some 2400V.

CCR TYPES

5. There are 2 styles by output steps. Style 1 is 3 step brightness (3 step output current.)
   a. Mostly 4 KW to 15 KW ratings used on medium intensity lamps 60W or less, taxiways and some runways.
   b. B10/B30/B100 represents 10%, 30%, or 100% intensity.
   c. 10% = 4.8A
   d. 30% = 5.5A
   e. 100% = 6.6A

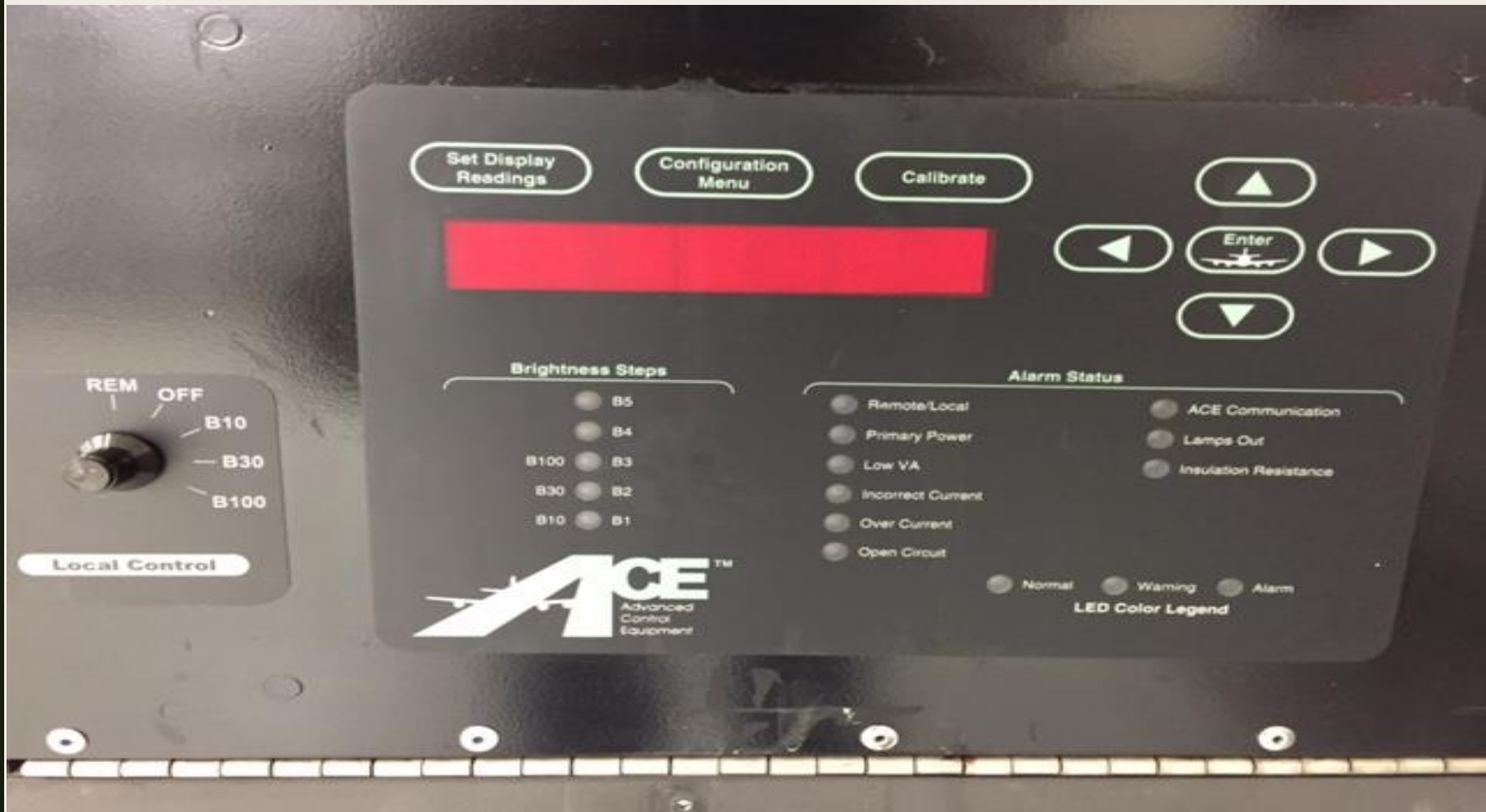
CCR TYPES

6. Style 2 is 5 step brightness (5 step output current.)
   a. B1 = 0.15% @ 2.8A
   b. B2 = 1.2% @ 3.4A
   c. B3 = 5% @ 4.1A
   d. B4 = 25% @ 5.2A
   e. B5 = 100% @ 6.6A
7. Realize a potential hazard exist whenever work is performed on or around energized electrical equipment.

