Abstracts for IEEE IAS ESTMP - Calgary 2014

Technical Presentations (see below for Panel Discussions and Tutorials)

Evolution of VFD Technology in Specialty / Long Lead / ESP Applications

Pat Robinson - Altelec Engineering Sales

MV VFD technology has dramatically changed over a period of decades. The first MV VFDs were 6 and then 12 pulse current source technology, which had many deleterious effects on both the power system and mechanical driven systems, but did and still do have an advantage in that they do not have dV/dt issues.
Voltage source technology came later, limited by voltage ratings of switching devices, and to an extent (depending on topology) still have issues with dV/dt, requiring special care and insulation systems to apply properly.
The technology has progressed to the point that some voltage source topologies can provide low dV/dt impact to electrical insulation systems, without filtering and without needing higher rated insulation systems, or any significant effect to the power or mechanically driven systems. This modular, low dV/dt technology, due to its unique nature, allows use of these VFDs in specialty applications including;

- Exceptionally long motor leads (up to 2.3km without external filtering, but no technical length limitation with LC filter), subsea, central hubs for land base VFDs.
- Electrical submersible pump applications where in addition to lead length the motor voltage is required to vary greatly depending on the depth and hp (traditionally done with LV VFDs and large, expensive multi-tap step up transformers and much filtering of input and output waveforms)
- Old sites with 2400v systems where a new or replacement VFD is required, the nature of the VFD allows the VFD to operate at the motor 2300v insulation without stress and switch to 4160v via setting change and reconnection of VFD isolation transformer primary. This allows the owner room to upgrade capacity in the future by changing the system transformer source to 4160v.
- In these applications it is important to note that due to the nature of the VFD, it will not impact the 2400v (or lower) insulation, even though it is a nominal 4160V VFD.

The presentation will describe how the topology allows for these capabilities.

Save Your Money… Through Innovative Power Cable Design

Blair Sackney - Southwire

One challenge we are continuously faced with on large projects is budget constraints. In the presentation we will look at ways to SAVE YOUR MONEY through innovative Power Cable design. Wire and cable can often exceed 10% of a project's total Electrical budget. Re-evaluating your old standby cable specification may allow you to realize substantial savings without sacrificing any system performance.
During the presentation it is our goal to provide and discuss power cable options currently tried and tested on Mega Projects. Many cable specifications were written years ago prior to recent

product advancements and are reactivated by default on new Mega Projects. Are some cables currently over specified? We will discuss the latest options, benefits and limitations.
Topics of discussion will include aluminum conductors, Teck vs. Tray Cables, UL vs CSA standards, single conductor vs. multi conductors, XLPE vs. EPR insulation.

IECEx Certification of Personnel Competency Scheme

David Adams – QPS Evaluation Services

As an owner or operator of a facility where potentially explosive atmosphere may be present, you have an obligation to operate a “safe” facility in order to ensure the health and safety of all workers and site personnel.
As you are aware, there are numerous codes, legislation and/or regulations covering the infrastructure of such facilities; building, fire, electrical, plumbing, HVAC and environmental, etc. However, there are very few, if any, codes or regulations governing the competency of the personnel designing, installing, maintaining, operating, etc., the various systems, equipment or programs. In most cases, it is left to the individual companies to “qualify” their staff for the particular function(s) in question. This is accomplished by providing training courses, on-the-job training, etc., but at the end of the day it is still a mainly subjective opinion on the competence of the staff, usually based on undefined criteria by possibly by the same examiner(s) that provided the training. Until now, this was really the only option for a facility owner to verify that the personnel on-site or related to the site are competent for the functions they are intended to fulfill.
This is the reason for the introduction of the IECEx Certification of Personnel Competencies (CoPC) Scheme. The IECEx Certification of Personnel Competencies (CoPC) Scheme – An internationally recognized Scheme to independently assess and Certify the competency of personnel working with or in the vicinity of potentially explosive gas or dust atmospheres (or Hazardous Locations).

