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PETROLEUM & CHEMICAL INDUSTRY COMMITTEE

12th PCIC Europe Annual Conference

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Electrical and Instrumentation Applications

FINAL PROGRAM

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PCIC EUROPE
PETROLEUM & CHEMICAL INDUSTRY COMMITTEE

12th Annual PCIC Europe Conference 2015 in London

Dear guests,

On behalf of the local committee, we are pleased to welcome you to London.

London is one of the most diverse and influential cities in the world. This year's conference location near the iconic Tower of London together with the London Eye, Buckingham Palace, Tower Bridge and Big Ben are some of the most visited landmarks on earth.

The City of London was founded by the Romans in the 1st century AD and it is the smallest city in the United Kingdom. In contrast, the London we all know has developed around this small city. The capital of the United Kingdom has maintained its trading tradition origins and is today an important business and financial centre. It is also home to a number of arts galleries, museums, libraries and theatres. Over 250 languages are spoken in London, making the capital the most linguistically and culturally diverse in the world. The world's first underground railway, or "tube" as it is known here, was opened here in 1854 and today is a network of more than 400km which, alongside the famous red double-deck buses and the black cabs, is a symbol of this city. This vast transport system offers the visitors the opportunity to visit famous landmarks or if you are looking for food and shopping enjoy the numerous restaurants and high street shops the city has to offer.

This year's conference location will offer the participants an environment for not only learning and networking with industry experts, but also experiencing one of the world's most vibrant cities.

We hope you enjoy the conference and your stay in London

The Local Committee PCIC Europe 2015
Hans Meulenbroek – Chair | Justin Mason | Bert Engbers, | Jonathan Hayward | Edwin Lawrance | Weslley de Lima | Martin Lester | Dan Thomas | Graham Doran | Steve Ward | Graeme Peck | Scott Newitt

PCIC EUROPE
PETROLEUM & CHEMICAL INDUSTRY COMMITTEE

Welcome to London

Dear conference attendees

For the first time in its young history, the Petroleum and Chemical Industry Committee (PCIC) Europe conference will cross the Channel to take place in London. Recognized for its expertise in the Oil & Gas and Petrochemical sector UK is one of the few countries in the world to concentrate leading end users, cutting edges engineering companies and global manufacturers.

Every week London is host to international conferences. Many of them are related to the Oil, Gas and Petrochemical industry and confirm how much London is a reference for organizing such event. In this context proposing "one more" conference represents a significant challenge. The program must be very consistent to meet high expectations from an experienced attendance. The organization must be perfect to set new references in a highly professional sector.

In this perspective our Technical Committee selected the very best papers and enriched the program for the first time with two Master Classes for experienced engineers. It also introduced for the first time Poster Presentations to favor the interactivity amongst the attendees around key topics.

Our Local Committee has also been very creative to balance London Conference program between an intensive technical content and various breaks and relaxing time to facilitate the networking between people. In that respect PCIC Europe Committee has been well supported by numerous sponsors to welcome you in their respective Hospitality Suites where they will reserve you surprises.

Proud of a decade experience to organize the most successful technical conferences in Europe for the Oil & Gas and Petrochemical electrical and automation engineers, we shall be more than pleased to welcome you in London.

Welcome to London

Jean-Charles Guilhem
Chair PCIC Europe

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The 2015 PCIC Europe technical program

Following the great success of last year's event in Amsterdam we are delighted to welcome you to London for 12th annual PCIC Europe Conference. This year represents a step change for PCIC Europe with a significant expansion of our technical programme reflecting the increased interest communicated by authors and our attendees. Significantly we see many of our previous conference attendees returning to join us in 2015 expressing confidence in our approach and the value delegates recognize in the quality of this global learning event with participation from all continents and far reaches of the world.

Looking to the Conference content you will find in the following pages a description of our extended technical tutorial and master class sessions together with an enhanced main technical programme all based around our four strategic topics of Personal Safety, Extreme Environments, Good Design Practice and Equipment, Systems and Components.

Overall we have a conference schedule built around 4 tutorial and 33 papers to be presented. The program content has been developed by authors representing multiple organizations embodying both differing experiences and perspectives to provide a truly enlightening experience to the conference attendee. In addition we have chosen 5 papers for plenary session delivery reflecting what we believe to be truly the best technical content and a message to communicate to the entire conference cadre. You will also find we have taken the time to align each conference session of either plenary single papers or paired papers to a strategic topic or area of common technical interest building on the feedback of attendees from the Amsterdam conference.

As a further development to this year's conference we have introduced a poster session at the end of Wednesday. Our aim here is to introduce the next generation of potential authors to conference and encourage informal networking and the breaking down the barriers to communication across a wider audience of delegates and presenters through the lens of an area of common focused technical interest.

You will find in the following pages details of our technical programme complete with short abstract summaries of the individual sessions to aid you in planning your PCIC Europe experience.

We look forward to the success of PCIC Europe and the engaged discussion with you at conference. Please take opportunity to meet with the conference organizing committee to discuss your ideas to contribute to the future conference events as we specifically welcome your input.

Justin Mason
PCIC Europe Vice Chair (Technical Chair)

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PCIC Europe Mission

To provide an international forum in the heart of the major source of petroleum products for the exchange of electrical and instrumentation applications technology relating to the petroleum and chemical industry, to sponsor appropriate standards activity for that industry, and to provide opportunity for professional development.

PCIC Europe Strategies

1. The PCIC Europe Annual Conference will be held in locations of industry strength, and its location will be rotated annually in an effort to attract national and international participation.

2. PCIC Europe will proactively promote participation by a broad base of PCIC Europe representatives, with an emphasis on both younger and senior engineers.

3. Attendees will be encouraged to participate in technical activities including authorship of papers and participation in IEC standards development including IECEx.

4. The quality of PCIC Europe papers is essential for the PCIC Europe mission and is given highest priority. Application oriented papers are given priority.

5. The technical content of the PCIC Europe Annual Conference will be continuously evaluated and updated to reflect the evolving needs of the industry.

6. Participation of users, manufacturers, consultants and contractors will be encouraged in the activities of PCIC Europe to strengthen the conference technical base.

7. PCIC Europe will offer tutorials directed towards enhancing the technical, communication, and interpersonal skills of petroleum and chemical industry engineers.

