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PETROLEUM & CHEMICAL INDUSTRY COMMITTEE

13th PCIC Europe Annual Conference

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Electrical and Instrumentation Applications & Automation

FINAL PROGRAM

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Phone: +49 30 254780

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13th Annual PCIC Europe Conference 2016 in Berlin

Dear guests,

On behalf of the local committee, "*Willkommen in Berlin*".

Following on from London in 2015, Berlin is another powerhouse of Europe. First established in 1307 with the union of two settlements, Berlin is situated on the Northern banks of the rivers Spree and Cölln. Now home to the German Federal Government Berlin is a cultural feast with international attractions ranging from the magnificent Brandenburg Gate to the delicious Currywurst. Berlin is also a city with a long of history and is the second largest city in Europe, a notable economic, political, and educational center, with a huge inland port and a flourishing global trade.

Berlin is an internationally recognized world city of culture and creative industries. The city has a very diverse art scene and is home to over 700 art galleries and 153 museams. The Fernsehturm (TV tower) at Alexanderplatz in Mitte is among the tallest structures in the European Union at 368 m (1,207 ft). Built in 1969, it is visible throughout most of the central districts of Berlin. The cuisine and culinary delights of Berlin vary greatly. Twelve restaurants in Berlin have been included in the Michelin guide of 2015, which ranks the city at the top for the number of its restaurants having this distinction in Germany. Many local foods originated from north German culinary traditions and include rustic and hearty dishes with pork, goose, fish, peas, beans, cucumbers, or potatoes. Typical Berliner fares include Eisbein, Schnitzel Holstein and the Berliner pastry known in Berlin as Pfannkuchen.

"This year's conference location will offer the participants an environment for learning, networking and relaxing with industry experts from all corners of the globe."

We hope you enjoy the conference and your stay in Berlin.

The Local Committee PCIC Europe 2016
Jeremy Andrews – Chair | Paul Donnellan | Bert Engbers | Melinda Ludwig | Rona Richter | Monika Rohr | Claudia Haasler | Ivo Raasch | Dr Dirk Steinmüller | Felix Seibl | Jens Fuglsang

PCIC EUROPE
PETROLEUM & CHEMICAL INDUSTRY COMMITTEE

Welcome to Berlin

Dear conference attendees,

The Petroleum and Chemical Industry Committee (PCIC) Europe visited many European capitals, but is coming to Berlin for the first time. This choice was driven by the convergence of different factors that came up to our committee as many evidences. First, Germany was appearing as producing more and more global players in the Oil & Gas and Petrochemical sector. Second, we could see that this emergence was propelled by innovation, especially in the digitalization area. Third, this evolution coincides with the recognition of big data and internet of things (IoTs) to become a major challenge for rather conservative processes industry. Fourth and not last, Berlin popped up over the years as one of the preferred destination for global travelers with excellent reasons as an opened city mixing visitors from all over the world and combining history and modernity.

The introduction of the digitalization in the Oil & Gas and Petrochemical industry will have consequences during some decades. But what appeared to us on the top of the list is the interaction between the electrical systems and the automation systems. Therefore we made the decision to add an automation program in parallel to the conventional PCIC electrical program. The selection of the papers for Berlin conference confirmed our assumptions since some of them were perfectly straddling over electrical and automation technologies.

In addition Berlin 2016 is following the London 2015 conference where we enjoyed a step change in term of attendance and expectations despite a shifting economic environment. As a result we get the duty to consolidate this success in Berlin with a program even more diversified and richer of learning. In practice it means twice more tutorials, 50 percent more papers and a broader choice of presentations with a program offering you four parallel sessions instead of two in the past.

The last point I would like to highlight is the extraordinary work of our Local Committee which has produced an intensive and fantastic team work to prepare this first conference in Berlin, not missing any details for the paper presentations as well as to create the best conditions for networking and entertaining you all along the PCIC Europe Berlin Conference.
Welcome to Berlin

Jean-Charles Guilhem
Chair PCIC Europe

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The 2016 PCIC Europe technical program

Last year's conference in London was a leap for PCIC Europe. It has been a real challenge for the technical committee to create an attractive conference once more. The committee decided in 2014 that we should revert back to our main objective. Since the beginning of PCIC-Europe in 2004 this objective is that "PCIC Europe is the premier European forum for the exchange of experience in the practical application of electricity and instrumentation in the petroleum, chemical and pharmaceutical industries, including all upstream and downstream activities", however contributing papers with an instrumentation background have been rare since 2009. This has resulted in a call for abstracts specifically in this field, in cooperation with Namur; we have received many responses from industry, both manufacturers as well as end-users. Therefore we needed to extend the number of parallel sessions, providing you with a wide range of possibilities to attend attractive and informative presentations.