Economics of Upsizing Conductors in Industrial Distribution Systems

Duane Grzyb - Magna IV Engineering

A rigorous examination of the new construction economics of installing increased gauge Teck 90 power cables supplying industrial induction motors.
This paper explores the hypothesis of obtaining an acceptable return on investment as well as a perceivable reduction in CO2 equivalent emissions by upsizing cables in new design.
The analysis method is described, identifying the various factors that were considered in this analysis, both positive and negative, to determine the realistic benefits (if any).
A test case is examined in detail, comparing several gauges of copper conductors (#1/0 - #4/0) supplying a 575V, 100HP induction motor. The modelled scenario uses 250 meters Teck 90 installed in cable tray at 30°C ambient. Steady state running temperatures are calculated for each cable type and considered in the evaluation.
Analysis is done based on current economic factors after which sensitivities will be identified to determine breakpoints where factors such as commodity copper price, interest rates, and labor rates make this upgrade attractive or unattractive.
Also Included in this analysis is the cost of capital, potential carbon tax impacts, and changing electricity costs.

Lastly, some guidelines which may help owners and engineers identify applications that are candidates for further consideration.

Advanced Industrial Electrical Installations

George Morlidge - Fluor

The objective would be to review the latest technology and philosophy in electrical installations in modern electrical installations. Some of the topics discussed may be old to some but will be new to others. It will emphasize how important it is to decide what you are doing at the inception of your project and how this must be bvuilt into the complete corporate structure of the project so there are no surprises as the project proceeds. Some of the topics to be discussed will be the down falls experienced in the use of tray cable, the use of rebar grounding and its advantages, 3rd generation modularization, variances in Alberta, and the Objective Based Industrial Electrical Code.

UL 943C: Special Purpose GFIs

Merv Savostianik – Startco Little Fuse

Although Class A Ground-Fault Circuit Interrupters (GFCIs) have been responsible for a 50% reduction in residential electrocutions, they have not been widely used in industrial applications yet. Their limitation on the system voltage (maximum 240V) and the allowed leakage current are the reasons that Class A GFCIs cannot be used for industrial personnel protection.
Many industrial power systems are 480 or 600V with ground-leakage current of more than 6 mA. Therefore, it is not practical to use Class A GFCIs for industrial applications. UL recognized the gap in industrial personnel protection and defined new special-purpose GFCIs in the UL943C Standard. Special-purpose GFCIs can be used on systems up to 600 V and allow a leakage current of up to 20 mA. For higher leakage currents up to 50 mA, equipment ground-fault protection devices (EGFPDs) can be used.
This presentation covers the UL 943C requirements and how it applies to personnel protection in industrial facilities. The differences between GFCIs and EGFPDs as well as field applications are discussed. The field application involves the design selection criteria, field installation considerations, and using the GFCI or EGFPD for preventative maintenance as well as preventing shock hazards.

CSA Z462, 3rd Edition, 2015 - How It May Impact Your Company

Terry Becker - ESPS

CSA Z462 is here to stay and if your company is using it to establish and implement due diligence to OH&S Regulations you need stay current with how it will change every 3 years. The 3rd Edition will have significant changes in it that will impact your company's Electrical Safety Program and how a Qualified Electrical Worker completes an Electrical Hazard Analysis for the energized electrical work tasks they complete.
Some of the changes you need to be aware of:
1. Hazard and risk are broken apart and Electrical Hazard Analysis will now be called Arc Flash Risk Assessment and Shock Hazard Risk Assessment. Approximately eighty (80) changes may be made with respect to "Risk Assessment."

2. The Hazard/risk category Table Method will change, you need to know why and what it means. The shock related PPE, and tools recommendations will be removed, the tables will be renamed to “Arc Flash Hazard Identification.”
3. When using the Hazard/risk category Table Method, the HRC 0 designation will be deleted.
4. The Prohibited Approach Boundary for shock will be deleted.
5. Specific emphasis is placed on clarifying what a “Normal Condition” is on energized electrical equipment.
6. Clarification is provided for when an Energized Electrical Work Permit is required.
7. Emphasis placed on “Battery Work Risk Assessment.”
8. Updated information in Annex D for “DC Incident Energy Calculations.”
9. Annex F renamed to “Risk Assessment Procedure.”
10. Annex O Safety Related Design Requirements is updated to recognize some additional “Engineering Safety by Design” opportunities related to reducing incident energy.

Evaluation of New Predictive Arc Fault Technologies in Switchgear

John A. Kay - Rockwell

An arc-fault occurring in switchgear can cause severe damage to the equipment, increases the risk to personnel working in the vicinity and can impose significant negative economic impact to a facility or process. Proactive and continuous detection of potential failure points within electrical control equipment can facilitate a more preemptive and complete arc fault prevention system.