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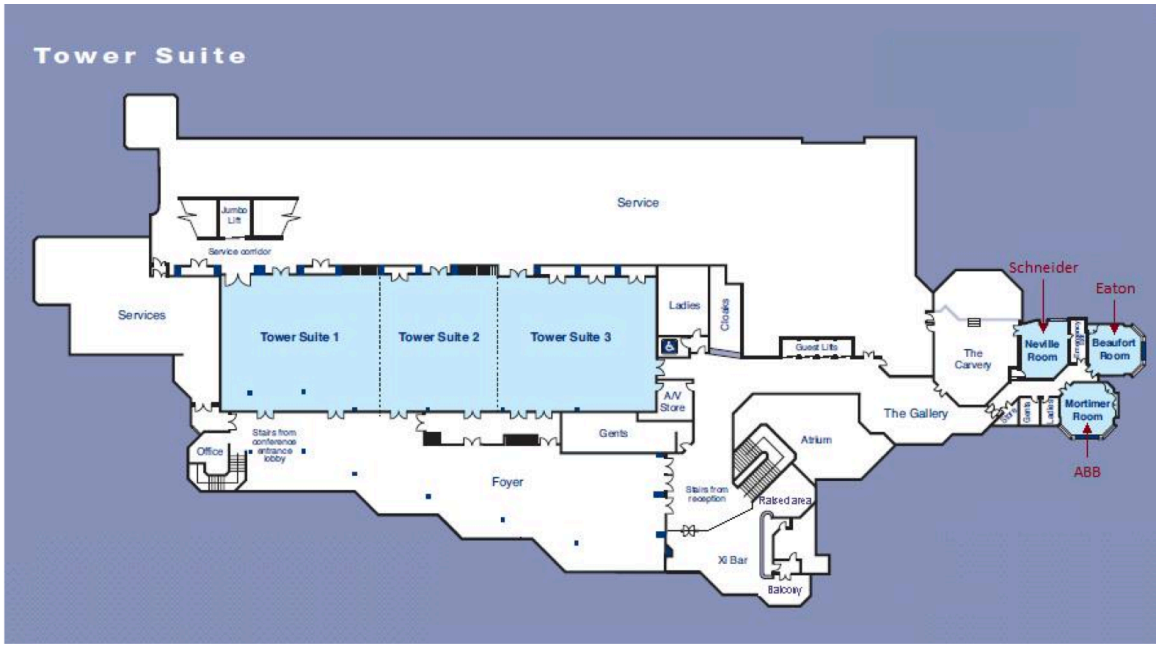
Conference Rooms & Hospitality Suites



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Schedule at a glance

Monday June 8th, 2015

18:00 – 21:00	Registration
18:00 – 0:00	Hospitality suites are open

Tuesday June 9th, 2015

08:00 – 18:00	Registration
08:30 – 8:45	Welcome address (Plenary session)
08:45 – 10:15	Tutorials 1 & 2 (2 parallel sessions)
10:15 – 10:45	Coffee break
10:45 – 12:30	Tutorials 3 & 4 (2 parallel sessions)
12:30 – 13:30	Lunch
13:30 – 13:40	PCIC US presentation
13:40 – 15:10	Paper presentations (Plenary session)
15:10 – 15:40	Coffee break
15:40 – 17:10	Paper presentations (Plenary session)
16:00 – 18:15	Hospitality suites are open
18:15 – 19:00	Welcome address & Keynote speech
19:00 – 22:30	Social evening
20:30 – 0:00	Hospitality suites are open

Wednesday June 10th, 2015

08:00 – 18:00	Registration
08:30 – 10:00	Paper presentations (3 parallel sessions)
10:00 – 10:30	Coffee break
10:30 – 12:00	Paper presentations (3 parallel sessions)
12:00 – 13:00	Lunch
13:00 – 14:30	Paper presentations (3 parallel sessions)
14:30 – 15:00	Coffee break
15:00 – 16:30	Paper presentations (3 parallel sessions)
16:00 – 0:00	Hospitality suites are open
16:30 – 17:30	Poster session and coffee break

Thursday June 11th, 2015

08 :00 – 13 :00	Registration
08:30 – 10:00	Paper presentations (2 parallel sessions)
10:00 – 10:30	Coffee break
10:30 – 11:15	Paper presentation (Plenary session)
11:15 – 12:30	Conference closing session incl. IEEE (Plenary session)

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Program

Tuesday June 9th, 2015

08:30 – 08:45	Welcome address (Plenary session)	
08:45 – 10:15	Tutorial #1 LO-114	Tutorial #2 LO-145
10:15 – 10:45	Coffee break	
10:45 – 12:30	Tutorial #3 LO-144	Tutorial #4 LO-136
12:30 – 13:30	Lunch	
13:30 – 13:40	PCIC US presentation	
13:40 – 14:25	Plenary session – Personal Safety – LO-132	
14:25 – 15:10	Plenary session – Extreme Environments – LO-119	
15:10 – 15:40	Coffee break	
15:40 – 16:25	Plenary session – Good Design Practice – LO-92	
16:25 – 17:10	Plenary session – Equipment Systems and Components – LO-91	
18:15 – 19:00	Welcome address Keynote speech: John Baxter	
19:00 – 22:30	Social event at the Tower Hotel: Barbecue evening and entertainment	

Tower 2 + Tower 3
Tower 2
Tower 3
Tower Foyer & Bridge 1+2

Wednesday June 10th, 2015

08:30 – 09:15	*Energy Efficiency* LO-69	*Regulation & New Standards* LO-109	*Operation & Maintenance* LO-97
09:15 – 10:00	*Energy Efficiency* LO-100	*Regulation & News Standards* LO-110	*Operation & Maintenance* LO-101
10:00 – 10:30	Coffee break		
10:30 – 11:15	*Operation & Maintenance* LO-77	*Novel Technology* LO-116	*Equipment Integrity* LO-73
11:15 – 12:00	*Operation & Maintenance* LO-26	*Novel Technology* LO-127	*Equipment Integrity* LO-79
12:00 – 13:00	Lunch		
13:00 – 13:45	*Large Drive* LO-107	*Lighting* LO-141	*Operation & Maintenance* LO-75

13:45 – 14:30	*Large Drive* LO-115	*Lighting* LO-74	*Operation & Maintenance* LO-135
14:30 – 15:00	Coffee break		
15:00 – 15:45	*Arc Flash* LO-94	*New Technology* LO-80	*Motor Reliability* LO-137
15:45 – 16:30	*Arc Flash* LO-82	*New Technology* LO-147	*Motor Reliability* LO-138
16:30 – 17:30	Poster session: LO-61, LO-85, LO-102, LO-111, LO-134 Coffee break		

Tower 1
Tower 2
Tower 3
Tower Foyer & Bridge 1+2

Thursday June 11th, 2015

08:30 – 09:15	Desing Integrity – LO-81	Installation Practice – LO-70
09:15 – 10:00	Design Integrity – LO-104	Installation Practice – LO-124
10:00 – 10:30	Coffee break	
10:30 – 11:15	Plenary Session – LO-90	
11:15 – 12:30	Conference closing session inc. IEEE	

Tower 2 + Tower 3
Tower 2
Tower 3
Tower Foyer & Bridge 1+2

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The following tutorials will be presented at the 12th PCIC Europe conference.

