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Toronto, Ontario
January 24 - 28, 2011

ESW 2011

2011 IEEE IAS Electrical Safety Workshop

changing the electrical safety culture

Our 18th Annual Conference

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- Products & Services Exposition
- Standards Working Groups
- Expert Presentations
- Technical Tours
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2011 IEEE IAS Electrical Safety Workshop
Program and Schedule

Revised September 15, 2010

Monday & Tuesday January 24 - 25

Monday January 24

8:00am – Noon	IEEE 1584 Working Group – Guide to Performing Arc Hazard Calc.; Conf Rm B
12:30–1:00pm	Tutorial Check In
1:00 – 5:00pm	Tutorial 1: Electrical Safety Management; Conference Room D
1:00 – 5:00pm	IEEE P1814 Working Group -Electrical System Design Techniques to Improve Electrical Safety; Conference Room D

Tuesday January 25

7:30 – 8:00am	Tutorial Check In
8:00 – Noon	Tutorial 2: Electrical Safety Basics; Conference Room D
8:00 – Noon	Technical Tours
8:00am - Noon	IEEE 1683 Working Group; Enhanced Safety Motor Control Centers; Conference Room B
11:30 – 12:30	Authors' Luncheon;
12:30–2:00pm	Guest Luncheon;

ESW2011 Opening Session – Grand Ballroom

1:00pm	Welcome to ESW 2011 Eva Clark, Chair ESW 2011
1:30pm	ESW2011-02 Keynote: Darryl Hill, PhD, CSP VP Safety & Health ABB; President American Society of Safety Engineers
2:15pm	ESW2011-03; *Electrical Hazards and Required Precaution;* Mohanmed Rashid Al-Qahtani
3:00pm	Break
3:15pm	ESW2011-04; *Case History: Serious Near In LOTO;* Shahid Jamil
3:30pm	ESW2011-05; *Ultrasound Applications for Electrical Inspections;* Sean Miller
4:15pm	ESW2011-06; *PPE in Electric Arc: New Research and Key Insights of Arc Testing;* Hugh Hoagland
5:00 pm	Session Adjourns
5:30-7:30pm	**Welcome Reception**

Wednesday January 26

7:00am	Workshop Breakfast Authors' Breakfast
7:35am	Early Bird Drawing
8:00am	ESW2011-07; Keynote Presentation: Dr. Joel Fish, Chief Medical Officer, St John's Rehab Hospital Toronto
8:45am	ESW2011-08; *Case History: Electrical Safety – Is Your Brain Engaged?* Leon Greenwood
9:00am	ESW2011-13; *Why Electricians and OSH*
9:00am	*Workers Take Risks by Working Live What You Can Do;* Gaven Howe PhD
9:45am	Break
10:00am	**Awards & Recognitions** • **ESW 2010 Prize Papers** Joe Rachford,, Chair ESW 2010 • **Recognitions in Electrical Safety** Danny Liggett, ESW Steering Committee
10:30am	ESW2011-11; *Service Contractor Realities – Minimizing Risks;* Ronald Bergeron
11:15am	ESW2011-12; *New OSHA Rules for GFCIs;* Stephen Antman, Danny Liggett, Roger Nolte
Noon	Lunch –
1:00pm	ESW2011-09; *Case History: The Label Says...;* Dennis Hill
1:15pm	ESW2011-14; *Proposed Changes to NFPA70E 2012;* Paul Dobrowsky
2:00pm	ESW2011-13; *D3 – Due Diligence Documentation for Electrical Supervisors;* Mike Doherty, Andy Kerr
2:45pm	Session Adjourns
3:00– 6:00pm	**Products & Services Expo and Social** Sheraton Hall ***Proven solutions and the latest in innovation in technology and services***

Thursday January 27

7:00am	Workshop Breakfast Authors' Breakfast
7:45am	Early Bird Drawing
8:00am	ESW2011-16; *Overview of Changes to IEEE Guide for Maintenance, Operation* & Safety; Dennis Neitzel
8:45am	ESW2011-17; *Electric Shock Injuries From Static Electricity Discharges* Lanny Floyd
9:30am	Break
9:45am	ESW2011-18; *Arc Protective Blankets;* Huel Gunter
10:30am	ESW2011-19; *Continuing Education & Development for Electrical Safety Professionals;* John Aeiker, PE, CSP
11:15am	ESW2011-20; *The Impact of Fuse Link Manufacturers on Arc Flash Energy;* Fabio Leite, Jose Grimoni, Fábio Malheiro and Luiz Tomiyoshi
Noon	Lunch
1:00pm	ESW2011-20; *Arc Flash Mitigation in an Active Data Center:* Steven Emert
1:45pm	ESW2011-21, *Applying Risk Management Principles to the Selection of Arc Flash PPE – II;* Daniel Roberts
2:30pm	Break
3:00pm	ESW2011-22; *Simulation Based Electrical Safety Training: An Innovation In Safety Culture;* Eben Myers
3:45pm	ESW2011-23; *Panel Discussion CSA Standard Z462 Workplace Electrical Safety;* Mike Doherty
5:00pm	Session Adjourns
5:30 – 7:30pm	**Networking Social**

