Assessing Your Airfield Electrical Distribution System

PRESENTED AT

The 2017 Airports Conference – March 30, 2017 – Hershey, PA

PRESENTED BY

Samuel Mullen, III - Burns Engineering, Inc.

Burns Airports

1

Presentation Objective

"To provide different approaches to improve electrical airfield distribution while offering methods to help improve safety, reliability and redundancy of these systems."

Airports Burns

Presentation Objective

How many of you have heard, “If it isn’t broken, don’t fix it.”?

Lets face it, things don’t get fixed unless there is a problem. Then it is hurry up and “Why is this not fixed yet?”

With today systems, waiting can cost the airport time, money and even loss of life if equipment is not in proper working order.

Burns

Presentation Agenda

- Assess the existing electrical airfield infrastructure
- Airfield Vault Redundancy and Reliability Options
- Determine Recommended Improvements
- Prioritize Recommendations
- Review Probable Construction Costs
- Summary

Burns

Assessing your Electrical Infrastructure

How well do you know your airfield equipment and infrastructure?

What is the current life of underground infrastructure?

- Airfield Lighting Cable
- Medium Voltage Power Cable for Vaults and FAA NAVAIDS
- Light Bases
- Conduits and Duct Banks

Assessing your Electrical Infrastructure

What is the electrical condition of your Airfield Lighting Vault Equipment?

- Vault Service Arrangement
- Vault Electrical Distribution
- Airfield Lighting Control and Monitoring System (ALCMS)

Assessing your Electrical Infrastructure

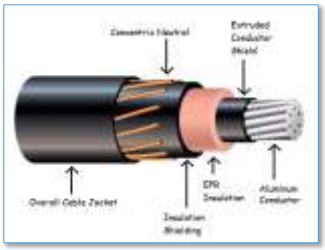
Series Airfield Lighting Cable (ALC)

- Typical ALC is 20 years and declines 10% to 20% per year
- FAA Circular Advisory 150/5345-7, Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits is the governing specification
- As cable insulation deteriorates, leakage current increases, and dielectric loss characteristic changes.
- De-Icing Fluids increase this deterioration
- Megger Testing plays an important part for testing insulation values

Assessing your Electrical Infrastructure

Medium Voltage Cable

- Is primarily used to service airfield lighting vaults and FAA NAVAID Systems
- Factors that affect life and accelerate failure are temperature, humidity, high moisture content, dirt, electrical and Mechanical Stress
- Typical standards include UL 1072, ICEA S-97-682
- Life is project 20 to 30 years of continuous service



Assessing your Electrical Infrastructure

Airfield Light Bases

- Standard types are FAA Type L-867 (non-load bearing) and L-868 (load bearing)
- Many years the standard was 10” diameter
- Most airports have standardized on 12” diameter
- Standard to follow is FAA Advisory Circular 150/5345-42H

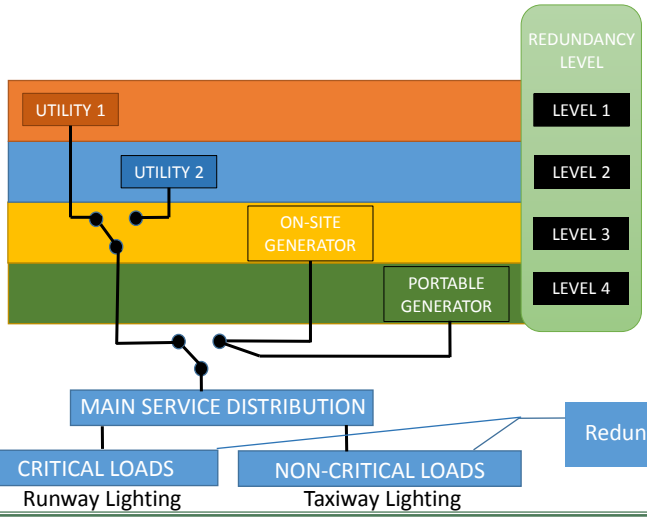
Assessing your Electrical Infrastructure

Underground Infrastructure – Conduits and Duct Bank

- Protect the enclosed cable from damage
- Composed of plastic, metal or fiber
- The duct banks of yesterday used different design and installation methods

Airfield Vault Redundancy and Reliability

Power Distribution and Redundancy for Critical Airfield Systems



Mobile Generator

On-site Generator

Airfield Vault Redundancy

Review of the Airfield Electrical Service Arrangement

This is a top to bottom approach

- Service Starts from the Utility to the Airfield Load
- Independent Utility Substations may not be available

Is the Airport considered a Continuous Power Airport (CPA)?