Ref	Title	Authors
LO-114	Uninterruptible Power Systems (UPS) – Design, technology, reliability & Operation Battery-backed UPS systems play an increasingly important role in providing secure power sources in both onshore and offshore petrochemical facilities. The technology of both supplied equipment and the UPS systems themselves is ever evolving, presenting contractors and end users with many design options, solutions & challenges. The purpose of this tutorial would be to provide a detailed analysis of both the manufacturer's design and technology options, and the end user requirements. This would include technology options for both UPS systems and batteries, equipment sizing and calculation methods, different configurations, ac vs dc, earthed vs unearthed distribution, industrial & hazardous area UPS systems. The user's perspective includes overall reliability/availability considerations for onshore/offshore facilities, supplied equipment requirements, derivation of battery standby times, safety & fault current levels, remote monitoring, diagnosis & and health care options.	Graeme Peck Hess graeme.peck@hess.com TBA Emerson
LO-136	Application of Electrical HAZOP (E-HAZOP) During Project Development Hazard and Operability study (HAZOP) is a well-established and proven technique in process industries. HAZOP review is based on IEC61882 and is a creative process based on prepared "Guide words" to identify potential deviations / Hazards & reliability issues from the design intent. HAZOP review is recognized as a fundamental requirement for any grassroots Petrochemical projects or where changes are made to an existing plant. This paper draws on the experience of Process HAZOP in Petrochem industries and outlines its application to Electrical installations in a practical way. Electrical HAZOP (E-HAZOP) is a technique that would efficiently Identify Electrical Hazards/reliability issues early in the project development and directly improves the project Safety, cost and schedule. The technique is risk based and proposes mitigating steps based on Cost-to-benefit ratio where applicable. The E-HAZOP process has proven to be one of the most useful ways for younger engineers to gain good experience and appreciation of the bigger picture early in their career. Note for reviewers: The E-HAZOP process is applicable to all electrical equipment / installation and the above Topic/sub-topic/ equipment type etc. were selected in order to unblock the submission.	Saeed Bagk ExxonMobil Engineering saeed.bagk@exxonmobil.com
LO-144	Overiew of Harmonics and Inter-Harmonics due to Large Variable Frequency Drives, Their Effects On Input Supply and Measures to Overcome Them Large (high power) Variable Frequency Drives (VFDs) inevitable change the shape of the supplying current and voltage sinusoidal waveforms. This change is a result of the accompanying effects of Variable Frequency Drives presence in distribution networks, which is expressed as harmonics and inter-harmonics distortions. Although, harmonics and inter-harmonics	Ilya Nariyev Fluor Ilya.nariyev@fluor.com Vijay Anantham Ganesan Siemens vijay.ganesan@siemens.com

	distortions seem to be similar phenomena, they have completely different effects on distribution systems and equipment within these systems. These effects are more pronounced in islanded Oil & Gas facilities. The purpose of this paper is to provide an overview of harmonics and inter-harmonics associated with Variable Frequency Drives. Also, this paper aims to highlight side effects, which might be experienced by the distribution systems and equipment due to Variable Frequency Drives presence. The paper focuses on theoretical review of the harmonics and inter-harmonics nature and their associated side effects. Finally measures to overcome the effects of harmonics and inter-harmonics on equipment connected to the supply network are proposed.	
LO-145	Practical site measures to prevent electromagnetic interference Electromagnetic Compatibility for Petrochemical Installations means the electronic equipment operating correctly when powered up, connected with other systems and in the environment of the installation. Seemingly minor cases where EMC is not achieved have resulted in process plant "trips", resulting in lost production running to millions of dollars per event and unwanted events such as depressurisation or flaring. This tutorial outlines the need for measures to ensure Electromagnetic Compatibility (EMC) and gives recommended guidance on the design and implementation of practical measures, to ensure the operational robustness of electrical and electronic systems and installations in petrochemical and oil and gas facilities	Paul Donnellan Shell paul.donnellan@shell.com Allen Gibson Roxtec allen.gibson@roxtec.com

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The following papers will be presented at the 12th PCIC Europe conference.

Ref	Title	Authors
LO-26	Case Histories on Motor Current Signature Analysis (MCSA) for Diagnosis of Airgap Eccentricity Problems in HV Induction Motors in Oil and Gas Installations Case 1 High airgap eccentricity was detected via Motor Current Signature Analysis (MCSA) in a 6.6 kV, 1.200 kW induction motor driving a cooling water pump on an offshore oil production platform and was the fundamental cause of mechanical damage to the corona shields on the stator coils. Interpretation of the current signature pattern indicative of an airgap eccentricity problem estimated the level of airgap eccentricity was between 20-25%. The airgap eccentricity was checked by the OEM in their factory and was found to be 24%. Tap testing of the stator slot wedges indicated that at least 60% of the wedges were not tight in the slots. Coils removed from the line end and star end of a phase clearly showed severe mechanical damage. Current spectra before and after the airgap eccentricity problem was rectified will be presented and photos of the mechanically damaged stator coils will also be shown, the stator was rewound. Case 2 High airgap eccentricity was detected via MCSA in an 11 kV, 1.450 kW induction motor driving a pump at an onshore oil tank storage depot. The motor was tripping out on high bearing temperature (95°C / 203°F). The fundamental cause of the problem could not be determined via vibration analysis. The current spectrum indicative of an abnormal level of airgap eccentricity was evident from the problem motor. The motor airgaps were checked on-site and the airgap eccentricity was found to be 35% and 20% at the drive-end and non-drive end respectively. This was rectified and the high temperature and vibration disappeared. Current spectra before and after the corrections will be presented.	William Thomson EM Diagnostics Ltd mcsa@consultant.com
LO-69	Understanding of gas engines responses to system load changes Use of gas engines for small, 1-3MW, and islanded power generation system becomes more economical comparing to gas turbine or diesel engine driven systems. This is due to increased efficiency of the gas engines, availability of the fuel gas and reduced emissions. Design of power generation systems includes transient studies to understand the systems response to disturbances caused by sudden load demand changes e.g. motor starts, partial loss of generation, loss of interlinks. Usually those studies done by software simulations using wide range of available governor models for gas/steam turbines and diesel engines. This paper examines lessons learnt from various power systems projects when gas engines were used as main power sources. It analyses attempts to model gas engines governors and their validation using engines responses results from factory tests. It is also reviews the project when software simulation was not deemed feasible and comprehensive onshore testing of power generation and power management system was undertaken to fine tune various operating scenarios before offshore installation. The paper is intended to aid design engineers to select and optimise power generation systems.	Zaur Sadikhov Shell zaur.sadikhov@shell.com

LO-70	Modular Integration of Process Equipment Packages for Oil and Gas Facilities An integrated design approach to a modular process equipment package is discussed. By incorporating the electrical, instrumentation and control equipment on the same platform as the process equipment, a higher level of modular integration is achieved. The benefits include a reduced number of on-site equipment terminations and the ability to precommission equipment prior to installation resulting in lower installed costs. The area classification, installation and transit barrier requirements for an integrated modular design approach are reviewed.	Allen Gibson Roxtec allen.gibson@roxtec.com Allan Bozek EngWorks, Inc. abozek@engworks.ca
LO-73	Root cause analysis and remediation of an arc flash incident onboard a pipe In December 2011, an incident occurs onboard a pips layer ship. It results in arc flash incident and explosion of a low voltage breaker. Paper aims to present results of the root cause analysis conducted beginning of 2012 and the very rare mechanism of DC fault tranferred to an AC switchboard, creating the conditions of arc flash initiation. Paper will also presents temporary remediation measures taken to secure ship for operation, before final modification to reach the target of 25 years of operation without further troubles.	Philippe Angays Technip pangays@technip.com
LO-74	Lighting Practices and Applications, Use of Light Sources / Luminaires in hazardous areas Ambient conditions, Lighting practices and light installations in hazardous areas differ from region to region and application around the world. For example HID light sources installed in "explosionproof" luminaires were the common used standard lamps in Division classified areas e.g. North America while fluorescent light sources installed in "increased safety" luminaires were the common used standard lamps in Zone classified areas e.g. Europe. The new technique, luminaires with power LEDs used in hazardous is now influencing more and more both regions. This paper will review the different standards, possibilities (pro and contras for different light sources) and risks for lighting in hazardous areas taking into account different regulations. All different techniques will be discussed as well as installation practices and details which must be known using luminaires in extreme ambient conditions such as high and low temperatures and offshore installations. Also an overview about lighting and design practices, planning installation of luminaires in different applications including the maintenance requirements and strategies will be given in the paper. VITA: Gerhard Schwarz studied electrical engineering in Mannheim with the degree "Master of engineering". Since more than 40 years involved in sales, product management and designing of products to be used in hazardous areas. Up to the end of 2011 responsible for R & D Explosion protected light and switchgear in Cooper Crouse Hinds GmbH and also responsible for the worldwide certification of hazardous area products. In 2012 working as senior technical consultant inside Cooper Crouse Hinds for all general questions related to explosion protection, R&D and certification. Since spring 2013 owner of a new founded consulting company in the field of explosion protection. Chairman of the German Committee "Electrical equipment for use in hazardous areas" in DKE, the German standardization association. Chairman of the of the working Group "explosion protected apparatus" in ZVEI, the German manufacturer association. Convener of the IEC TC 31 MT 60079-18 Maintenance Team on Encapsulation "m". Convener of the IEC TC 31 WG 40 Working Group luminaires. Head of the German delegation in CLC TC 31 and IEC TC 31. Involved in numerous CLC and IEC standards committees for electrical products to be used in hazardous areas, such as flameproof, increased safety and intrinsic safety. Also working as German expert in the IEC MT 60079-14 Maintenance Team on Electrical installations design, selection and erection. Last but not least also involved in IEC EX Scheme as German expert. Peter Thurnherr studied	Gerhard Schwarz Consultanting GSA_consult@web.de Peter Thurnherr Thuba Ltd Peter.thurnherr@thuba.com