Again, the committee has managed to provide you with 4 attractive tutorials with a high level of end-user experience included. The following pages take you through the technical program focusing on our strategic topics of Personal Safety, Extreme Environments, Good Design Practice and Equipment, Systems and Components.

The conference schedule has 36 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 for the conference attendee. 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 London conference.

In the following pages you can find 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.

Paul Donnellan
PCIC Europe Vice Chair (Technical Chair)

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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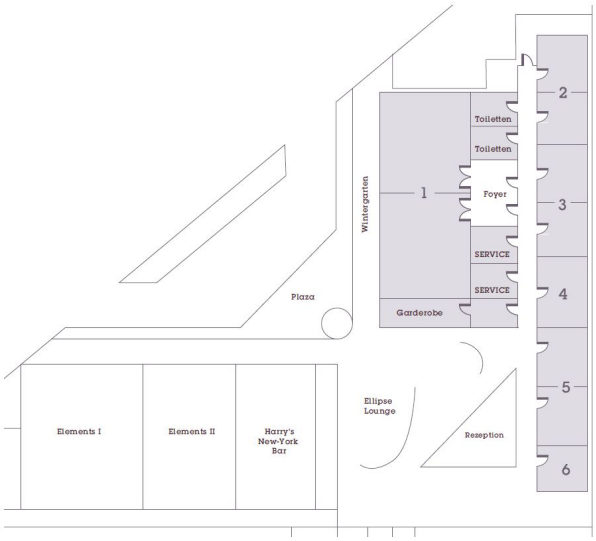
Conference Rooms (Groundfloor)



ZIMMER (394)

	King	Twin	Single
CLASSIC ZIMMER	274	77	3
DELUXE SUITE	2	-	-
PENTHOUSE SUITE	16	-	-
EXECUTIVE SUITE	17	-	-
EXECUTIVE SUITE MIT SAUNA	5		
INSGESAMT	314	77	3

VERANSTALTUNGSRÄUME

1 EMPORIO I + II	5 EXPERIENCE I + II
2 ESPERANTO I + II	6 EPSILON
3 EMBASSY I + II	7 EVEREST, 6. ETAGE
4 ETON	8 EXEDRA, 7. ETAGE

Hospitality suites (7th floor)

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Program

Monday June 13th, 2016

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

Tuesday June 14th, 2016

Time	Emporio I	Emporio II	Esperanto	Embassy
08:30 / 10:00			BER-102 Tutorial - Assessing Energy Saving Potential for Electric Motors in Petroleum&Chemical Ind. *ABB & Sabic*	BER-93 Tutorial - Specifying process gas chromatographs *Siemens Industry*
10:00 / 10:30	Coffee			
10:30 / 12:00			BER-57 Tutorial - Impact of load-shedding reaction time on power system stability *Siemens & Shell*	BER-91 Tutorial - Process data analytics: improving operations and maintenance in the process industry *ABB*
12:00 / 12:10	Welcome address			
12:10 / 12:55	Plenary - BER-62 Industrie 4.0 architecture (RAMI 4.0) and its links with IEC standards for a connected world *ZVEI & 2B1st Consulting*			
12:55 / 13:55	Lunch			
13:55 / 14:10	Namur presentation PCIC US presentation Notices			
14:10 / 14:55	Plenary - BER-100 Automation Security Innovation - Barrier or Technology Enabler *BASF*			
14:55 / 15:40	Plenary - BER-45 Responsible Person - Are the responsibilities fully understood? *CompEx & EEMUA*			
15:40 / 16:10	Coffee			
16:00 / 18:15	Hospitality suites are open			
16:10 / 16:55	BER-53 How to validate by simulation arc protection systems to mitigate arc effects *Schneider Electric*	BER-48 An Innovative Performance Model for Monitoring and Diagnostics of MV Switchgear *ABB*	BER-78 Challenges of Networking the Smart Oil Field *Moxa, Inc.*	BER-98 Holistic Alarm Management Throughout the Plant Lifecycle *ABB*
18:30 / 19:00	Keynote speech : Dr Thomas Steckenreiter, Bayer			
19:00 / 22:30	Social event at the Sheraton Berlin Grand Hotel Esplanade			
20:30 / 0:00	Hospitality suites are open			