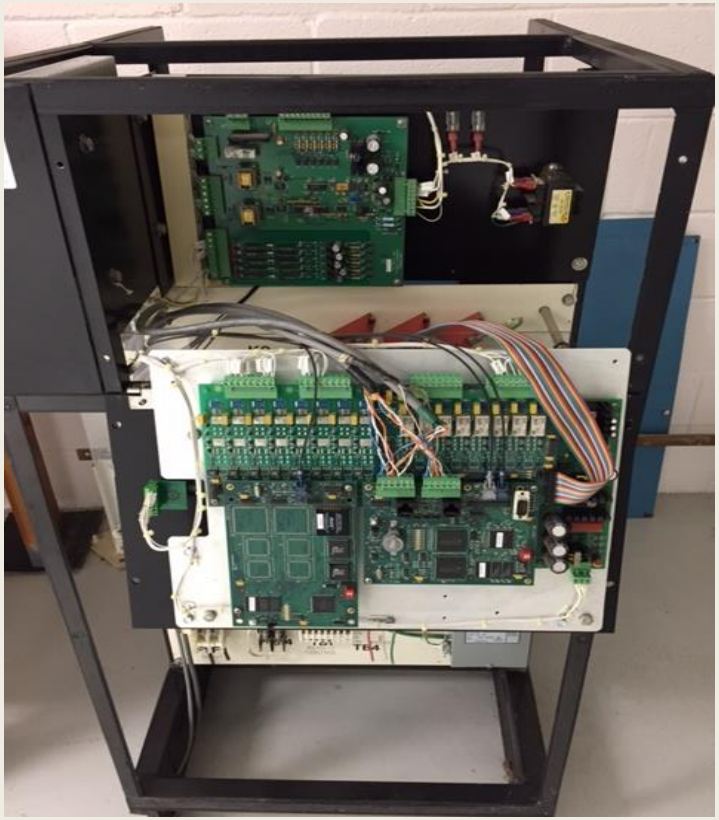
CCR TYPES

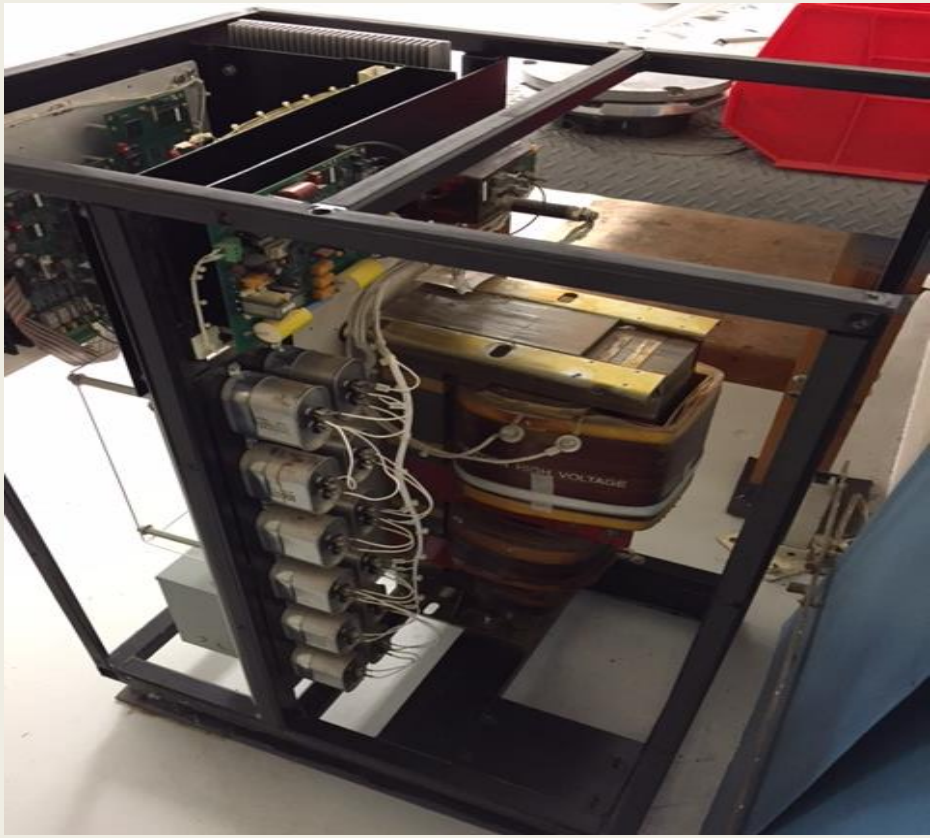
1. A 3 Step CCR is usually used on a Taxiway
2. A 5 Step CCR is usually on the Runway Lighting (because light intensities are higher).
3. A 6.6 Amp maximum CCR output is the most common type used.
4. The 20 Amp maximum CCR output is primarily used at Military Airports.
5. The advantage of the 20A CCR is that for the same load, it has a lower output voltage than the equivalent 6.6A CCR.
6. The 20A CCR is the only type available in the 50KW and 70KW CCR.

CCR DISPLAY


Set Display Readings
Configuration Menu
Calibrate
Enter
REM
OFF
B10
B30
B100
Local Control
Brightness Steps
B5
B4
B100
B3
B30
B2
B10
B1
Alarm Status
Remote/Local
Primary Power
Low VA
Incorrect Current
Over Current
Open Circuit
ACE Communication
Lamps Out
Insulation Resistance
Normal
Warning
Alarm
LED Color Legend
ACE
Advanced Control Equipment

CCR DISPLAY





DETERMINING CONSTANT CURRENT REGULATOR SIZE REQUIRED

1. **(Number of Light Fixtures) X (Lamp Wattage + L-830/L –831 Loss)**
   Note: *L-830/L -831losses are:*
   - ***80% for 30-65W*** *(add 6W for 30W lamp, 9W for 45W and 13W for 65W);*
   - ***85% for 100W*** *(Add 15W for 100W lamp);*
   - ***90% for 200 – 500W*** *(Add 20W for 200W lamp, 30W for 300W and 50W for 500W)*

   = ____ VA ← **Make Calculation For Each Type of Wattage Lamp**