mechanical engineering, electrical engineering and business administration in Basel and has a B.Sc. diploma. Thuba Ltd, which was founded in 1932, has been manufacturing explosion-protected electrical equipment since 1955 and he has been in full charge of the company since 1977. His field of work is in the design and production of electrical equipment for use in explosive gas and dust atmospheres in all types of protection. The company is also an accredited Inspection Body (SIS 145) for installations in hazardous areas. He is the chairman of the Technical Committee TC31 in Switzerland, a member of the international TC 31 working groups and maintenance teams General Requirements IEC 60079-0, Increased Safety ICE 60079-7, Non-Sparking IEC 60079-15, Risk of Ignition of Optical Radiation IEC 60079-28, Trace Heating IEC 60079-30-1 and IEC 60079-30-2, Inspection and Maintenance IEC 60079-17 and the convener of "Electrical installations design, selection and erection" IEC 60079-14.

LO-75

Operation of Power Systems Incorporating Fault Current Limiting Devices

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Power systems on large offshore plants such as Floating Production Storage Offloading (FPSO) must have minimal footprint and weight. This often results in having to use Fault Current Limiters (FCL) to avoid exceeding the short-circuit current ratings of the electrical equipment. Pyrotechnic devices are often used and these operate within less than 4 ms which is much faster than the circuit-breakers (CB) which need 50-70 ms to open. Also the FCLs will operate only based on the current flowing through them, independent of the location of the fault which could be on a bus-section or somewhere on an outgoing feeder, even downstream of the CB. Thus a feeder fault, cleared by its CB could result in separation of the main switchgear into two or more islands. It is necessary to take the operation of FCLs into account when defining the possible acceptable operation configurations in order to be able to maintain production after a serious fault. Recent experiences where the complete switchgear lineup was tripped for a single fault are not acceptable. In addition the fast load-shedding algorithms must also be designed with FCL operation in mind. This will require consideration of multiple conditions over a lapse of time in order to define which loads must be tripped in order to avoid unnecessary production losses. The paper will address both of the above.

LO-77

Avanced Rotor Fault Diagnosis for High Voltage Induction Motors via Continuous Transforms

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This work presents a field case study for rotor fault diagnosis on high voltage induction motors operating in a petrochemical plant. The methodology employed is based on the application of advanced signal processing tools (Continuous Transforms) that enable to obtain a 'complete picture' of the rotor condition. Indeed, unlike the classical tools that often rely on the detection of few fault frequencies, these new tools allow extraction of the evolution of a wide range of fault components during the startup transient and steady-state evolutions, which enables improved reliability. This is crucial in large motors, where a false diagnosis may result in significant losses due to inspection, repair, or forced outage. An additional contribution of the work is its immunity to external disturbance that introduces components that are not related to the failure, which is difficult to detect with classical tools. The results of the work prove how the advanced continuous tools enable an improved visualization of the fault components, distinguishing them from the other components that are not linked to the failure.

LO-79

Risk Profiles for Electrical Assets

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Many industries own electrical assets that were installed during decades of expansion in the 1960's, and 70's and which are operating well beyond the standard manufacturers design life of 25 years. Typically the equipment is working satisfactorily, but owners have safety and/or availability concerns

and know that it cannot last indefinitely. However, capital funds for replacement are often understandably constrained. This paper presents a structure using data on likelihood of failure (from inputs such as maintenance, industry experience, and statistical analysis) together with data on consequences (from knowledge of site operations and studies such as arc flash) to build a profile on a Risk Matrix. The paper continues with a discussion of how the Risk Matrix can be used to focus maintenance efforts and justify capital investment for modifications or replacement.

LO-80

Advances in MI Cable Capabilities for Downhole and Offshore Applications

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Electrical heating has been used for many years for flow assurance and now is being adapted for reservoir stimulation, viscosity reduction, "in situ" conversion of heavy oil and off shore umbilicals. This paper starts with a short review of flow assurance applications in Alaska, Norway and Canada. It then reviews the current and developing technology and some of the heat transfer parameters for use of high voltage - high power MI (Mineral Insulated) electrical heaters in a number of applications, including deep sea umbilicals, viscosity reduction in reservoirs and flow assurance heating for sea floor bed pipelines. In the past MI Cable heater voltages have been limited to operation below 600 volts. Significant material and processing advances have now permitted standard operation at 4160 volts with testing in the 10kV range. This has a number of operational advantages in providing longer length heater capabilities and less parasitic heating loss in the non-heated sections. MI cable production technology is now available to fabricate MI cable heaters that can produce 1600 meters lengths without external splices. The thermal heat transfer from the well casing to the reservoir is usually the limiting factor on the amount of energy that can be transferred from the electrical heater. Both constant power and constant temperature heaters are explained with the emphasis on in operation reliability of each type of heater. The paper concludes an economic analysis of the opportunity provided by a high voltage MI cable heater system in various applications.

LO-81

Circulating zero sequence currents in offshore oil-installation distribution system caused by asymmetric phase induction

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Circulating zero sequence currents in the medium voltage distribution system on a large oil installation in the North Sea caused spurious earth fault trips during heavy motor starting. The root cause to the problem was not obvious, but investigation and analysis showed that zero sequence currents circulating in phase conductors were caused by asymmetrical inductance in parallel distribution feeder cables. Analysis was performed using two-dimensional finite element method software. The induced circulating zero-sequence current is proportional to the load current, and it is interpreted as an earth fault current by feeder protection devices. Given an expected future load increase, there will be little or no margin between the circulating zero-sequence current and the tripping threshold. This is a practical problem that can be prevented during the engineering and installation phase of the electrical system if engineers are aware of the problem. However, if the problem is discovered during operation, required effort and cost associated with rectification may be unpractical and/or unacceptable. The paper will include basic theory that is needed to understand the problem of spurious "earth fault" trips caused by asymmetrical inductance in parallel distribution feeders. The fault investigation, some "lessons learned", and software analysis of the fault will be described. The paper will also discuss some theories that were investigated, but found not to be the root cause. Further, some proposed corrective measures are described – and the final chosen corrective measure is presented. Finally, examples of the same problem that can be found in the literature are shortly discussed.