Friday January 28

7:00am	Workshop Breakfast Authors' Breakfast
8:00am	Early Bird Drawing
8:15am	ESW2011-24; *Arc Flash Reduction System Application Considerations;* Ed Larsen
9:00am	ESW2011-25; *Arc Flash Hazard Assessment in the Mining Industry;* Matthew Hopper
9:45am	Break
10:00	*Reinvigorating Electrical Safety;* Brett Brenner
10:15am	ESW2011-27; *Stray Current Analysis;* Peter Sutherland, PE
11:00am	ESW2011-28; *The Misuse of Voltage as a Parameter of Concern for Electrical Hazard;* Don Zipse
11:45am	*Invitation to ESW 2012* Dennis Neitzel, Chair ESW 2012 Daytona
Noon	ESW 2011 adjourns

Post Conference Tutorials

Noon	Tutorial Lunch
1:00 – 5:00pm	Tutorial 3: *Use of Systems Safety Techniques to Perform Hazard Analysis on Electrical Systems & Electrical Safety Programs* Tutorial 4: *How to Create an Effective Electrical Maintenance Program*

Mark your calendar!

ESW 2012

Jan 30 – Feb 3, 2012
Daytona Hilton
Daytona Beach, Florida

The ESW registration & information desk hours

Hours: Monday 11:00AM to 4:30PM; Tuesday – Thursday 7:30AM to 4:30PM; Friday 7:30AM to 1:30PM
Check with the registration desk for any questions and additional information

ESW 2011

2011 IEEE IAS Electrical Safety Workshop

January 24-28, 2011
Toronto, Ontario

Keynote Presentations

Darryl Hill, PhD, CSP
Vice President Safety & Health ABB
President American Society of Safety Engineers

Joel Fish, MD
Chief Medical Officer
St. Joseph Rehab Hospital

Pre-Conference Tutorials

Electrical Safety Management (Monday 1-5pm)
Abstract: This tutorial will use ANSI Z10-2005, Occupational Safety & Health Managing Systems (harmonized with CSA Z1000) as the framework for benchmarking existing programs and for designing and implementing a state of the art electrical safety program. It will incorporate the requirements of NFPA70E-2004, Standard for Workplace Electrical Safety (harmonized with CSA Z462) and other recognized industry standards to achieve a comprehensive program based on proven safety management principles. The attendee will be provided the knowledge and tools to assess existing programs, identify improvement opportunities, and develop implementation plans

Learning Objectives: Attendees will gain knowledge in the elements of a comprehensive approach to electrical safety management. The attendees will be provided information to help create a blueprint for designing an effective electrical safety program and integrating it into an overall Safety, Health, & Environmental management system. The blueprint can be used for designing a new program or to assess quality of an existing program, and enable the attendees to assess and design real, sustainable improvements in how electrical safety is managed in their organizations

Instructors: Mike Doherty; Lanny Floyd, PE, CSP; & René Graves, CSP

Electrical Safety Basics (Tuesday 8am-12pm)
Abstract: This tutorial is a basic electrical safe work practice class. The intent of the tutorial is to provide attendees with the basic safe work practices that are required to perform electrical work. The tutorial will addresses the electrical safe work practices and personal protective equipment (PPE) requirements to safeguard personnel from electrical hazards including the hazards of electrical shock, arc-flash, and arc-blast. Key safe work practice requirements of NFPA 70E and CSA Z462, arc flash hazard issues, and safety by design will addressed. This tutorial will prepare attendees to better follow the subjects covered during the IEEE IAS Electrical Safety Workshop that will follow this tutorial.

Learning Objectives: Attendees will gain knowledge of these topics:

- History, scope and content of NFPA 70E, CSA Z462 and IEEE 1584.
- Electrical Incident Data – Why electrical safe work practices are important for your safety.
- Key electrical safe work practices.
- Arc Flash, Incident Energy, and Personal Protective Equipment Requirements.
- Prepare attendees to better follow the IEEE IAS Electrical Safety Workshop presentations.

Instructors: D. Ray Crow, PE; Danny Liggett; and Ken White, PE

Post-Conference Tutorials

Use of Systems Safety Techniques to Perform Hazard Analysis on Electrical Systems & Electrical Safety Programs (Friday 1pm – 5pm)
Abstract: The results of Hazard Analysis (HA) are most-often assumed to translate into restrictive work practices and additional Personal Protective Equipment. Properly applied, HA can result in LESS restrictions to work processes and more freedom for workers to safely perform their jobs. Most importantly, HA will allow employers to KNOW that their employees are protected from hazards rather than to HOPE they are protected. This tutorial will provide both lecture and hands-on instruction on how to properly apply HA to common work practices.