2. **(Number of Signs) X (Total VA for all signs)**
   Note: *See Application Note 2 for Low VA signs*

   = ____ VA ← **Make Calculation For Each Type of Sign**

3. **Cable Power Loss = (0.78 Ohms per 1000 ft.) X (Current)^2** **= ____ VA**

TOTAL VA = ____ VA

Choose Next Largest Size CCR (try to allow 10% for safety factor)

Example: (101 Light Fixtures) X (30W + 6W) = 3636 VA
(11 One Module Signs) X (105 VA) = 1155 VA
(4 Two Module Signs) X (210 VA) = 840 VA
(10,258 feet) X (0.78/1000 ft.) X (6.6A)^2 =345.5 VA

TOTAL VA = 5979.5 VA

Answer: **Use a 7.5 KW CCR**

CCR TYPES

It's a good idea to obtain manuals for your equipment if you do not have them. Please follow the suggested periodic maintenance for each piece of equipment at you facility. When sizing CCRs please refer to the previous slide, and know what type of CCR works best for your application. Please allow me to explain the difference between a SCR CCR and a Ferroresonant CCR.

1. SCR CCRs are smaller in size, less expensive, very noisy harmonics, produce a poor sine wave which is worst when the CCR is over sized and should not be used on circuits that have flashing lights.
2. Ferroresonant CCRs are larger in size, more expensive, very low harmonics, produce a good sine wave, there is no effect on circuits with flashing lights, and there is no effect if the CCR is over sized for the actual load.