LO-82

Investigating Ways to Prevent Electrical Arc Flash

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Electrical arc flash hazard mitigation techniques focus on the reduction of hazard levels in an electrical power system. Analysis of arc incident energies pre- and post-mitigation to reduce hazard levels shows that risk control measures can lead to significant reductions in potential harm and damage should an arc flash occur. However, mitigation methods alone do not necessarily prevent arc initiation. This paper reports an investigation into the initiation of electrical arcs within the context of a study into new approaches to reducing the hazard posed by arc flash. In addition to the local physical arrangement of the busbars, onset of the arc is influenced by specific weaknesses or defects of the insulation system. However, the influence of these local factors diminishes once the arc is formed. Thereafter, arc current and the power dissipated in the arc depend both on the ability of the surrounding network to sustain the electrical discharge and on transient interactions between the impedance of the feeder network and the impedance of the arc itself. To study arc initiation with the aim of identifying factors that could reduce the likelihood of arc onset, measurements of short-term arc characteristics under various initial conditions are presented. Measurements primarily concern the time-domain transient voltage and current waveforms in an experimental configuration designed to allow variation of parameters that may influence arc initiation. These waveforms are captured on a nanosecond timescale so that the temporal development of arc power and impedance can be analysed as a function of different arc initiation mechanisms. Results are analysed to show how the impedance of the voltage supply and the quantity of electrical energy stored in the circuit physically close to the arc affect the arc evolution and the magnitude of the power dissipated.

LO-90

Industrie 4.0 - What can Oil & Gas and Petrochemical sector learn from this concept?

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Over the last years the developed countries realized that no economical growth could be sustainable without a solid industry. To relocate the industrial activities back home, the developed countries created the concept of Future of Manufacturing. The purpose is to mobilize all the technologies, all the know-how and all the great ideas that could drive to invent the most competitive industry in the world. From this generic concept, each developed country is currently mobilizing its local champions around ambitious programs. In Germany the Future of Manufacturing concept has been branded "Industry 4.0" by reference to the fourth industrial revolution. As first global exporter, Germany intends to maintain its industrial leading position through the Indusrie 4.0 program launched at large scale in Hannover Fair 2013. With the customer at the center of the decision ring, the first goal of Industrie 4.0 is to cut time to go to market and to optimize the whole added value chain from the design phase to first production. The purpose of this paper is to present the leads of Industrie 4.0 as one of the most advanced programs of the Future of Manufacturing and to investigate the areas where it could benefit to the Oil & Gas and Petrochemical sector. Industrie 4.0, as the other similar programs, is primarily developed to fit with the manufacturing industry. Therefore its implementation in the process industries is not trivial and supposes adjustments. From first examples, the paper will highlight the areas where manufacturing industries good practices may find immediate application in Oil & Gas and Petrochemicals industries and the areas requiring more specific approach.

LO-91

Comprehensive deployment of emerging condition monitoring technologies in electrical switchgears

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Electrical switchgear is an important component of the overall electrical system in an Industrial set up. Predictive maintenance of electrical switchgears involving condition monitoring has long been in practice. The previous two decades have seen improvement in the condition monitoring technology aiming towards betterment of data collection, trending and

	analysis. New condition monitoring technologies emerging in the recent years is being applied to electrical switchgears as well. Application of sensor technology, use of high frequency current transformers, integration of diagnostic features in protection relays are some of the recent trends. This paper reviews various condition monitoring technologies currently available for electrical switchgears and attempts to present a comprehensive view on how such technologies can be deployed in practice to improve the reliability of the equipment.	znurubayli@glensol.az Shahid Jamil BP Shahid.jamil@bp.com Prahbat Saxena Schneider Electric Prahbat.saxena@schneider-electric.com Simon Chabriere Schneider Electric Simon.chabriere@schneider-electric.com
LO-92	How does 'designing-in' permanent thermal monitoring lead to improvements in the operational Safety and Reliability of a complex Oil & Gas facility? As the complexity technology used in installations increases, some regions of the world may find it hard to source and recruit suitably skilled personnel. This can lead to a gap developing between the skills required to commission and maintain the facility and those that are available. Such a gap can lead to a major reduction in the safe and reliable operation of the facility. To minimise this gap companies are using the extensive experience of permanent monitoring in rotating equipment & considering permanent monitoring solutions in 'static' electrical infrastructure. This paper will take the example of a major O&G operating company integrating permanent non-contact infrared based thermal monitoring in the LV & HV systems for a mega project in Kazakhstan. The paper will identify and review the: - Significant performance gap between the perceived level of protection of existing technology and the actual level delivered. - Underlying problems the operator was trying to resolve and its requirements will be examined in detail. How new technology was developed to meet those requirements providing an early warning of potential failure & dynamically adjust the thermal alarm levels to suit the load on the circuit. - Vendor neutral requirements of the technology & how this enables integration with existing SCADA systems, results in improved asset integrity management, better safety, improved reliability and operational uptime. The paper will address how such an evolution can be integrated in the technical specifications of the E&P for the design & construction phases of a large project where many 'players' are involved in the delivery and operation of the equipment.	Ross Kennedy QHi Group Ltd ross@qhigroup.com Michael Mendiola Tengizchevroil LLP (Chevron) mendiolam@chevron.com Daniel Thomas QHi Group Ltd Dan.thomas@qhigroup.com
LO-94	Arc-flash hazards at a temporary construction site Construction sites for industrial complex or installations need temporary electrical power systems. This temporary construction power demand is often supplied from a utility feeder. The small power demand may undermine the need of arc-flash hazard analysis. Use of approximate design methods, and available made-to-fit equipment including protective devices may result in high arc-flash incident energies. This paper presents a case study illustrating the challenges involved in performing arc-flash analysis for a construction site. It emphasizes the need to perform adequate risk evaluation while deciding against performing arc-flash analysis at temporary power locations. Various methods available for performing arc-flash hazard analysis for such installations using a power system analysis software are discussed.	Gupta Alok BP Alok.gupta@bp.com Robert R Foy BP Bob.foy@bp.com Shervin S. Shokooh ETAP (OTI) Shervin.shokooh@etap.com

LO-97

On-line partial discharge (OLPD) condition monitoring (CM) of complete high voltage (HV) networks in the oil and gas industry

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This paper presents an innovative technique for the remote, on-line partial discharge (OLPD) high voltage (HV) insulation condition monitoring (CM) of complete HV networks in the oil and gas industry. The technology gives the operator an 'early warning' against 'incipient' faults in the HV insulation across the network and supports preventative maintenance interventions and condition based maintenance (CBM) asset management schemes to help reduce unplanned outages. This new OLPD condition monitoring solution applies wideband sensors located at the central switchboards of the facility (including drilling ships, FPSO's, offshore production platforms and onshore refining facilities). The wideband sensors are able to measure partial discharge in the complete HV circuit, including the switchgear, cable and the remotely connected HV plant (Motor/Generator/ Transformer/ RMU). The new technique, applied to the remote OLPD monitoring of Ex/ATEX HV motors, was first published in a joint paper by HVPD and Chevron at the IEEE-PCIC 2012 conference with further developments presented at the IEEE-PCIC 2013. Real-time pooling of condition data from multiple, distributed monitoring units is carried out with all data passed to a central OLPD monitoring database for logging, display, benchmarking and trending. The condition of individual plant items is displayed on a user interface screen that contains a 'mimic' of the network's single-line diagram (SLD) with superimposed, colour-coded plant condition criticality data to provide a quick and easy way to detect any 'bad actors' within the network. The paper concludes with a Case Study of the installation of a complete HV network OLPD monitoring system across the entire 11kV networks of a Stena Drilling HR drilling vessel, to monitor the insulation condition of the HV cables, switchgear, transformers, motors and generators.