Learning Objectives: Attendees will gain knowledge of these topics:

- Understanding the systemic nature of Safety and its implications on Hazard Analysis
- Learning of the existence of 13 Hazard Analysis tools and how to use 3 of them…
- Learning how to properly assess Risk and when to stop trying to control Risk
- Use of the MORT chart for Hazard Analysis, Accident Investigation and for developing Electrical Safety Programs
- Practical applications of Hazard Assessment on three common electrical tasks.

Instructor: John J. Kolak, BSEE, MS, CSP

How to Create an Effective Electrical Maintenance Program (Friday 1pm – 5pm)
Abstract: Have you ever wondered just how to start an electrical maintenance program but didn't know where to start? Join us for a ½ day workshop designed to give you an overview of the critical requirements of a successful program. The workshop outlines a typical Electrical Distribution system will discuss in detail the key factors required of an electrical maintenance program, how to approach the maintenance requirements of each piece of equipment within the distribution system and how these processes integrate together.

Learning Objectives: Attendees will gain knowledge of these topics:

- Implementing NFPA 70B processes in line with the requirements of NFPA70E and CSA Z462
- Understanding RCM processes and their benefits.
- Correct use of condition based measurement techniques (IR, Ultrasound, MCA, etc…) and the required measurement parameters for good data collection and report generation
- How to successfully combine maintenance tasks with the required safety standards
- Complete an outline document for the business case for your electrical maintenance Program

Instructor: Martin Robinson

Technical Program

1:00pm Tuesday – Noon Friday

Electrical Hazards and Required Precaution

Mohammed Rashid Al-Qahtani
Saudi Aramco

Several international organizations, such as the Occupational Safety and Health Administration (OSHA), argue that electric shock, arc flash, and arc blast are the primary causes of personnel injuries from electricity. Further, the National Fire Protection Association (NFPA) reports that the most common cause of home fires are electrical incidents. The purpose of this research is to address the hazards of electricity and outline the required precautions individuals should take based on international standards versus the existing industry practices. A questionnaire and interview were used to gather information about the hazards of electricity and common precaution measures. The data collected from the questionnaire allowed the researcher to analyze the training, safe working practices, and established procedures for electrical safety in the industry. The findings indicate that electrical safety was not addressed appropriately in the industry as recommended by international standards.

As a case study, this paper will share the significant improvements that were done by the Saudi Petrochemical Co. (SADAF) with regards to Electrical Safety. Those improvements started with conducting an audit by external agent for SADAF electrical safe working practices versus NFPA 70E recommendations, followed by the development of a detailed electrical safety procedure and related sub procedures. Training was done to the electrical staff and general awareness sessions were conducted for the company staff. New procedure was developed to assure proper authorization & qualifications of electrical staff. Flash hazard analysis were done, protection boundaries were identified and the required arc flash personal protective equipment were provided. This paper will share all those improvements and changes in details.

Ultrasound Applications for Electrical Inspection

Sean Miller
UE Systems

Ultrasound inspection is fast becoming a breakthrough technology, as an effective screening tool, for detecting the potential for arc flash through non-invasive procedures. With new advances in the technology, hand-held ultrasonic instruments are used to scan enclosed electrical apparatuses with fast, accurate and simple procedures. This method can also alarm personnel, as well as identify the presence of arcing, tracking and corona, in high, medium and low voltages. This also includes over head lines and high voltage gear. These advancements are helping to improve work practices and overall Electrical Inspection, as well as safety standards to help reduce electrical accidents and injuries, including Arc Flash Incidents.

PPE in Electric Arc: New Research and Key Insights of Arc Testing

Hugh Hoagland
eHazard.com

Clothing and other PPE exposed to arc flash and blast will be reviewed with a special emphasis on new research and uncommon results of unique research on blankets, shields and other methods of mitigation other than PPE. This paper is an update of a continuing series at the workshop with more hazard focus than in previous years. Four types of arc flash exposures will be reviewed and expanded upon including: Ejected Arc, Infrared arc, Arc-in-a-box, and Tracking Arc.

Why electricians and OSH workers take risks by 'working live' and what can you do to change this behavior?

