SUCCESSION PLANNING LEGACY:
WHAT ARE YOU LEAVING BEHIND?

APRIL 10, 2017

Roger Grylls, C.E.T.
Vice President
Electrical Engineering + Technical Field Services
» 6 Offices in Canada, Head Office in Edmonton, Alberta
» 4,500+ Clients
» 1,150 New Projects in 2016

We add value wherever power, automation, control and lighting systems are found.
SUCC ESSION PLANNING LEGACY
WHAT ARE YOU LEAVING BEHIND?
Succession Planning Legacy

What is succession planning in the context of electrical system maintenance?

• How reliable is your electrical distribution system?
• How safe is your electrical distribution system?
• Does your electrical maintenance plan exist only in the heads of a few staff?
• How do you know your maintenance dollars are being spent effectively?
Design an electrical maintenance program that allows for succession planning growth in knowledge base and provides best value for your equipment investment.
Agenda

» Evaluating Equipment Performance

» Identifying Equipment for Repair, Upgrade or Replacement

» Budgeting and Planning for Maintenance

» Training of Personnel
Evaluating Equipment Performance

Danger, High Voltage, Keep Out; doesn’t mean keep out forever!
Electrical systems are made up of numerous electrical components that work in an integrated manner to safely supply power to system loads. These components have their own specific operational limitations and maintenance requirements.

Evaluating Equipment Performance
Assessing Equipment Condition

» Maintenance history
» Records
» Failure history
» Operational familiarity
» Where is equipment in its lifecycle

Evaluating Equipment Performance
Component Failures

The bathtub curve describes the relative failure rate of products. Some will fail relatively early (infant mortality failures), some will fail during the relatively long period typically called normal life others will last until wear-out.

Infant Mortality
- Caused by defects and mistakes
- Material defects
- Poor design
- Assembly/Installation errors

Evaluating Equipment Performance
Maintenance of Electrical Equipment

» Increases availability and reliability
» Satisfactory operation for the entire life-cycle of the equipment
» A cost effective approach

Evaluating Equipment Performance
The Cost of Neglecting Maintenance

FM Global looked at 617 electrical loss incidents between the years of 2001 and 2011 totalling US$3.3 billion. In 84 of the 617 incidents (~13.5%), lack of maintenance was identified as a major contributing factor. This represents US$800 million (average loss/incident ~9.5 million).

Source: CSA Z463-13 A.8
Electrical Equipment Failures

With vs. Without Preventative Maintenance

Source: CSA Z462

Evaluating Equipment Performance
Equipment failures can result in not only equipment damage but personnel injury. Understanding hazard potential is key to knowing how to protect personnel.
Performance Testing

» Electrical systems generally exist in a mechanically static state until an event happens
» Performance testing vs maintenance
» System function testing
» As per CSA Z462, electrical power systems equipment operated when its in poor condition because of lack of maintenance presents a higher risk of personnel exposure to electrical shock and arcing faults.

» Did you know that circuit breaker manufacturers recommend mechanical functioning breakers once per year.

» A NETA study done in October 2007, indicated that 22% of service-aged circuit breakers had some type of malfunction and 10.5% did not operate at all during maintenance testing.

Heid K & Widdup R, Total Clearing Time of Protective Devices and Its Effect of Electrical Hazards
CSA Z462-15
» Workplace Electrical Safety
» Released January 2009, new revisions 2012, 2015 and soon to be 2018
» Developed by a Technical Committee comprised largely from industry
» Technically harmonized with the Canadian Electrical Code, NFPA 70E and other standards

Evaluating Equipment Performance
» Covers more than just arc flash hazards
» Essentially a toolkit of work practices, definitions, equipment requirements, equations, look-up tables and sample forms
The incident energy analysis and selection of PPE are completely dependent on the protective devices functioning exactly as designed.

Protective devices shall be maintained to adequately withstand or interrupt the available fault current and to function in accordance with their designed operating times.

*Note:* Improper or inadequate maintenance can result in increased opening time of the overcurrent protective device, thus increasing the incident energy.

Evaluating Equipment Performance
Arc flash levels are the product of time and energy. Proper equipment operation is essential to the control of the time component of the equation.

**Set and forget = misoperation, danger and negligence**

Evaluating Equipment Performance
Electrical Safety Authority (ESA) analysis of electrical incidents in the year 2008 indicated that adherence to CSA Standard Z462-12 would have eliminated 100% of fatalities and 94% of critical injuries.
Agenda

» Evaluating Equipment Performance

» **Identifying Equipment for Repair, Upgrade or Replacement**

» Budgeting and Planning for Maintenance

» Training of Personnel
**Maintenance Planning**

» How much, how often?
- Use performance test results and findings as a guide
- Categorize critical items
- Shutdown opportunities
  - Budgets!!
» Applicable guides, standards
Process and Procedures for Maintenance

CSA Z462 states:

“Sites shall have procedures and practices in place to manage the integrity of electrical equipment”

CSA Z462 recommends referring to CSA Z463 for guidance related to electrical strategies.
CSA Z463 complements the Canadian Electrical Code, Part 1, and is part of the CSA Z460 trilogy of electrical safety publications:

» CSA Z460: Control of Hazardous Energy – Lockout
» CSA Z462: Workplace Electrical Safety
» CSA Z463: Guideline on Maintenance of Electrical Systems

Identifying Equipment for Repair, Upgrade and Replacement
The CSA Z463 guideline provides

» Strategies on electrical maintenance
» Practical applications to integrate electrical maintenance into quality management systems
» Guidelines on electrical safety and specific equipment related maintenance practices
» Analysis of inspections, testing and failure results
CSA Z463 states

» The asset owner should develop a detailed maintenance plan
» The maintenance plan should identify all the maintenance activities required to confirm the safety, reliability, and integrity of the electrical system and equipment
» The maintenance plan should identify the frequency of inspection and comply with the equipment manufacturers recommended maintenance intervals and tasks (NETA MTS)

Identifying Equipment for Repair, Upgrade and Replacement
Application of this guideline can range from enhancing existing QMS, safety systems to providing practical guidance and specific examples for the development of electrical maintenance programs.

Identifying Equipment for Repair, Upgrade and Replacement
Testing and Inspections

» What is it suppose to do?
  • Design consideration
  • Applicable settings and drawings

» Environmental considerations

» Criticality of system

» Current condition of equipment

» Budgets for upgrades and replacements
Identifying Equipment for Repair, Upgrade and Replacement

Is my equipment within ‘spec’?
NETA (International Electrical Testing Association)

Founded in 1972

Sets out standards for:

» Maintenance intervals
» Scope of inspections and electrical tests
» Expected results and acceptance criteria
» Technician qualifications
» Testing company qualification
» Test equipment calibration
Identifying Equipment for Repair, Upgrade and Replacement

» Specific to electrical Industry
» Promote competence in electrical testing and electrical system maintenance
» Equipment specific standards for acceptance and maintenance testing
» Accrediting body
Two-fold Accreditation Process

» Company certification
» Technician certification
Identifying Equipment for Repair, Upgrade and Replacement

**Document standards**

» **Maintenance Testing Specifications (MTS)**
» **Acceptance Testing Specification (ATS)**
» **Standard for Certification of Electrical Testing Technicians (ETT)**
» **Standard for Electrical Commissioning Specifications (ECS)**
» **Endorsed by American National Standards Institute (ANSI) in 2007**
Identifying Equipment for Repair, Upgrade and Replacement

References

ASTM, EASA, IC EA, IEEE, NECA, NEMA, NFPA, UL and others
How does a maintenance plan aid with succession?
Identifying Equipment for Repair, Upgrade and Replacement

Trending Test Results

» What do these test results mean, what do I do with them?
» Good, bad, normal wear and tear?
» Industry Standards, like equipment, rate of degradation
Agenda

» Evaluating Equipment Performance

» Identifying Equipment for Repair, Upgrade or Replacement

» **Budgeting and Planning for Maintenance**

» Training of Personnel
Budgeting and Planning for Maintenance

Repairs

- What items are in need of repairs or replacement during a shutdown?
- Are additional resources needed to execute the repairs?
Replacement and Upgrades

» Are the parts available?
» What information is needed to specify a replacement or upgrade?
» All equipment will eventually reach end of life
» Sound maintenance strategies can help plan for this inevitability
» Finding a balance between reliability, cost and safety is key to having a successful maintenance plan
Good maintenance practices and strategic upgrades can extend the life of equipment, improve performance, safety and prolong the equipment replacement as long as practical.

A good maintenance plan will get the best life out of your equipment and provide the best value for that investment.
A good maintenance plan helps predict your replacement budgets. Knowing your equipment will reach end of life in 10, 5 or 2 years allows you to budget properly and affords the time to get the most competitive replacements in a non-urgent timeframe.
Which breaker would you rather be standing in front of?
Personnel

» Are the required skills available to perform all of the maintenance activities?
» What are the specific duties of maintenance personnel?
» What are the specific training requirements for maintenance personnel?
» Are staff qualified to perform the required tasks?
Maintenance Involves

» Understanding hazards
» Understanding performance requirements
» Technical competence and execution
» Evaluation of results
» Budgeting for lifecycle
There are numerous maintenance strategies. Talking to a professional can assist in proper development of a maintenance program based on equipment, performance needs and budget.
Agenda

» Evaluating Equipment Performance
» Identifying Equipment for Repair, Upgrade or Replacement
» Budgeting and Planning for Maintenance
» Training of Personnel
Succession Planning for Staff

» How involved does your staff get?
» How routine are maintenance activities?
» How much specialized equipment and resources are available?
**Technician Certification**

» Appropriate educational background

» Technical examinations

» Appropriate years of service
Summary

» Maintenance, regulatory compliance, safety and reliability are inter-related concepts that all need to be addressed together

» Owners need to understand hazards relating to electrical equipment

» Hazard levels assume equipment will operate within design tolerances

» Electrical equipment requires routine maintenance to function properly

» All equipment will eventually reach end-of-life

» Proper maintenance leads to the longest equipment service life, highest safety for personnel and best value for owner
A Sustainable Approach to Electrical Maintenance

Magna IV Engineering