- FAA Orders 6950. 2D and Advisory Circular 150/5340-30H – provide guidance for electrical power policy implementation at the National Airspace System Facilities (NAS)
- CPAs provide continuous operation in the event of area-wide utility power failure

Service Configuration

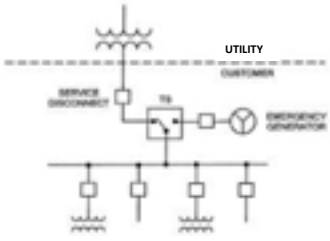
- Single Primary Commercial Source with Alternate Source
- Single Primary Commercial Source with Standby Generator
- Dual Commercial Sources with Standby Generator

Airfield Vault Redundancy and Reliability

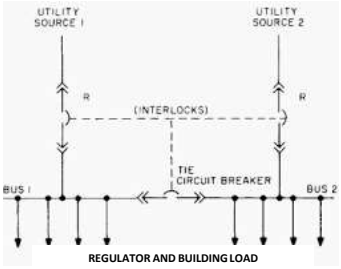
Electrical Equipment Arrangement

To meet FAA electrical power policy requirements, the power system should be sufficient for:

1) The safety of aircraft movement, 2) Efficient air traffic operations, 3) Meeting requirements of national defense and 4) Minimizing inconvenience and cost to the aviation community.



REGULATOR AND BUILDING LOAD



REGULATOR AND BUILDING LOAD

Airfield Vault Redundancy and Reliability

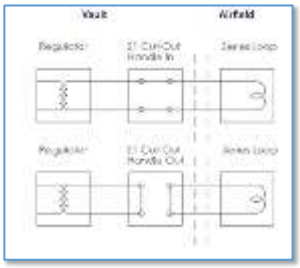
Cleaner Electrical Equipment Arrangement

- Standardize of common utilization voltage, i.e. 480VAC
- S-1 Cutout Mounting
- Input Voltage Busway versus Cable Conduit installation to Constant Current Regulators (CCRs)
- Stand Alone versus Switchgear Style CCRs
- Critical and Non-Critical Electrical Panelboards
- Remove Electrical Equipment not in use

Airfield Vault Redundancy and Reliability

Constant Current Regulator S-1 Cutout Mounting

- Isolating the series lighting circuit from the CCR for maintenance or testing
- Cabinet versus Locally Adjacent to CCR
- Lock Out and Tag Out Considerations



Burns

Airfield Vault Redundancy and Reliability

Busway versus Cable /Conduit Installation Methods

- Install Cable and Conduit can be complex with little flexibility
- Material versus Labor Costs
- Future Integration of CCRs

Burns

Airfield Vault Redundancy and Reliability

Stand Alone versus Switchgear Style Constant Current Regulators

- Switchgear Style CCRs are self contained and stacked light circuit breakers
- Switchgear Style CCRs can reduce floor space but removal/insertion around the line-up has to be considered
- Standalone CCRs can be replaced easily but input power and control has to be re-installed

Airports Burns

Airfield Vault Redundancy and Reliability

Integration of Panelboards

- Distribution of Critical and Non-Critical Airfield Loads
- Challenging process of balancing the Airfield Loads
- Location of the Panelboard

Airports Burns

Airfield Vault Redundancy and Reliability

Airfield Lighting Control and Monitoring System (ALMCS)

- The evolution of the ALCMS has changed significantly over the years
- From the start of push button/toggle switch, to PLCs, to Distributed Control and Monitoring Systems
- While these systems have evolved, updating to the new platform systems increases its reliability
- This come with a wide range of options for the Controller to Maintenance

Airports Burns

Airfield Vault Redundancy and Reliability

Other Vault Considerations

- Post an updated single line diagram in each room of the vault to assist maintenance and quick shut down of electrical equipment
- Rubber safety mats in front of distribution equipment such as Switchboard, Switchgear and Generators
- LED light fixtures with vapor lenses to operate in cold temperatures
- Re-Align door hinges and frames
- Damper/Louver and Exhaust Fan Operation for fire suppression
- External Quick Connect for Portable Generator