Gavan Howe, PhD
President and CEO of Howe Brand Communications

This paper will explain the research finding's of Gavan's Master's thesis on the question of 'why trained experts take the risk of working unnecessarily on live, energized electrical machinery and equipment, and what is the role of emotional appeal in communications aimed at mitigating risk taking behavior? Gavan's primary research with electricians and OHS approved workers in Ontario, in conjunction with the IBEW, showed amongst other learning's this is a gendered issue as there have been no known fatalities to female electrical workers in Ontario in over a decade. Gavan found that due to the lack of attention to this pressing question in the academic literature, much work is needed at both the individual as well as organizational level. His research showed that there are risk takers, risk-seekers, and risk bearers, and the drivers allowing workers to take, or bear life altering risks are diverse, highly interrelated, and essentially stem from the Demand for live work, or Supply of those who would work live (other than for power line workers). He will share case histories of how the Ontario Electrical Safety Authority (his thesis sponsor), as well as the Electrical Safety Coalition of Ontario benefited from this new research in the creation and execution of several fully integrated communications campaigns which had a significant impact by raising awareness of the dangers of live work Gavan will demonstrate risk mitigation strategies and tactics for industry practitioners because as Sparrow stated: "The risk literature so far has not given us a well-developed organizational theory for risk-control. Neither, conversely, has organizational theory paid explicit attention to the distinctive character of the harm-reduction task".

Serious Near-Miss in Locking-Out and Disconnecting a 4 kV Motor

Shahid Jamil
Imperial Oil

A serious near miss occurred during the lock out and tag out of a 4 kV motor which had the potential for a serious injuries or fatality. The workers were required to lock out a 4 kV motor but mistakenly locked out a different 4 kV motor. They then disconnected motor's power cables in the field with the motor starter not locked out and cables not grounded at the starter Two important steps in the electrical lock out procedure were not followed Although the procedure was correct and complete, but the procedure was further improved. New and unique lock-out tags were developed and their use was implemented to enhance electrical safety.

Electrical Safety – Is your brain engaged?

Leon Greenwood
PPL Electric Utilities Corp.

In an 18 month time span our plant incurred three separate electrical safety incidents – all three could have caused serious personal injury. Fortunately we were spared by protective clothing and by reliable circuit protection. This paper is not about how good our clothing is or how well maintained our equipment is, it is about how our brain and our thinking process needs to be engaged on electrical safety. The first incident occurred when a three phase molded case breaker handle broke with the breaker in the closed position. An arc flash occurred when the screwdriver used slipped into the live breaker internals. The workers were not aware of the proximity of the live parts within the breaker. The second incident occurred when workers were drilling mounting holes for a relay in an MCC cubicle. The cubicle was connected to the bus while the work was being performed. A flash occurred when the worker drilled into one of the wires connecting the cubicle stabs to the line side of the breaker. The worker was unaware that the wires ran across the back of the cubicle. The third incident occurred when workers cut into a

conduit which contained live wires. The wiring had been abandoned in place. The workers were unsure if there were wires in the conduit and were attempting to cut a wedge out of the conduit to see if there were wires inside when the reciprocating saw contacted the wires. The contact caused a flash. There were alternate means by which the workers could have checked to see if wires were present. Note to committee: If this paper is accepted, I could do this as one presentation or as three individual case histories spread across the three days of the workshop.

The Label Says…"

Dennis J. Hill
URS Corp.

NFPA 70E-2009 requires that electrical equipment "be field marked with a label containing the available incident or required level of PPE". Labeling of equipment is an effective method of alerting personnel of the shock and arc-flash hazards as well as providing details of necessary protective clothing and procedures. Since arc-flash labeling is intended to protect the worker, it is particularly helpful to consider the various ways in which labeling can go wrong. It is in the best interests of all to avoid any situation which could lead to either a false sense of security or to excessive PPE. This is a real life collection of examples from facilities having arc-flash labeling programs in which corrections were needed to the labels, personnel training, or maintenance. It is also encouraging to see that these shortcomings are easily identified and in most cases are corrected with proper attention. The presentation will include diagrams of systems, equipment, labels, and conditions to illustrate the issues and solutions.

Service Contractor Realities – Minimizing Risk

Ronald Bergeron
Bergeron Electric Ltd.

Contractors face many difficulties in making safety practical for service electricians. Typically, the sites have no electrical staff, no drawings, no maintenance of electrical gear, and certainly no arc flash analysis. Most managers/owners balk at spending money on safety and maintenance when everything is running well and no one has been hurt. These everyday situations put electricians at risk for accidents and injuries. Ideally, electricians should not work in these situations. The reality is that the customer will not pay for regular maintenance or for a study…but they want the work done. If a contractor refuses a job, it is certain that another contractor or plant staff will do the work. Short of closing up shop, the only alternative for the conscientious contractor is a "least worst" scenario…that is to minimize risk. Many contractors find the goal of meeting all safety regulations as overwhelming, impractical and costly, and so they don't bother at all. The culture needs to be changed…and the first step is to recognize that a "minimize the risk" approach is acceptable. The author describes how this has been accomplished in his company. He first gives typical examples of the contractor/customer world. He then outlines the program of knowledge (courses, safety meetings, checklists), the PPE (clothing, equipment, portable kits) and policies (no live work, random audits) utilized to minimize risk for his staff. Included is a grid he developed that integrates Z462 table 4 and Ministry of Labour regulations in one easy-to-use page for field use by his electricians The culture can be changed by showing contractors practical ways to minimize the risk. That happens when we simplify the process and show them how easy it is to be safer in all situations. This will improve the prevention of electrical incidents and injuries.