COLLABORATION AT IT'S
FINEST!


SAFETY FIRST

YOU WANT TO GO HOME THE SAME WAY YOU CAME TO WORK!!

ENJOYING ME TIME!


Airfield all nice and illuminated


Storms start to roll in.....
Phone call.....Airfield down TROUBLE!

Troubleshooting Airfield Lighting Systems

We will go over some basic troubleshooting techniques. First you want to verify if the problem is in the Vault or the field. There are numerous problems you may encounter which normally are created from two types; an open circuit or a short circuit.

1. Safety
    a. Coordinate and communicate with co-workers as to what's what.
    b. Know your circuit. (Find drawings, or someone who knows how it's laid out. This will help you stay safe and out of other circuits.)

Troubleshooting Airfield Lighting Systems

c. Wear your SAFETY equipment. SAFETY gloves, ear plugs, SAFETY glasses, and use a true RMS meter.

d. Always treat your circuit like it's hot. Again even though commonly done at some airports. It is not recommended to change lamps with the circuit on.


UNPROTECTED
SPLICES IN WATER
Splices repaired on 7-17
7/18/2005 2:01:17 PM


RICHARD SAYS....
NEVER, NEVER,
NEVER ASSUME IT'S
OFF!!!
DO NOT CROSS
POLICE LINE DO

Troubleshooting Airfield Lighting Systems

2. There are some basic troubleshooting techniques we can use and you don't have to be an expert.
   a. Sense of smell
   b. Sense of sight
   c. Sense of listening
   d. **YOU** need to know if someone else has worked on the circuit
   e. **DO NOT TOUCH!**

Troubleshooting Airfield Lighting Systems

3. Recent weather?
    a. Thunder storm
    b. Rain
    c. Extremely hot or cold

4. Any recent digging?

Troubleshooting Airfield Lighting Systems

5. The Open circuit is a common problem found in airfield circuitry. An open circuit; is defined as a circuit, which does not have a complete path for current to return to the source.

    a. Open circuit can be in the field wiring
    b. Open circuit can be in the isolation transformer
    c. Open circuit can be in the light unit
    d. Open circuit can be in the CCR

Troubleshooting Airfield Lighting Systems

6. The short circuit will be the opposite of the open circuit, there is a shorter path for current to to return to it's source. Also referred to as a ground.

    a. Short circuit can be in the field wiring
    b. Short circuit can be in the isolation transformer
    c. Short circuit can be in the lighting device
    d. Short circuit can be in the CCR

If you find yourself in over your head seek help from a supervisor.

Troubleshooting Airfield Lighting Systems

Troubleshooting Airfield Lighting Systems

Quick Reference to Troubleshooting

1. Don't panic! Accidents usually occur doing things we are most familiar with.
2. Communicate..... what is actually out on the field.
3. Distinguish if the problem is in the Vault or the field.
4. If no lights, I'm checking the CCR first. Is it on? Did it trip out? If so check the display to see what did it trip out on? Is the switch on the CCR in the correct position? Has the circuit breaker tripped? Will the CCR reset or does it reset but trips out again? At the same time I'm using my senses, any unusual noises in the Vault? Do I smell anything burnt? Do I see smoke? (hope not) Anyone recently been working on the circuit that day? If the CCR still will not stay on, my next step will be to (loop) the CCR out. This takes the field section of the fault out of the equation. Now if the CCR stays on with the field part of the circuit not connected, then I know my problem is in the field. If it does not stay on, then I know the problem is in the CCR.

Quick Reference to Troubleshooting

5. Problem in the field……. Depending on the fault, in this case (no lights) then before I leave the Vault I'm going to lockout tag out the circuit, ensure any S-1 cut out devices are removed then check continuity on the field circuit. Meanwhile I'm communicating with tower or the power to be, and ensuring some qualified help is on the way.

When you are in over your head
Call for your team members!


CAT
NOW THAT THE TEAM HAS SHOWN UP!


ONE PERSON NEEDS TO BE IN CHARGE!