Airports Burns

Assessing your Electrical Infrastructure

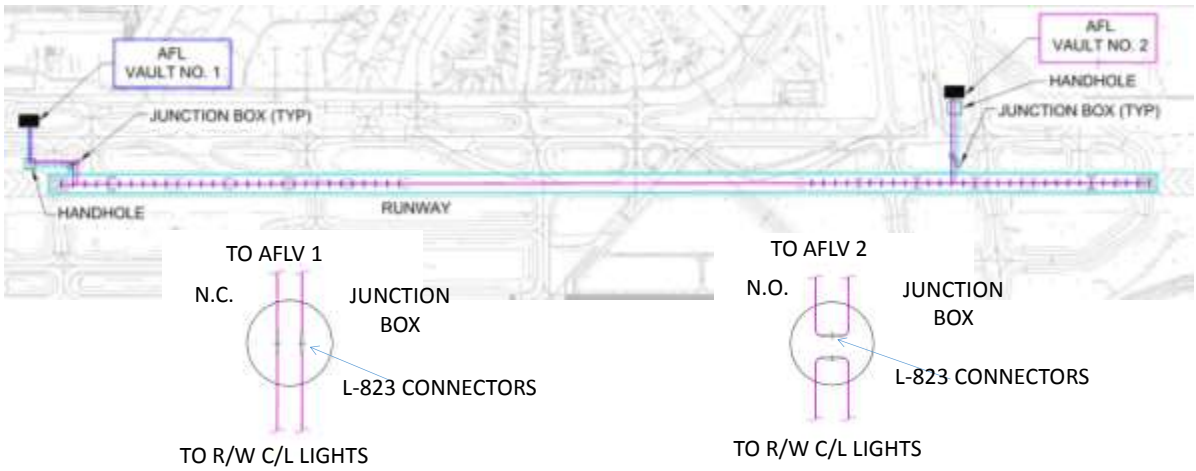
Airfield Circuit Configuration

How are your Runways fed?

How are your Taxiways fed?

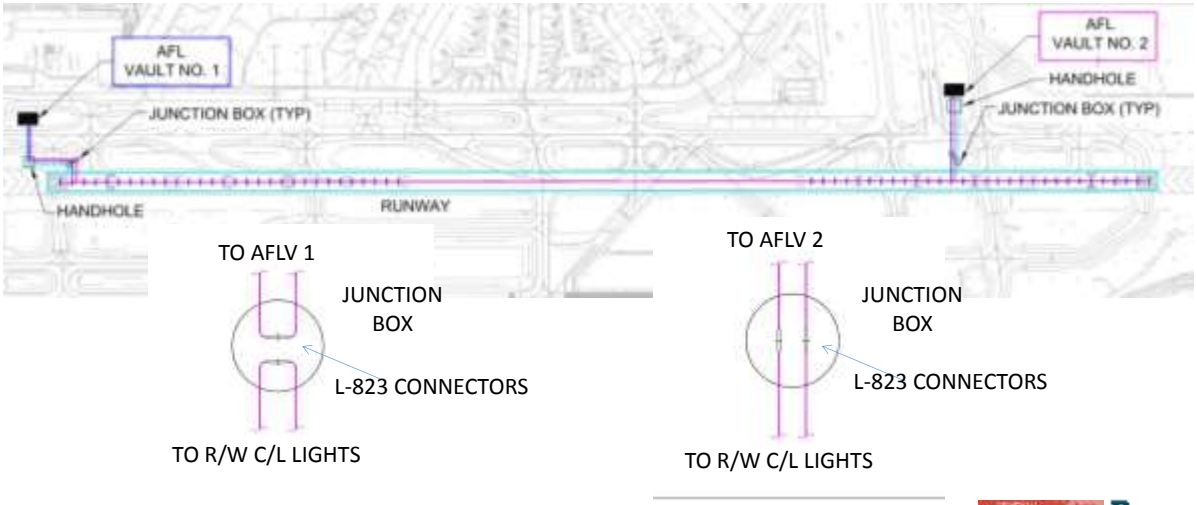
Assessing your Electrical Infrastructure

Airfield Circuit Configuration – Scenario One



Assessing your Electrical Infrastructure

Airfield Circuit Configuration – Scenario Two



Assessing your Electrical Infrastructure

Airfield Electrical System Tracking

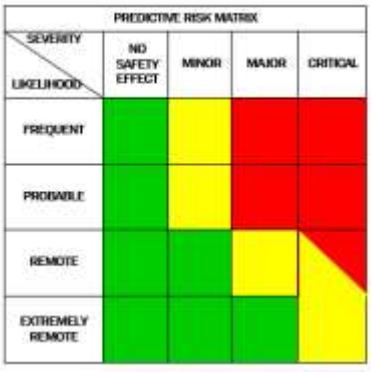
- Radio Frequency Identification tags are installed within a foot of the light or sign
- Initial survey is conducted map the location of the asset
- Maintenance program be developed to track each electrical item

Determine Recommended Improvements

- Perform a Airfield Assessment Report
- Review all airfield electrical systems from top to bottom
- Open your infrastructure – Remove electrical distribution equipment covers, pump down existing manholes
- Take lots of photos
- Identify any single points of failure

Determine Recommended Improvements

To Identify Immediate Deficiencies, Risk of Failures, and Potential Problems, a Predictive Risk Matrix can applied.