New OSHA Rules for GFCIs

Stephen Antman
Technology Research Corporation

Danny Liggett
DuPont

Roger Nolter
PSE&G

This presentation will cover Ground Fault Circuit Interrupters (GFCIs) as defined under OSHA General Industry Electrical Standard S29CFR1910, Subpart S, effective Oct 2008. These recent OSHA changes outline GFCI Requirements for General Industry temporary wiring installations that are used during construction-like activities including certain maintenance, remodeling or repair activities, involving buildings, structures or equipment. This General Industry rule covers new requirements for higher voltage applications, such as applications requiring 230V and 480V (the most common high voltage power needs). We will present the history of GFCI Standards, GFCI internal make-up and knowledge that will save lives. We will also cover applications up to 600V, 80A, with examples from manufacturing/process plants, entertainment examples, municipal/institutional applications and more.

Proposed Changes to NFPA 70E 2012

Paul Dobrowsky
Innovative Technology Services

This presentation will cover the expected changes to the 2012 edition of NFPA 70E. Attendees will learn about the Proposals and Comments as acted on by the NFPA 70E committee.

D^3 – Due Diligence Documentation for Electrical Supervisors

Mike Doherty
Infrastructure Health and Safety Association

Andy Kerr
Horizon Utilities Corporation

Electrical supervisors have very important accountabilities to ensure the safety of the workers on their crews. They are on the front line when it comes to due diligence in all safety aspects of the job. More often than not they provide the company with the last opportunity to ensure that everything reasonable for safety has been completed Well completed documentation is the best way to establish safe work and prove that all best safety business practices have been instituted on behalf of the company. Often this is not the case. The real challenge is to get the work very well done but maintaining safety as the number one priority. The authors feel that a comprehensive suite of practical documentation can be used to accomplish leading edge safety principles while keeping work programs on schedule, the best of both worlds. This presentation and paper will detail in visual and written representations the electrical safety workflows using existing, new and very innovative document strategies. The electrical safety workflow documentation methodologies will be described in a simple and straight forward manner to ensure timely & practical due diligence safety applications for supervisors in the field.

Overview of Changes to IEEE Guide for Maintenance, Operation, and Safety of Industrial and Commercial Power Systems

Dennis K. Neitzel
AVO Training Institute, Inc.

IEEE Std. 902, Guide for Maintenance, Operation, and Safety of Industrial and Commercial Power Systems, also known as the IEEE Yellow Book, has been an excellent resource management, safety professionals, and maintenance personnel since it was published in 1998. This presentation will provide an overview of this IEEE standard for those who are responsible for

safety, operations, management, and maintenance of industrial and commercial electrical power systems. The IEEE Color Book series is in the process of being revised into numerous “dot” standards, under the 3000 series of standards, with the Yellow Book being divided into three such “dot” standards. The new “dot” standards for operations and management, maintenance, and safety are:

- 3007.1, Recommended Practices for Operation and Management of Industrial and Commercial Power Systems
- 3007.2, Recommended Practices for the Maintenance of Industrial and Commercial Power Systems
- 3007.3, Recommended Practices for Electrical Safety in Industrial and Commercial Power Systems

This presentation will also provide an overview of the IEEE Color Book Reorganization effort, as well as some specific revisions that produced IEEE 3007.1, 3007.2, and 3007.3.

The Impact Of Fuse Link Manufacturers On Arc Flash Energy

Fábio Leite
DuPont do Brasil

Jose Grimoni
University of São Paulo

Fábio Malheiro
UNESP-Ilha Solteira

Luiz Tomiyoshi
DuPont do Brasil

The traditional operational and hazard control paradigm of an electrical installation has several issues pertaining to the diversity of equipment. A large maintenance inventory is a reason for concern for any manager, but the arc flash hazard is a particularly new phenomenon and the effects of equipment diversity on this phenomenon are even newer. The class of arc hazard can be increased, simply by changing the fuse link or circuit breaker manufacturer. Management pressure to operate as well as non-standard practices and installations are also partly responsible. The aim of this study is to take a typical situation in an industrial plant and to statistically simulate, by means of a dedicated software program, the fuse arc flash interruption performance of various manufacturers. The purpose of this study is to obtain a more objective indication of the influence of different fuse link manufacturers on arc flash incident energy.