LO-100

Maximize Power Efficiency and Profitability through Medium Voltage Electric Heating Technology with Zero Emissions

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Low voltage (below 1000V) electric heating equipment has limited the use of electric heating for petroleum and chemical operations due to high output and current draw. This paper introduces the benefits of medium voltage (MV) electric heat and MV thyristor control technology to enable alternative heating methods. The focus will be on the enablement of new application methods and the reduction in installation, maintenance, and operational costs. The presentation will also introduce MV heating technology as a clean, efficient, and emissions-free. Lab data, original analysis, and third party testing results will be presented as a means of educating the audience and to provide a model for industry standards regarding this new technology. A medium voltage electric heating element has been developed capable of very large power output that can operate on voltages up to 7,000 Volts. These elements are superior to low voltage element with the invention of new dielectric materials that provides an ultra-high insulation resistance and enables the element to reach withstand voltages in excess of 13,000V during safety testing. These two properties deliver superior performance and reliability, even at high temperatures. Typical failure modes seen with low voltage elements (e.g. stitching and dielectric breakdown) are not evident with new MV elements technology. The elements can be integrated into applications requiring welded connections or fittings to facilitate serviceability. MV elements are capable of controlling process streams to 1°C utilizing SCR control technology. This ensures maximum heat production at close to 99% efficiency and minimal I2R losses over long distances.

LO-101 Relative Merits of Off-line and On-Line Testing of Rotating Machine Stator and Rotor Windings

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The deterioration of the stator and rotor windings in motors and generators are an important cause of failure. Many tests have been developed over the years to evaluate the condition of the windings in order to anticipate winding failure. Some tests are on-line (performed during normal operation of the machine) and some are off-line, and can only be performed when the machine is shut down, and sometimes partly dismantled. The advantages and disadvantages of off-line vs. on-line testing are contrasted. Off-line tests for stator windings include the insulation resistance, polarization index, polarization/depolarization, power factor, partial discharge, DC hipot, and surge tests. Depending on the type of rotor winding, the insulation resistance, RSO, pole drop growler tests can be used. The range of on-line tests is more restricted, but includes the partial discharge, ozone, dissipation factor, endwinding vibration, air gap magnetic flux and current signature analysis tests. This paper will briefly discuss each test, with more detail provided for the newer tests that have been introduced in the past 10 years. Tables will be presented for the failure processes that each test detects, and their relative effectiveness for finding these specific problems. Recent important changes to IEC and IEEE standards concerned with these tests will also be outlined. The conclusion is that although a large number of tests currently exist, no single test will find all the possible winding problems. Furthermore, predicting end of winding life based solely on tests seems to be an unrealistic dream and so visual inspections are often required to confirm the findings from diagnostic tests.

LO-104 Using a multiphysics to power cables are restrained safely

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Trefoil cable formation is used where three phases are carried by three single core power cables rather than a single three phase multicore cable. The advantage of installing three single core in such a configuration is that it minimises the induction of eddy currents, therefore reducing the effect of localised heating, while maintaining the current carrying capacity of the circuit. Trefoil cable restraining devices are structures used to hold the three single core power cables in a triangular touching (trefoil) formation, along the length of the laid cables. Short circuit fault conditions of single core cables in trefoil formation result in high dynamic electromagnetic forces, these forces need to be restrained correctly in order to prevent extensive damage to the cable management system and more importantly potential loss of human life. Manufacturers of trefoil cable restraining devices are required to physically test their designs in an applied test, where a section of three single core power cables are held with cable restraining devices and exposed to a three phase short circuit. Each assembly of cable restraining devive, cable and applied current will yield a different result, so in theory an infinite number of tests are required. These, physical tests can be costly in terms of both expense and time. To avoid this, a time-dependent multiphysics model, including currents, induced electromagnetic forces, material plasticity and contact analysis has been set up. This can fully describe and simulate the dynamic load conditions on the cables and cable restraining devices during a short circuit fault condition.

LO-107 Large 2- parallel VSI drive system for 2-pole two windings synchronous motor without current balancing reactor

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Large high speed variable drive system had been realized by using 2-pole two windings synchronous motor and 12-pulse (2-paralle) LCI (load commutated inverter). As LCI is a kind of current source type converter, the current balance for two windings can easily be realized. Recently VSI (voltage source type inverter) started to apply for larger than 20MW compressor drives and 2-paralle system becomes necessary for much larger compressors applications up to 100MW. Because of a strong magnetic interaction between two windings, which is a specific feature for

	2-P machine, small output voltage unbalance of two VSIs result in large current unbalance and additional heat loss at rotor surface. An additional current balancing reactor between inverter and motor was necessary to achieve a realistic motor design. This paper explains that 2-parallel VSI drive system for 2-P and two windings synchronous motor can be realized without current balancing rector by applying a special PWM method and a current balance control considering the specific feature of the two windings of the 2-Pole synchronous motor. This configuration is useful for smaller layout and higher system efficiency of the drive system. The detail of analysis and design of motor and VSI control will be shown with a simulation result for a 50MW drive system.	Toshiba Mitsubishi-Electric Industrial Systems Corporation Ohgashi.yoshihiro@tmeic.co.jp
LO-109	What is new in next edition of IEC 60079-7 standard of Ex e motors? Similar paper was presented on proposed changes of Ex motors in PCIC Europe 2013 conference. The paper had preliminary proposed changes since then the standard have many other changes in final draft. The authors would like to summarize new changes in this paper along with previously covered changes for the next edition of IEC 60079-7 standard of Ex e motors. The main area of topic will be on proposed rules for motors operating on drive and temperature measurement methods/techniques. It is assumed that the next edition will become standard in the year of 2015. The authors are working group members of IEC/TC31/WG27 committee of electrical rotating machines and would like to present key major changes as stated above.	Bharat Mistry General Electric Co Bharat.mistry@ge.com Rajendra Mistry Siemens Industries Inc Rajendra.mistry@siemens.com William Lawrence FM Approvals William.lawrence@fmapprovals.com Evans Massey Baldor Electric Co lemassey@baldor.com
LO-110	EI Model Code of Safe Practice Part 21: Relationship of 3rd (2013) Edition To Previous Editions and Other Static Electricity Standards An overview of the electrostatics recommendations in MCoSP Part 21 is presented and the relationships between these recommendations, previous editions and other important modern electrostatics safety guidelines such as IEC 60079-32-1 and NFPA77 are discussed	Harold Walmsley Harold Walmsley Electrostatics Ltd haroldw@nildram.co.uk
LO-115	MTBF comparison of state of the art medium voltage drive topologies for Oil & Gas applications As process interruptions can be very expensive reliability and availability values of a VFD are often two of the most important specifications when selecting a drive. Reliability figures are hard to compare because methods and values depend on suppliers using different assumptions and failure definitions. The main medium voltage drive topologies for Oil & Gas applications (3L, 5L, multilevel) will be compared with respect to their main power components (semiconductors, capacitors, PCBs, etc.) considering component stress and field data experience. The total reliability of these drive systems (including transformers, cooling unit, control) will be calculated using same methods and assumptions.	Jeremy Andrews Siemens Jeremy.andrews@siemens.com Marc Hiller Siemens Marc.hiller@siemens.com Klemens Kahlen Siemens Klemens.kahlen@siemens.com Stephan Busse Busse.stephan@siemens.com
LO-116	Design and Optimization of an Off-grid Hybrid System for Supplying Offshore Platforms in Arctic Climates A hybrid power system placed in the Beaufort Sea in order to power supply the offshore oil and gas platforms is investigated in this paper. The proposed microgrid includes various energy sources such as photovoltaic panels, wind turbines, diesel generator as a secondary power source and stationary storage system. The pre-feasibility study of the system along with the simulation of each component and the proposed topology are discussed. The energy management strategy and the implementation of	Maria Kalogera Shell Korea Ltd Maria.kalogera@shell.com Paul Donnellan Shell Projects & Technology Paul.donnellan@shell.com