RECOMMENDED WORK

1. The existing vault service equipment was reviewed from the medium voltage (15kV) south switchgear through incoming service 750kVA step down transformer and 480V service. The equipment has been in service from the mid 1980's until now. While the switchgear and transformers are operating adequately, the service is beyond its useful life and does not provide the redundancy essential for its low visibility, Category II runways.
2. S-1 Cutouts have been installed on the walls behind each of the CCRs. In Regulator Room No. 1, it is increasing difficult to access the cutouts due to maneuvering through the racks to the wall. The racks create a tripping hazard and the cutouts cannot be removed smoothly.
3. A lot of dust and debris was coming in through the front door entrance from the front driveway. The driveway is not paved which is leading to most of the debris coming into the building. This additional dust and debris can lead to premature failure of electrical equipment inside the vault, especially sensitive electronics associated with the CCRs and ALCMS. Recommend paving driveway and cleaning electrical equipment including vent and fan units.

Determine Recommended Improvements

Option Comparison Recommendations:

- Using the Predictive Matrix, a Summary of Capital Improvement Projects (CIPs) can be generated
- This approach will streamline when electrical equipment repair or replacement is required for improving reliability and safety
- These recommendations are then prioritized and approximate construction costs can be attributed

Determine Recommended Improvements

Example of Recommended CIPs

Priority		System	Approximate Cost	Impact	Duration of Construction / Time Frame
Airfield Lighting System	1	Remove and replace remaining 10-inch diameter light bases and fixtures, transformers, conduit and cable	$1,340,000.00	Reliability, Safety	1 Year / By 2019
	2	Upgrade ALCMS – PCs, Hardware, and Software	$810,000	Reliability, Redundancy	1 Year / By 2018
	3	Removal and replacement of aging cable	$940,000	Reliability, Safety	1 to 1-1/2 Years / By 2019
	4	ALCMS (with CCR) – Addition of IRMS monitoring	$1,060,000	Reliability, Maintenance, Safety	< 1 Year / By 2018
	5	RFID Asset Management Tracking	$178,000	Reliability, Maintenance, Safety	½ year / By 2020
Airfield Lighting Vault	1	Additional room to split the runway and taxiways airfield circuit loads	$613,000	Reliability, Redundancy, Survivability	1 Year / By 2019
	2	Install redundant electrical panelboards within FLV4 and FLER to maintain critical runway and taxiway circuits	$16,000	Reliability, Redundancy	<1 Year / By 2018
	3	Mounting of S-1 Cutouts next to CCR for easy identification and function	$108,000	Reliability, Maintenance, Safety	<1 Year / By 2019
	4	Reconfigure FLV3 incoming service feeders based on preferred and alternate sources	$20,000	Reliability	< 1 Year / By 2020
	5	Replacement of doors and jams, seal all conduit penetrations for fire protection system	$ 10,000	Reliability, Maintenance, Safety	3 months / By 2017

Prioritize Recommendations

- Anything that is a high risk of failure should come first
- Based airport funding, projects can be combined or kept as individual
- Look for improvements that will drive safety, reliability and redundancy to the electrical systems
- Confirm the electrical system is meeting Standards and Codes to keep workers safe

Recommendations

Facilitate Improvements

- After the assessment, get the planning process going
- Drive the execution of the projects based on priority
- Look at the short and long term picture – Existing or New System Upgrades Needed?
- Maintain a list of these critical projects
- Engage the FAA for these projects

Recommendations

After Construction is Complete

- Develop and Maintain good As-Built plans
- Provide training of each electrical system when put into service
- Provide Operation and Maintain Manuals pertaining to the equipment is use
- Post single line and other Electrical Diagrams in Airfield Lighting Vaults and in Maintenance

Summary

- Assess your existing airfield electrical infrastructure
- Verify the typical life of electrical item, its current condition
- Looks for ways to improve reliability and redundancy
- Once the deficiencies are identified, list and prioritize them
- Push for the improvements through future construction projects

Questions and Contact Information

Questions?

Samuel Mullen, III
smullen@burns-group.com /(215) 979-7700 x7723