In this presentation, a number of different new sensor technologies, proving pre-emptive detection, are evaluated based on extensive studies and actual user experiences. The most significant technologies are examined more thoroughly. It has been documented that the two major non-contact causes leading to an arc-flash event in switchgear are insulation degradation and thermal stresses. This presentation covers the detailed measurement results under both of these conditions. New hybrid sensor technologies both for partial discharge (PD) measurement and thermal detection are introduced and evaluated. An effective signal processing technique, needed for extracting the essential indication of a developing fault, is also presented. Analytical results for the associated pre-arc conditions are established and conclusions for applying any of these new sensor technologies are given.

When these new sensor systems are interconnected to predictive protection systems communicating with SCADA or PLC systems, on-line predictive monitoring is now a very real option available to increase the safety and reliability of switchgear and controlgear. Connection of pre-emptive arc detection system to protection, PLC or SCADA systems has also been discussed.

Ask the Right Safety Questions

Ron Zieber - TransAlta

This paper discusses some key audit methods and questions used to evaluate worker behaviors and adherence to corporate electrical safe work standards. This research was prompted by the question: “Are the approaches used and the questions asked during an audit really uncovering all aspects of worker behavior?” Human factors play a significant role in both

getting accurate responses from workers during audits as well as motivating facilities to address audit action items.

Risk Management Principles in Safety Standards

Daniel Roberts - Schneider

Abstract: Effectively managing occupational health and safety is a layered endeavour. Standards such as CSA Z1000, ANSI Z10 and OHSAS 18000, provide a framework for an organization to manage occupational health and safety and continuously improve performance. Standards such as CSA Z462 and NFPA 70E address workplace specific hazards. Effective application of the requirements of the latter is best achieved within the framework of former. Risk management principles are being integrated into both levels of Standards, it is therefore becoming increasingly important to understand the relationship between Standards and how these principles apply in a layered approach.

The A-B-C of Arc Flash Labeling in Manufacturing Facilities

Eduardo H. Enrique – Stantec

The arc flash study and labeling of electrical equipment in manufacturing facilities follows the guidelines laid out in IEEE Std 1584-2002, IEEE Std 1584a-2004 and IEEE Std 1584b-2011. These standards address the calculations required to determine the maximum incident energy when a fault occurs. In some manufacturing settings with a large number of process machines the study becomes extensive and tedious. There are situations, however, where the arc flash risk category of the electrical equipment can be predetermined by the characteristics of the electrical system at the point of connection. Based on the control panel operating voltage, it is possible to group the equipment as belonging to one of three distinct groups: A, B and C. A machine belonging to any of these groups can be labeled as having a hazard/risk category of zero without performing an arc flash study. The classification of machines by groups substantially reduces the incident energy calculation efforts. This paper describes the necessary conditions for an electrical equipment to belong to one of the above groups.

Why Upgrade Protection and Grounding of Generators at Plants?

Wayne Hartmann – Beckwith

In the past fifteen years, significant changes have occurred in the protection and grounding of generators which impact generators at petroleum refineries and chemical plants**.** This paper provides updates on generator protection upgrades and highlights protection areas that are still not addressed by some generator owners and new protection areas not previously addressed. New generator protection changes are reflected in recent IEEE standards such as C37.102-2006. This paper discusses these changes as they apply to industrial generators, the risks of ignoring the changes, and instances in which old generator electromechanical relay protection is inadequate.

Additionally, the paper discusses hybrid grounding of generator stator windings, which substantially reduces stator ground fault damage—avoiding lengthy generator outages to repair. This type of grounding is a new concept in generator grounding introduced in IAS Working Group papers published in 2002. This grounding scheme has been installed on many

generators but must be coupled with proper relaying as well as transient overvoltage protection. The paper also highlights new protection requirements for gas turbines starting with an LCI and protection advances made possible by digital technology which has fostered new methods not possible with older technologies.

Criticality of Electrical Maintenance Programs and the new CSA Z463

Kerry Heid - MEC

It is becoming more evident every day that one of the most important aspects of an electrical safety program is a strong understanding of what is required for electrical maintenance. Establishing safe working zones, incident energy values and associated arc flash boundaries hinge on the proper operation of the electrical protection and switching components.