	different scenarios that show relevant characteristics of the strategies are also presented. Finally, a multi-objective optimization of the system is carried out for the best trade-off between emissions and cost.	
LO-119	Trace heated PIP, Islay feedback and path to future In 2012, 125 m meter under the sea surface, the first in the world PIP electrically heated was installed. This paper will briefly remind the technology used, the results of the test performed offshore and development ongoing, including demonstration not only of capability to prevent hydrates formation, but also to destroy an hydrate plug as an ultimate mitigation measure.	Philippe Angays Technip pangays@technip.com Bruno Leforgeais Total E&P Bruno.leforgeais@total.com
LO-124	Trace Heating Sheath Temperatures Unlocking Mysteries & Exposing Myths Interpreting approved standards and control technologies to meet the requirements for certification of trace heating sheath temperatures can be a complex task. The design of Trace Heating requires that sheath temperatures do not exceed the temperature limits of the specific area classification, in explosive atmospheres, the maximum temperature limits of the Trace Heating itself and the maximum temperatures of the piping, process, and or equipment. The recently approved IEC/IEEE 60079-30-1 [3] standard has very specific normative requirements for testing, certification and design of Trace Heating in hazardous locations. This paper will explain and provide examples for the proper application of these normative requirements and application of today's trace heating control and monitoring technologies.	Ben C Johnson Thermon Manufacturing Ben.Johnson@thermon.com Peter Klerkx Thermon Europe Peter.klerkx@thermon.com Jan Verstraten Dow jcverstraten@dow.com Peter Baen Thermon Manufacturing Peter.baen@thermon.com
LO-127	A systematic way to proof the robustness of the Motorformer- and HVDC-technology A systematic way to proof the robustness of the Motorformer-and HVDC-technology as a result of a Root Cause Analysis, RCA for offshore-environment	Terje Knutsen Statoil tekn@statoil.com Thobias Østerholm ABB tobias.osterholm@se.abb.com Tord Godal Statoil torgod@statoil.com
LO-132	Managing Electrical Safety at work place - working with Specialist Contractors A OEM specialist visited site for maintenance activities during plant turnaround and received an electrical shock. This paper discusses reflective learning from that incident. Incident investigation findings and recommedations to prevent such incident in future are discussed in the paper. Emphasis to OEM engineers that compliance with site Electrical Safety Rules is mandatory for ALL, equipment experts are not an exception !. Often OEM engineers are regarded as "experts" on their own equipment and consequently less focus may be placed on supervision of their job then would normally be done in case of company staff or other contractors.	Shailesh Chauhan Shell Shailesh.chauchan@shell.com
LO-135	Strategic management of ageing assets to maximise recovery of oil and gas The paper will look to explore how strategic asset management of electrical assets can help maximise production of oil and gas by reducing unplanned outages and extension of asset life. Looking at the essentials of asset management including condition monitoring, the paper will look at how condition monitoring information can be utilised to form Health and Criticality Indices, which in turn enables more granular and robust asset extension and replacement decisions, at the same time as reducing	Kirsty Jefferson EA Technology kirstyljefferson@hotmail.co.uk

	operational losses. Drawing upon case studies from work undertaken around the world within the petrochemical sector and from working with electrical network operators across multiple sectors, the paper will cover asset management principles from the instruments and techniques used to gather valuable information on asset condition and performance; learning gathered from failure analysis; asset life cycle and asset management maturity. The paper will share effective ways to manage the condition data that exists within businesses to effectively utilise it to optimise decisions about investment and asset life extension.	
LO-137	Lifetime extension study Electrical motors Polymers Lifetime extension study Electrical motors Polymers In the past years we have had some incidents with motor equipment in the polymers plants. Some incidents are: 1. 16 K103 a defect isolation of the high voltage windings due to loosen slot wedges and laminations; a loosen pressure finger; and a defect of the exciter winding. 2. 17K102: all slot wedges loosen, with results high partials discharges in the HV winding 3. 17K103: overhaul on short term necessary, due to partial discharge measurement problems are early recognized 4. K6501 Partial discharging in the high voltage windings. 5. Bearing problems of HV and LV motor on al plants. Based on the incidents, bad performance of our electrical drives and the high age of almost our electrical drives a life time extension study is initiated. During this study the history of the past 5 years is used to determine the actual risk. After this the mitigation options/scenario are determined to get the risk for the next 5 years. The new risk matrix from the SAFER project is used in the study for determining actual and future risk. In the presentation I would like to give the audience an insight in the process of the study and the advice to the Asset owner.	Fer Körver Sabic Fer.korver@sabic-europe.com
LO-138	Analyzing the Impact of Increasing the Efficiency of Large Induction Motor This paper analyzes the optimum efficiency of the high voltage motors for potential common use in the chemical, oil and gas (COG) industry. Currently, the efficiency of the low voltage motor (up to 500 hp) is well defined in NEMA MG-1, IEC 60034 and IEEE-841. In many countries the premium efficiency standard (IE3) is mandatory and it is the standard product by most of the manufacturers. However, when the motor ratting increase, the motor efficiency increase and there is no guidelines in the international standards specify the minimum efficiency for medium and high voltage motors (above 500 hp). This paper will evaluate the impact of increasing the efficiency above the manufacturer experience value. The effect of reducing the losses and motor cost are analyzed in an effort to assist in selecting the most appropriate economical construction for future installations.	Hussain Balfaqih Saudi Aramco Husain.balfaqih@aramco.com Yoshio Sekitani Hitachi Ltd Yoshio.sekitani.au@hitachi.com Abdullah Alamri Saudi Aramco Abdullah.amri.13@aramco.com
LO-141	Light emitting diodes (LED) for installation in Zone 1: a feasible procedure to determine the equivalent protection level In recent years, first devices with LED light sources appeared in the Ex's world. Even if LEDs technology require higher purchase costs than traditional sources, from the technical point of view, there are advantages that can offset this high cost. The most important are: - low power consumption, that allow both electrical energy saving and installation of small section cables and lower protection; - high number of operating hours, that permit save on the cost of maintenance and on the hourly cost of the LED lamp. The EN IEC 60079-7 standard explicitly excludes LED sources from the set of EPLb components for the lack of an adequate knowledge of failure phenomena. By taking into consideration the numerous technical and economic advantages that LED sources provide to the Ex world, the proposed study aims to evaluate analytically the LED technology in order to determine the failure rate according to its failure mode. The method that we intend to adopt is the SIL according to the EN IEC 61508, which has already been adopted for other equipment, components and sub-systems used in the field of functional safety. It is well	Kim Fumagalli Nuova ASP k.fumagalli@nuovaasp.net Martina Mirko Nuova ASP Paolo Corbo Nuova ASP

known that some devices can be used as active control of dangerous sources, with a real and expected level of reliability, if they have been qualified according to the EN IEC 61508. Further proof of what expressed above is the ATEX European harmonized standard EN50495: 2009, which defines the integrity level of the functional safety of active control systems and compares it with the level of fault tolerance of the Equipment Under Control (EUC).