Electric Shock Injuries from Static Electricity Discharges

H. Landis “Lanny” Floyd, PE, CSP
DuPont

Most people are aware of static electricity discharges at two extremes – the annoying, but not dangerous shock from static accumulation from sliding across an automobile seat, and the highly dangerous and destructive energy discharge in lightning strikes. Between these two extremes are static discharges from manufacturing operations that can cause shock injuries. The hazards of static electricity in industrial and manufacturing operations are generally viewed as ignition source in flammable and explosive environments, and not as a source for shock injury. This hazard and measures to control the static electricity shock hazard and safeguard people are not addressed in the most visible and read standards addressing electrical safety in the workplace. This paper will describe manufacturing scenarios in which the potential for injury from static electricity discharges exist, and discuss methods to prevent, control, and protect personnel from injury. The paper will include a case history involving shock injury.

Arc Protective Blankets

Huel Gunter
Salisbury by Honeywell

The use of Arc Protective Blankets (APB's) date back several decades, when each manufacturer had their own testing parameters in the absence of a National Standard. In June of 09 ASTM published F2676 Standard Test Method for Determining the Protective Performance of an Arc Protective Blanket for Electric Arc Hazards. This test method is used to evaluate the ability of the APB to withstand the effects of arc flash/arc blast. We will discuss the testing and ratings assigned to an APB, along with regulatory compliance, manufacturer comparison, use and care.

Continuing Education & Development for Electrical Safety Professionals

John D. Aeiker, PE, CSP
DuPont

Electrical safety professionals are not born as electrical safety professionals. We learn, grow, and develop the knowledge and skills to do our work and be effective in our field. A number of means are available to us to learn and develop. This presentation will examine the stages of development for an electrical safety professional and how continuing education enables us to improve our ability to make a positive contribution and impact in our field. A paper the author co-authored for the 2002 PCIC in New Orleans that investigated switchgear related incidents identified lack of knowledge and understanding of fundamental principles of electrical safety as one of several key factors in many electrical related incidents. Inadequate knowledge of electrical safety safe work practices and electrical technology were the primary or secondary shortcomings in those planning electrical work and those approving the work prior to commencing it. Additionally, inadequate knowledge often influenced the investigation process and resulted in improper identification of key factors and root causes of the incidents. Electrical safety professionals were often not involved in electrical related incident investigations. For professionals, both engineers and electricians, the challenge of obtaining licenses can be daunting and grueling. It takes many hours of study as well as several years of on-the-job experience to meet the qualification requirements for these licenses. Most regulatory driven registration and licensing programs now require some form of continuing professional development to retain the registration or license. Seminars, workshops, conferences, university/college courses, and vendor sponsored training provide many varied opportunities for advancing knowledge and skills as well as meeting the licensing continuing education requirements to remain current in one's professional field. In addition to the technical knowledge and skills required to be an effective electrical safety professional in today's world, "soft" skills are required to lead and influence constant use and improvement of safe work practices throughout the workplace. These skills include: interpersonal, oral and written communication skills, oral presentation skills, and the ability to lead in a wide variety of situations involving a wide spectrum of people and organizational levels. Often, an electrical safety professional's ability to influence others to commit resources and energy to improving an organization's capability and discipline related to electrical safety is through these interpersonal and communication skills rather than being based on technical knowledge. Technical knowledge is important but it is lost without effective abilities to lead and influence others. How does an electrical safety professional "fit" in an organization? It varies - some are bosses, some are workers, some tell, some offer advice, some influence, some listen, some don't, some act, some don't, some talk, some do, some lead, some follow - each style presents the need for a different approach to be effective. Understanding your role as an electrical safety professional and growing in it to be better year after year helps you to "lead" or "coach" or "mentor" those in your organization and improve the implementation of the electrical safety program in your organization.

An Arc Flash Hazard Assessment in the Mining Industry – A Case Study

Matthew Hopper
Eaton Corporation

When it comes to electrical safety in the workplace, arc flash has become the most prominent topic over the past decade. The Occupational Safety and Health Administration (OSHA, including state chapters) is the only government body that recognizes NFPA-70E, Standard for Electrical Safety in the Workplace. However, OSHA does not have jurisdiction in mining operations. Electrical safety for metal and nonmetal surface mining industry is covered by the Code of Federal Regulations (CFR) Title 30, Part 56, Subpart K (Electricity). The Mine Safety and Health Administration (MSHA) is responsible for enforcing electrical safety in mining operations. CFR Title 30 does not reference personal protective equipment (PPE) to protect electrical workers against arc flash hazards.

This paper is a case study of an electrical safety assessment for a large Metal/Nonmetal surface mine and the obstacles encountered. The primary intent of this particular assessment was to quantify the incident energy at locations where an employee might work on energized electrical equipment where an electric arc flash could occur. The incident energy was then used to determine the NFPA-70E Hazard Risk Category and appropriate PPE to protect the qualified worker. Installations traditionally not found outside the mining industry such as mobile sub-stations, drills and excavators with tail cables, and specialized grounding techniques posed challenges for both the analysis engineers and the mine electrical employees. Work tasks associated with these types of installations are not referenced in NFPA-70E and differ from those found in non-mining industrial facilities. As a result, this project forced the mine to reassess their overall electrical safety program.