The CSA Z463-13 Guideline on Maintenance of Electrical Systems is the newest developed guideline to improve safety for workers and protect property through the adoption and systematic application of maintenance strategies for electrical equipment. By defining methods of identifying equipment and systems, this guideline will directly impact worker electrical safety and the reliability necessary for the safe operation of electrical equipment; the reliability of which should then be managed within the context of an organization's overall safety, reliability, and maintenance management system.

Organizations can use this Guideline to optimize the integration of other programs and systems, such as hazardous energy lockout control programs and workplace electrical safety programs, into their business management systems for critical equipment maintenance strategies. While conducting the critical analysis of existing maintenance strategies, an organization can improve the management of the electrical safety program as well as its maintenance and reliability program.

This guideline is meant to join the maintenance practices standards and electrical safety alongside InterNational Electrical Testing Association (NETA) standards Maintenance Testing Specifications and NFPA 70B, *Recommended Practice for Electrical Equipment Maintenance*.

This presentation will cover the some key maintenance topics such as justification for maintenance, maintenance strategies and elements of an electrical maintenance program. This presentation will also provide an in depth look at Z463 and an overview of the other maintenance standards.

Electrical Submersible Pump Performance Improvement in Thermal Application through Electrical Power Quality Audits

David Shipp - Eaton

The Surmont Phase 1 Oil Sands facility in Northern Alberta has 36 SAGD (Steam Assist Gravity Drainage)well pairs (1 injection well and 1 production well per pair). Gas Lift and Electrical Submersible Pumps (ESP) are the lifting methods selected for production wells based on reservoir conditions. The ESP systems utilized are medium flow rate and low head requirement, with conventional surface system configuration including step down transformers, Variable Speed Drives (VSD) and step up transformers feeding the ESPs down-hole. Unusually high failure rates and underperformance of down-hole electric components triggered a comprehensive power quality audit.

This paper will cover the unique petroleum engineering requirements of a SAGD well system, the basic electrical design criterion to meet these requirements, and then describes the methodology used to identify the electrical power delivered from the VSD as the main root cause of the performance problems and the recurrent failures as well as the upgrades and improvements performed in the surface components to improve system reliability and performance. This paper will walk the reader through the field pre-study measurements, sine wave filter application, implementation and post field measurements proving it works as designed.

Protection and Control Power Supplies – Another Look

John Hodgson - Leading Edge Sales

Protection and control power supplies have evolved over the years from current shunt devices, to AC power, to capacitor trip units and finally to newer, and continuously better battery sources. One of the common denominators in today's battery banks is size matters when related to standby time.

This paper and presentation will reinvestigate the determination of battery sizing through some more simple calculations and review the rationale of battery bank design in today's power systems. Much of the information provided is based on personal experience in testing and investigating battery banks in the field. Although applicable to all voltages this discussion will concentrate on the more common industrial utilization level of 120VDC.

Alternatives to the status quo of battery and charger power supplies will be explored. New technology in breakers and protection will be looked at from a load impact perspective. This paper is meant to suggest some options for how we design and apply critical power for our electrical power system protection and control systems.

A case study of a recent project will be explained and discussed with some real time feedback on performance and a short analysis of economics. Comments and questions regarding the application will be requested and hopefully lead to some good interaction with the audience.

Transient Phenomena in MV Vacuum Circuit Breakers: Case Study

Rasheek Rifaat and Felix Choo – Jacobs

Medium voltage (MV) industrial distribution power systems utilize vacuum type circuit breakers (VCB's) for numerous applications. MV System short circuit ratings are increasing and, with the utilizations of power factor correction capacitors, short circuit current limiting reactors and other components the system configurations are more sophisticated than ever. VCB's have in-service history and their technologies are mature. However, misapplications have been associated with some failures in VCB's and in system components switched by them. Such failures are avoidable with better evaluation of transients associated with VCB's applications in modern industrial systems. This presentation examines the Transient Recovery Voltages in some MV vacuum breakers and the switching transients at connected transformers and motors. As current interrupting processes differ between VCB's and other breaker types, modeling of VCB switching requires diligence. Case studies utilizing the Electro Magnetic Transient Program (EMTP) are presented to demonstrate remedial actions in some cases and application's limits in others. Results are examined against IEEE, IEC TRV Standards and supplier's provided test data. Study findings are presented for future references and for

advancing the usage of EMTP (ATP) for the performance of robust analytical studies and practical evaluations of VCB's applications.