LO-147

Separation of Water-in-Oil Emulsions Using Selective Heating

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The separation of water-in-oil emulsions is a significant and ongoing challenge for the oil industry, particularly where the field is producing "heavy-viscous" crudes and the components in the liquids may lead to more stable emulsions. Established technologies such as gravity separation and electrostatic coalescence result in relatively large separation equipment and associated plant footprint and weight, high energy consumption and high demand for chemical additives. In many cases multiple separators are required in series to reduce the water content to meet downstream processing demands. This paper reports a novel, selective heating approach to reduce the water content in a more efficient manner, more efficient energy usage, and may reduce the reduce the requirement for production chemicals. Microwave and radio frequency heating can be used to preferentially heat the water droplets dispersed in the continuous oil phase, so enhancing coalescence and increasing settling speed in gravity separation. Settling times may be reduced by over 90% and energy use decreased by 70-80% based on studies with Harding and Azeri Crudes. Using this process the same separation may be achieved using smaller capacity plant, or higher throughputs processed with existing infrastructure, so there may be significant opportunities in both mature and developing fields. The opportunities and challenges for scale up, integrating of power equipment and the implementation of the process in a petro-chemical environment are discussed.

PCIC EUROPE
PETROLEUM & CHEMICAL INDUSTRY COMMITTEE

The following papers will be presented as posters during the poster session on June 10th from 16:30 to 17:30

Ref	Title	Authors
LO-61	Reducing Arc Flash Risks with Electrical Safety Maintenance Devices Every year thousands electrical workers are injured or even killed whilst at work. Safety and trade organizations around the world are enforcing that workers do not open electrical switchgear for maintenance activities unless they put the equipment into a safe work condition, use the proper Personnel Protective Equipment (PPE) and ensure the appropriate level ofsafety and equipment training is given to everyone involved in the maintenance operation. In the USA and Canada the National Fire Prevention Association (NFPA) and Canadian Standards Association (CSA) are at the vanguard of driving a cultural change within the electrical maintenance industry with the NFPA 70E /70B and CSAZ 462/463 standards and guidelines. The essential element for electrical safety is to ensure that the equipment is in an electrically safe condition before any work is commenced, keeping personnel away from energized electrical equipment is paramount. Unfortunately there are maintenance tasks that have to be completed whilst the switchgear is under load and energized; companies are starting to implement the use of Electrical Maintenance Safety Devices (EMSD'S) to allow maintenance tasks to be completed whilst the switchgear remains closed and in a safe and guarded condition ensuring the inspector is never exposed to the dangers of Arc flash or electrocution. This paper will discuss the different types of EMSD's that are available and how they are used in an electrical maintenance program.	Martin Robinson IRISS Group mrobinson@iriss.com
LO-85	Electro-Pneumatic Power Supply (EPPS) for Applications in Hazardous Environments Within the Knowledge Transfer Partnership (KTP) programme, the University of Reading and EXPO Technologies collaborated on the development of an Electro-Pneumatic Power Supply (EPPS) for operation in high explosive risk atmospheres, certified for Zone 1 and gas group IIC. A key innovation of the EPPS is its capability to operate safely in hazardous environments and there are no similar products available on the market. In hazardous environments, close attention must be paid to sources of energy that can potentially ignite explosive gases. Standard mains-connected power supplies require safe cabling and connections that can introduce a high level of complexity and cost. Batteries are an alternative to some power supplies, but lifetime is often an issue. Recently, wireless monitoring has become very desirable in hazardous environments, but common energy harvesting systems, normally deliver very low power and so are not suitable for applications demanding more power. The EPPS presented here is designed to operate with no connection to an electric network, to maximize efficiency, compactness, simplicity and reliability. The device is designed to have 10 years lifetime with no maintenance required. The inductive generator is coupled with a custom microturbine spun by compressed air and it is capable of generating power in the range of 100 mW - 5W (Ex ia). Applications range from battery replacement to the supply of complex wireless network systems. The paper describes characterisation tests performed, as well as the modelling of the EPPS along with simulations performed in support of the search for technical solutions to comply with safety standards.	J. H. Fowler Expo Technologies Ltd D. Mason Expo Technologies Ltd dmason@expoworldwide.com A. Wang Expo Technologies Ltd

LO-102	Determining subtransient reactance and testing it according to IEC 60034-4 & IEEE Std 115 The requesting of values for subtransient reactance of synchronous generators occurs for different reasons: either the subject is focused on optimization of the protection system and for this reason requires a minimum reference value, or in cases of isolated operation when occasionally the central issue is the management of harmonics in the system, and for this reason should establish maximum values for this parameter. In both cases it is essential obtaining reliable values which makes relevant this analysis and discussion about subtransient reactance and the test procedures. This poster discusses the scope and interpretation of IEC 60034-4 (Rotating electrical machines – Part 4: Methods for determining synchronous machine quantities from tests) and IEEE Std 115 (IEEE Guide for Test Procedures for Synchronous Machines) standards, exemplifying them through tests performed at shop floor to obtain the reactance subtransient for a synchronous generator.	Aline Jorge. Mendonça WEG Equipamentos Elétricos S/A alinejm@weg.net Elissa S. De Carvalho WEG Equipamentos Elétricos S/A elissac@weg.net
LO-111	LEDs in Lighting. What we see & how we measure The electrical lighting industry is in the midst of the biggest and most rapid change in over a hundred years. Conventional light sources that have been used for decades are being pushed aside in favour of solid state lighting (SSL). SSL sources offer longer life and significant energy savings over their predecessors. While Light Emitting Diodes (LED) are perhaps best known, other sources such as OLED are changing or about to change the face of the lighting industry as we know it. SSL light sources aren't just changing what fixtures are available they are also changing the language of lighting, how we measure light source and fixture performance. Everything we knew about lighting is changing will continue to change for the next few years. This paper discusses what is changing, the various light sources and the impact it is having and will have on the application of lighting.	Ian MacLeod & Hubbell imacleod@hubbell.com Marty Cole - Hubbell mcole@hubbell-canada.com
LO-134	A journey across Turkey over 1000km of earthing and lighting diagnostics In 2013 EA Technology embarked on the mammoth task of undertaking individual High Voltage Earthing and Lightning protection surveys of electrical assets along a pipeline that traverses through Turkey. At each location soil resistivity, earth resistance, earth continuity, earth integrity, touch and step potential measurements were undertaken together with a full lighting protection survey of all the buildings and structures at each location. Partial Discharge measurements utilising the EA Technology range of instruments were also undertaken on all High Voltage Switchgear. The paper will describe all the measurement techniques involved during the survey work together with how the results were analysed and collated to provide the customer with a definitive prioritisation list of issues. The paper will also describe the logistical and challenges of delivering such an intense and prolonged project over wide ranging and challenging environmental conditions that were encountered during the site survey. Work was undertaken in temperatures ranging from -20°C in the winter to +30°C in the summer, with many site locations extremely remote and only accessible on unmade roads via FWD vehicles.	Jason Butler EA Technology jason.butler@eatechnology.com