This paper provides maintenance and safety personnel in surface Metal/Nonmetal mining operations with a step by step guide to implementing an electrical safety program that meets the requirements of MSHA, CFR Title 30 and NFPA-70E.

Arc Flash Mitigation in an Active Datacenter

Steven Emert

Since the 2005 NEC mandate requiring arc flash labels the emphasis has been mainly on how to get the correct information on an arc flash label. To date thousands of arc flash studies have been preformed. The studies generated untold numbers of labels. These labels with the best information available have been placed on electrical equipment in facilities located across this country.

The aftermath of all of this work has been a significant increase in the electrical community's awareness of the dangers of arc flash. The other result has been that a significant quantity of electrical distribution equipment has been labeled as 'DANGEROUS – NO SAFE PPE EXISTS' This has become a major problem for those charged with operating and maintaining those electrical distribution systems.

This presentation will discuss practical techniques that have been successfully used to mitigate high levels of arc flash energy in active / live datacenters. Datacenters typically require large electrical distribution systems which traditionally have very high levels of arc flash energy.

We plan to discuss how to re-coordinate a distribution with the focus on reducing arc flash. We will also discuss how the new coordination was implemented without shutting these datacenters down. This included replacing MV and LV protection equipment.

Applying Risk Management Principles to the Selection of Arc Flash PPE – II

Daniel Roberts
Schneider Electric

An update of last year's paper on applying risk management principles to the selection of arc flash PPE. The 2010 paper utilized risk management principles found in ISO 31000. The 2011 paper will incorporate concepts from the soon to be published CSA Z1002 Standard "Occupational Health and Safety Risk Management," of which the author is a Technical Committee member.

Simulation-Based Electrical Safety Training: An Innovation in Safety Culture

Eben Myers
Etcetera Edutainment

An organization's safety culture is marked by shared responsibility, mutual respect, and collective understanding of safety practices and incident prevention. Effective safety training is instrumental in creating the foundation on which to build a safety culture and encourage best practices. Simulation-based electrical safety training presents dangerous realities safely, by connecting workers with hands-on cause-and-effect learning experiences that would otherwise first be encountered on the job. It also offers a platform for cross-training to raise awareness of workplace dangers that exist when interacting with co-workers who are performing hazardous tasks. Simulation-based electrical safety training goes beyond teaching concepts and definitions by providing a virtual environment for interaction, practice, and immediate application of information. In this way it reinforces roles and attitudes, contextualizes information, and serves as a content-rich foundation for a safety culture. This type of training has been used for decades by the medical industry and the military because they understand that only a fraction of learning effectiveness comes from completing lower-level tasks, such as recalling terminology and procedures. The complex application of concepts is achieved through personalized experiences and unconstrained decision-making with realistic consequences Trainees become immersed in simulation-based electrical safety training because simulations engage learners in meaningful activities, personalize experiences, and form knowledge connections to real-world situations. For example, trainees understand arc flash calculations performed on paper, but the learning experience pales in comparison to seeing an arc flash incident unfold on-screen, or most compelling - creating and triggering an incident oneself in a virtual environment. Simulation-based training gives trainees ownership of experiences and information, and the confidence to apply what they've practiced to real-world situations. Safety training is an important bottom line for any safety culture, and simulation-based electrical safety training offers trainees a robust, personalized experience that engages and empowers them far beyond the classroom.

Estimating Fire Losses Associated with Circuit Breaker Malfunction: Concept and Application

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This paper describes the concept and application of a method for estimating structural fire losses due to branch circuit breaker failure in buildings. The method provides a bridge between circuit breaker functional test data and statistical fire loss data. New test results are presented for field samples of a particular line of circuit breakers that have a high defect level. The test results are then utilized, together with published electrical fire statistics, to estimate the annual number of fires and consequent injuries, deaths, and monetary loss associated with the defective breakers. An estimate is then made of the reduction of injury and loss that can be achieved by encouraging property owners to replace the defective breakers. The problems associated with aligning

electrical safety organizations and professionals toward recommending replacement of the defective breakers are discussed.

What are you missing in your Electrical Safety Program?

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Have you implemented an Electrical Safety Program? If you have what did you base the framework or the Table of Contents of your Electrical Safety Program on? Did you consider applicable Occupational Health & Safety Management System Standards (e.g. CSA Z1000 or ANSI Z10) for guidance on what content you should have developed in your Electrical Safety Program? Do the requirements provided in the Electrical Safety Program you developed meet acceptable due diligence requirements? Have you audited your Electrical Safety Program documentation, or had it audited by a third party subject matter expert? This paper will review recommended framework(s), and identify where you may have fallen short in developing your Electrical Safety Program.