Panel Discussions

Panel Discussion - Equipment Temperature Limitations for Wiring

Rene Leduc - Marex Canada, George Morlidge - Fluor, Tim Driscoll - OBIEC Consulting, Scott Basinger - Eaton

Previous versions of the CEC (Canadian Electrical Code) had very conservative wire ampacities. There has been an effort to harmonize and update wire and cable ampacities to come to realistic capabilities of the conductor and insulations. In the 2012 CEC, the ampacity tables were updated and harmonized with the NEC (National Electrical Code) in the US, and have been generally increased with the 90°C Conductors seeing the biggest changes from previous Code versions. A new rule No. 4-006 setting temperature limitations was introduced, which is harmonized with the NEC. This rule is based on equipment capabilities having connections at 75°C and has the effect of nullifying the increased 90°C conductor ampacities. The industry has used 90°C conductors as standard for decades, but the increased ampacities for these conductors in the 2012 CEC cannot be used as the CSA Part ll standards have not been updated to allow connection to equipment at temperatures beyond 75°C. Therefore the increased ampacity for 90°C conductors is not available for the industry to use.
This Panel Discussion presents viewpoints from Manufacturers, End Users, Engineers and Designers, and Inspectors, intended to stimulate discussion, and hopefully develop a path forward for equipment to accept higher 90°C conductors ampacities.

Panel Discussion: Fire and Life Safety Considerations

Ark Tsisserev - AMEC, Aaron Lober - Magna, Aaron Gillrie - Magna

Coming Soon

Panel Discussion: Commissioning and Startup

Chris Dedeurwarder – Pembina Pipelines, Brennan Pasitney – Chemco, Kevin Rookes – TransCanada Pipelines, Paul Bedard – PCS Valance

Coming Soon

Tutorials

Design and Operation of Motor Bus Transfer Schemes
Thomas Beckwith – Beckwith

This tutorial discusses the design and operation of automatic schemes to transfer loads from an interrupted bus section to the alternate bus within petroleum/chemical facilities without damaging the motors being transferred. It is extremely important to maintain continuity of electric service to these facilities when the normal (usually utility) source has sustained an outage.

Many petroleum/chemical facilities have at least two independent supply sources in a main-tie-main configuration. Each source supplies a bus section (typically at 4.16 or 13.8 KV) with a normally open bus tie between the bus sections. Upon loss of supply the bus section must be quickly transferred to the alternate supply to avoid a major outage. The transfer most be done without damaging the motors supplied from the bus section that has sustained the outage. The tutorial discusses various schemes to provide this transfer, operating experience with each scheme as well as new designs made possible through the use of digital technology.

Hazardous Location Lighting
Marty Cole - Hubbell

Basics of Lighting Technology - The various light sources are discussed in terms of performance measurements such as efficacy, lumen depreciation and life.

Advancements Lighting Technology
- LED Technology and luminaires for Hazardous Locations has advanced at an unprecedented pace. This segment discusses LED lighting technology, where it is presently at and where it is expected in the near future.
- OLED technology is briefly discussed. While still in the development stage, OLED is being touted as the next great lighting invention.
- Other light sources such as Induction and Plasma are also discussed.

Basics of Hazardous Location Lighting
- This section deals with the requirements for lighting in hazardous locations and includes fixture construction for the various Hazardous Area classifications and Temperature Code Considerations.

Lighting System Design Considerations
- Understanding Photometric Data and light measurements (confusion around photopic and scotopic measurements)
- Working with Lighting Design Programs
- Installation rules and Requirements - Mounting issues and considerations – safer maintainability

Designing, owning and operating a Lighting System

- This section includes the use of controlled optics fixtures to improve light placement and reduce fixture counts, the cost of lamp replacement and what programs such as group re-lamping offer

Regulations Effecting Hazardous Location Lighting: includes a brief discussion of the CSA Standards and NRCan (Canada's Energy Efficiency Regulations) that relate to hazardous location lighting, and more importantly some that don't

Motor Testing

Dennis Bogh – General Electric

Topics that would be covered include:

- Incoming material and vendor testing
- Sub-assembly tests and quality checks
- Rotor and Stator tests and quality checks
- Final assembly tests
    - Routine
    - Complete
    - All of the API tests in addition

The purpose of this tutorial is to familiarize the attendee with manufacturing processes used in the factory to test and quality check a medium voltage motor. Of course heavy emphasis will be placed on the API procedures and requirements.

Industrial Battery Technology and Applications

Yves Lavoie – Primax

Coming Soon