AVOID DAMAGING FIXTURES
WITH SNOW PILES

Meters & Meggers Used at RDU

PUSH BUTTON STYLE

FLUKE 1507 INSULATION TESTER

CLAMP METERS AND MUTI METERS TRUE-RMS

Airfield Cable Splicing

Demonstration by Mr. Ronnie Jones

The Primary Connector Kit

The primary cable connector kit is designed to provide a separable connection between:

1. a non-screened primary airfield cable(5 kV or less) and an FAA L-830 isolation transformer.
2. in a non-screened primary series circuit cable. One kit is required for each cable splice or transformer installation. Each kit conforms to FAA L-823 Style 3 plug and Style 10 receptacle with crimp-on pin and socket contacts.

Airfield Cable Splicing

Preparing the Cable

1. **Ensure the cable is clean.** The cable needs to be cleaned off from dirt and grease. It also needs to be dry. Do this on both ends of the splice, twelve inches from the end.
2. **Ensure cable is smooth.** The first five inches of the cable should be smoothed out with sand paper to ensure a good seal with the housing and heat shrink. This will help with any possible chance of air pockets forming.
3. **Stripping the jacket off the conductor.** You now are ready to strip the jacket off the conductor. You need to strip back about one inch. Once you strip it back ensure that you didn't nick the conductor. Make sure there is no jacketing left on the conductor where it was stripped. You should slide the crimp on the conductor to ensure proper length exposed.

Airfield Cable Splicing

4. **Pencil the jacket.** Now it is time to pencil, or cut the jacket at an angle all the way around the cable, so that it looks like a sharpened pencil. There are a couple of ways to do this, first, use a penciling tool. Second, use a knife and cut the jacket at a 20-30 degree angle. Once the penciling is complete inspect the conductor for any nicks that you might have made.

Airfield Cable Splicing

Crimping

1. **Check the length of the conductor.** Try the crimp on the conductor for a proper fit. Ensure that it is the right size crimp for the conductor. Next, while the crimp is on the conductor check to make sure there is not excess conductor exposed or that the crimp does not go on all the way. You may need to cut off some of the conductor or strip more of the jacket off.
2. **Inspect the crimping tool.** Ensure the crimping tool is in good working condition. Make sure the proper die is in place for the size crimp you have.
3. **Crimping the crimp.** Slide the crimp on the conductor. Double-check everything again before you actually crimp. Each manufacture tells you how many times to crimp their crimp. For the type that we use it is twice.

Airfield Cable Splicing

Housing

1. **Ensure the cable and crimp is clean.** Before you put the housing on, ensure that the jacket and crimp are clean from shaving and dirt.
2. **Ensure you match up the proper housing with the proper crimp.** Before sliding the housing over the crimp, make sure you have the right house according to the manufacture.
3. **Push the housing on.** This is why you penciled to jacket. Push the housing on a little bit then pull back off, you should see some silicone on the jacket. Smear the silicone around the conductor, this will help to push the housing on all the way. The male crimp should come out about one inch. The female should stay in about one inch. Check with the manufacture specs thou.

Airfield Cable Splicing

Heat Shrinking

1. **Installing the heat shrink.** Before you plug the two ends together, you need to slide a heat shrink tube over one end. Then you can plug the ends together.
2. **Note:** Look out for air pockets!
3. **Properly placing the heat shrink.** Once the ends are together slide the heat shrink over the splice. You want the heat shrink to be even on both sides of the splice.
4. **Time to heat.** You can use either a torch or heat gun to heat the heat shrink. You want to start in the middle working outward ensuring that you go all the way around the cable. While heating keep an even slow motion to ensure that no air is trapped under the heat shrink. Make sure you don't get to close or touch the heat shrink with the torch or heat gun or you will burn the heat shrink. Once heat shrink is complete, you are done!

SO WHY DO WE DO ALL OF THIS?

IT'S MY AIRFIELD I CAN RUN IT HOWEVER I WANT!!!

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.

2. Applicability. The Federal Aviation Administration (FAA) recommends the guidance and specifications in this AC for the Maintenance of airport Visual Aid Facilities. In general, use of this AC is not mandatory. However, use of this AC is mandatory for all projects funded with federal grant monies through the Airport Improvement Program (AIP) and with revenue from the Passenger Facility Charges (PFC) Program. See Grant Assistance No. 34, Policies, Standards, and Specifications, and PFC Assurance No. 9, Standards and Specifications.