Arc Flash Reduction System Application Considerations

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Arc flash reduction systems temporarily lower the potential arc flash incident energy level while live work is being performed in order to protect the workers and allow them to wear less restrictive PPE. These systems may be necessary in electrical installations where the speed of operation of upstream circuit breakers has been intentionally slowed in order to achieve selective coordination. This may have been accomplished by increasing the instantaneous trip level of the circuit breaker or by utilizing a circuit breaker with no instantaneous trip function at all. Reducing the arc flash hazard, should an arc fault occur, can be achieved a number of ways. These methods include activating the circuit breaker trip unit instantaneous trip function, setting this function to a lower level, or by enabling a special faster acting instantaneous trip function. The paper will discuss a number of aspects of arc flash reduction system operation that should be considered when applying such a system and determining if it will result in safe work practices and Code compliance. The objective of the presentation is not to convince the listener that arc flash reduction systems are good or bad, but rather to highlight the considerations that must be taken into account when using one in an attempt to develop safer live work practices.

Reinvigorating Electrical Safety

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As our lives evolve to include more advanced technologies, our reliance on electricity continues to grow. The U.S. Energy Information Administration (EIA) predicts an increase in electricity usage of 2.9% for 2010 with total consumption from all segments totaling 3784 billion kilowatt hours for the year. Increased electricity usage translates to an increased potential for electricity-related injuries, deaths and property loss. Electrical hazards cause more than 300 deaths and 4,000 injuries in the workplace each year, ranking sixth among all causes of work-related deaths in the United States. In addition, more than 53,000 home electrical fires result in more than 450 deaths, 1,400 injuries and $1.4 billion in property losses annually. The mission of the Electrical Safety Foundation International is to advocate electrical safety at home and at work. In response to changing population demographics and the increased availability of computer technologies, ESFI has reevaluated the way electrical safety awareness materials have historically been presented. New materials provide a more dynamic approach to learning through the use of tools

such as virtual simulations and interactive web-based activities. Other advancements are the availability of downloads and internet viewing, which allow for more widespread use without the costs traditionally associated with safety awareness materials. These reduced-cost approaches come at a good time for employers, consumers and community leaders who are still recovering from the recent period of economic instability.

This presentation will provide attendees with an overview of the electrical safety awareness resources available from ESFI. Updated workplace safety materials, including the popular Never Assume Electrical Safety Series, address electrical safety in a variety of settings from offices to construction and industrial operations. Consumer-related materials address electrical safety practices in the home, during renovations, around the holidays, and with regard to counterfeit electrical products.

Stray Current Analysis

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Stray currents, sometimes called "objectionable currents" are part of the same phenomenon called "stray voltage." Stray currents can cause electric shocks to humans in swimming pools. Stray voltages caused by the multigrounded neutral system can have severe effects on both humans and farm animals. These can cause injuries to humans and farm animals in a similar manner to step and touch potentials in substations, only in the home and farm environment. Accidents to humans typically result from shock hazards at swimming pools, bath tubs, basements, and other wet locations. These have led to the development of the Ground Fault Current Interrupter (GFCI). Accidents to farm animals are typically from cows receiving shocks in barns from contact with metal objects, especially during milking. Low levels of electrical current, not large enough to cause painful shocks, may cause reduced milk production. This paper will begin with a discussion of the typical electric utility distribution system for homes and farms in the US, and the domestic wiring system that it feeds. The flow of currents for both unbalanced loads and ground faults will be estimated, along with the voltages that are associated with the currents. The level of hazard for various configurations will be calculated. Finally, methods of remediation will be explored.

The Misuse of Voltage as a Parameter of Concern for Electrical Hazard

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The National Electrical Code infers 30 and 50 volts may be a safe voltage. Safe for what type of animals? Human or dairy cows? As for humans Article 411 Lighting Systems Operating at 30 volts or Less, states "Exposed bare conductors . . . shall be permitted" and "shall NOT be grounded. "Article 457 is a section on Agriculture Buildings where Equipotential planes are required "to prevent a difference in voltage from developing. . ."; again inferring equipotential planes will provide electrical safety for dairy cows and pigs from dangerous and harmful voltages During a panel discussion at ESW the moderator asked a panel if they felt 50 volts was a safe voltage level to eliminate electrical shock hazard, and no-one lifted their hands. The moderator continued to reduce the voltage level and each time no-one on the panel lifted their hands. Finally he went to 0 volts and everyone lifted their hands. But were they correct? This presentation will present the facts that using voltage as the criteria for determining electrical safety is deliberately deceptive, deceiving and misleading. The presentation will discuss the correct parameters that should be used by electrical engineers and electrical craft personnel to present to the public the correct method to determine exactly what are the electrical parameters that constitute a danger from electricity. The basis of the presentation has withstood the scrutiny of electrical utility experts and the courts' multiple Daubert hearing process that has resulted in inferring the information is NOT JUNK SCIENCE.