Federal Aviation Administration

National Part 139 CertAlert

"Advisory"Cautionary"Non-Directive"Advisory"Cautionary"Non-Directive"Advisory"Cautionary"Non-Directive"

Date:	**June 25, 2014**	**No. 14-03**
To:	**Airport Operators, FAA Airport Certification Safety Inspectors (ACSIs)**	
Subject:	**Preventive Maintenance of In-Pavement Lighting Systems**	
Point of Contact:	Randy Moseng, AAS-300, (404) 474-5114 Alvin Logan, AAS-100 (202) 267-8743	

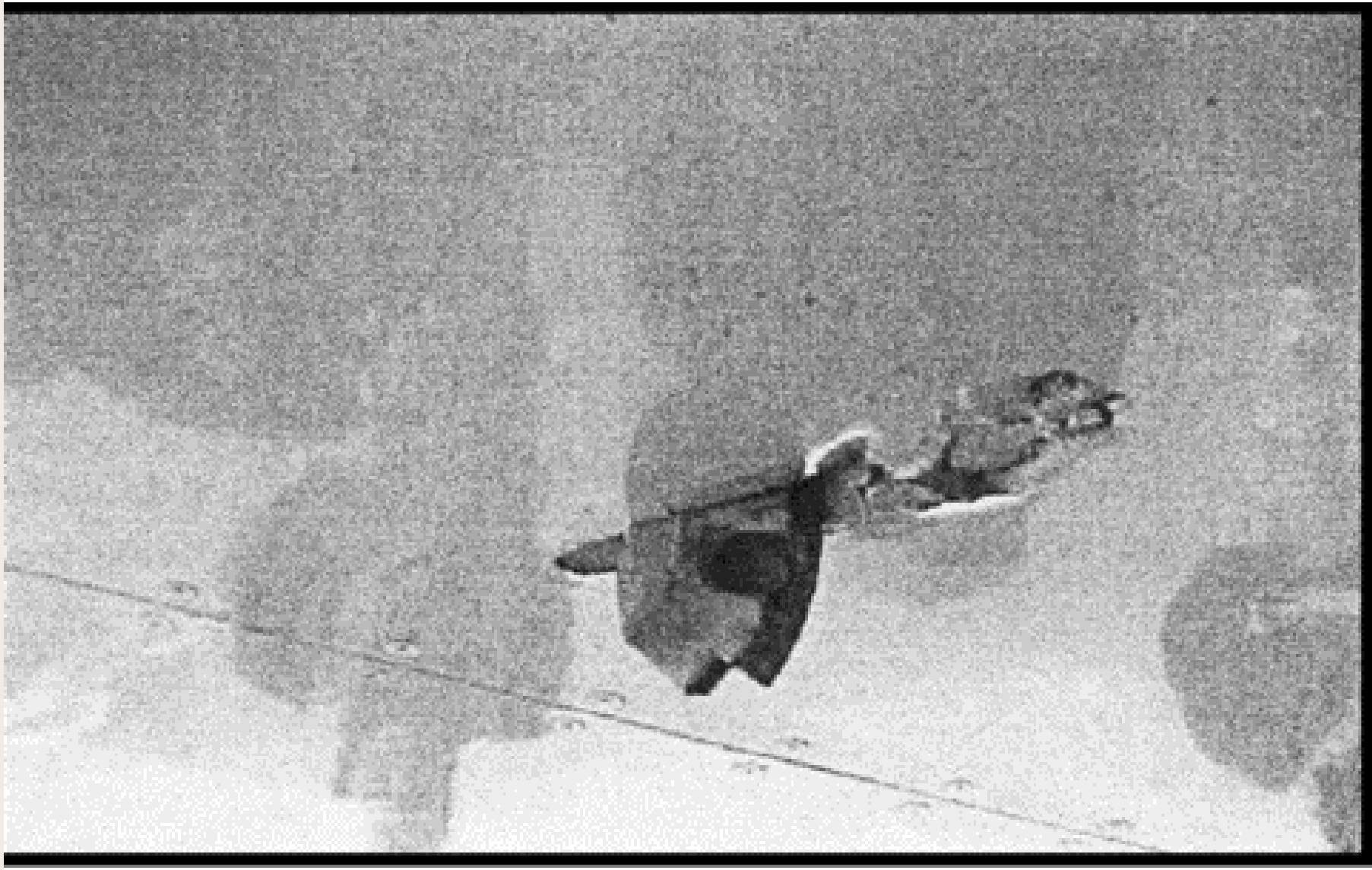
1. **Purpose.** This CertAlert informs airport operators of a recent incident in which a departing air carrier aircraft dislodged an in-pavement runway light fixture, causing significant damage to the aircraft. It reminds them to properly maintain lighting systems as required by 14 Code of Federal Regulations part 139.311(d). This section states, "Each certificate holder must properly maintain each marking, sign, or lighting system installed on the airport." Airports comply with this requirement through routine inspections and by applying a detailed preventive maintenance program.

Part 139 Cert Alert

2. **Background.** In recent incidents, physical damage to an aircraft resulted from the failure of in-pavement runway light fixtures. Lapses in maintenance programs for these in-pavement fixtures may have played a role. These incidents highlight the importance of preventive maintenance programs, associated checks, and inspection procedures. Such surveillance is particularly important with in-pavement lighting systems because they are subjected to physical stress caused by moving aircraft and require additional maintenance, especially in touchdown zones and on busier runways.

3. **Recommendations.**

   a. The current version of Advisory Circular (AC) 150/5340-26, *Maintenance of Airport Visual Aid Facilities*, provides specific guidelines for maintenance of airport visual aid systems. This AC discusses maintenance procedures for in-pavement lighting systems and provides guidelines and a schedule of periodic checks. It is important that maintenance personnel review the schedule of periodic checks, including the need to periodically check bolts used to install in-pavement lights and torque them to the required standard. Other specific recommendations found in the AC include the following:



Example of Problem – Pilot Visual Aids - Lighting

The runway centerline light fixture caused extensive damage to the B-747.

Example of Problem – Pilot Visual Aids - Lighting

The cost of repairing the B-747 from the damage caused by the runway centerline light fixture is unknown. In addition to the costs related to the actual damage to the aircraft, the airline had the additional cost of ferrying the aircraft to a repair facility and loss of revenue during the period the aircraft was out of service for repairs.

Part 139 Cert Alert

i. Torque bolts used with in-pavement lights per the manufacturer's recommendations. Always use a calibrated torque wrench. Never use an impact driver because this could cause over-torque of the bolts. Installed bolts require periodic checks to ensure they remain at the required torque.

ii. Always use a two-part locking washer assembly with in-pavement light fixtures.

iii. Always use new bolts and washer assemblies. Never reuse bolts.

iv. Never leave a fixture with a bolt missing. Missing bolts place additional stress on the fixture as well as the remaining bolts.

v. When maintenance other than simple cleaning is required, removal of the light fixture and replacement with a refurbished unit is necessary. Although AC 150/5340-26 offers a recommended schedule for periodic checks, they should be tailored to the facility based on local conditions such as environmental issues and runway traffic load.

b. Airport operators should review the requirements in AC 150/5340-26, as well as the maintenance recommendations found in the current version of AC 150/5340-30, *Design and Installation Details for Airport Visual Aids*, Chapter 12, that discuss the unique requirements associated with the maintenance of "load-bearing lighting fixtures" such as in-pavement centerline or touchdown-zone lighting.

c. Engineering Brief (EB) 83, *In-Pavement Light Fixture Bolts*, offers guidance and information to be used when installing stainless steel hardware to secure in-pavement light fixtures. It also offers guidance on the use of anti-seize compound with stainless steel bolts and the use of ceramic-metallic coated bolts in lieu of stainless steel. Operators should be aware of EB 83 when selecting materials such as bolts and installing light systems.


Question
Time!


SGRS
SGRS
SGRS
SGRS
SGRS
SGRS
THAT IS OUR TIME
AND WE THANK YOU FOR YOURS
RDU AIRPORT AUTHORITY