Wednesday June 15th, 2016

Time	Emporio I	Emporio II	Esperanto	Embassy
08:45 / 09:15	BER-67 IEC Tested CB Interrupting Capability For Networks With High DC Time Constant *Fluor & Siemens*	BER-42 Partial Ride-Through with Model Predictive Control *ABB, Statoil & Gassco*	BER-73 Reduce total cost of ownership via the integration of intelligent field devices *Rockwell Automation & Fluor*	BER-63 Migration of Safety Instrumented Systems (SIS) *Siemens AG*
09:15 / 10:00	BER-47 Advances in Motor Protection Relay Feature *SELINC & BP*	BER-82 Transformerless Topologies for Medium Voltage Converters *WEG*	BER-96 Virtual Commissioning in a virtual environment *Siemens*	BER-69 DIMA- Method for the integration of modular process units *WAGO, Helmut-Schmidt University & Technische Universitat Dresden*
10:00 / 10:30	Coffee			
10:30 / 11:15	BER-37 Direct-On-Line Energization of Subsea Power Transformers *Hazel, Vizimax Inc, OceanWorks International & Rockwell Automation*	BER-80 The importance of NFC tracking system for MV & LV Switchgear *Skema*	BER-59 Commissioning of low current arc flash (optical) detection technology *Saudi-Aramco*	BER-68 Using an Integrated Engineering Model to Drive Profitability and Productivity *Schneider Electric*
11:15 / 12:00	BER-90 MARTIN LINGE world longest Power From Shore Oil&Gas development *Total*	BER-64 Study of the test base influence on the electric motor reed critical frequency *WEG*	BER-54 Innovative Retrofit Upgrades for Safety and Reliability in Aged Switchgear *ABB & ENI*	BER-72 Upgrading Process Gas Chromatographs at the BP Kinneil Terminal, Grangemouth *BP & Siemens*
12:00 / 13:00	Lunch			
13:00 / 13:45	BER-38 How do we know? A journey of assessment and assurance *BP*	BER-87 A novel solution for the reliable OLPD monitoring of large VSD-operated HV motor *HVPD, Statoil ASA, Gasco & Karsten Moholt AS*	BER-81 Redundancy communication architectures and the benefits for the O&G industry *Siemens*	BER-75 Discover and leverage the potential of digitalization in the Process Industry *Siemens AG & Wittenstein*
13:45 / 14:30	BER-86 Electrical System Management in Preparation and During Decommissioning Offshore *Shell*	BER-56 Case Stories of Induction Motors Fault Diagnosis Based on Current Analysis *Politecnica de Valencia & Ube chemical Europe*	BER-55 The advantages of active arc fault protection with regard to process outage time, equipment & personnel safety *ABB*	BER-99 Cyber Security in Energy Automation Systems *Siemens*
14:30 / 15:00	Coffee			
15:00 / 15:45	BER-50 Alternative insulation gas for Medium Voltage Switchgear *ABB*	BER-84 OLPD Condition Monitoring of Complete Networks in Oil & Gas Facilities *HVPD & BP*	BER-79 Digitalized Copper – the comparison of a traditional power and process automation control system set-up vs. an integrated control using IEC 61850 *ABB & Shell*	BER-103 Magnetic resonance technology: another way of multiphase flow measurement *Krohne*
15:45 / 16:30	BER-58 An Optimized Technique for VAR Flow Control Using Existing Infrastructure *Saudi Aramco*	BER-46 IEC 61850-based EMCS training simulation tools ensure operational efficiency and peace of mind. *Schneider Electric*	BER-52 Clarifying the voltage and current harmonic roles in the turbogenerator design *WEG*	BER-92 Impact profitability and safety through effective operator qualification *SimSci by Schneider Electric*
16:00 / 0:00	Hospitality suites are open			

Thursday June 16th, 2016

Time	Emporio I & Emporio II	Esperanto	Embassy
08:30 / 09:15	BER-89 Different Protection Modes of EX LED Luminaires *Nuova ASP, Politecnico Di Milano & SILEx Engineering Srl*	BER-61 Flameproof Motors operating in the Artic Circle without the need for pre-heating *WEG*	BER-101 Hydrocarbon Process, Single and Multi-layer Level Measurement *Endress+Hauser*
09:15 / 10:00	BER-40 Are the IEC requirements for overpressure testing of Ex d equipment appropriate? *Jim Munro International Compliance Pty Ltd*	BER-66 Importance of Control Engineering to Minimize Torsional Vibration in VSDS *ABB*	BER-74 Power-i A significantly improved approach to explo. protect. by Intrinsic Safety *Physikalisch-Technische Bundesanstalt Braunschweig*
10:00 / 10:30	Coffee		
10:30 / 11:15	Plenary - BER-76 Safety Instrumented Systems Field Data Feedback - A Decade of Experience *BASF SE*		
11:15 / 12:00	Plenary - BER-44 All-Electric FPSO: Onshore and Offshore commissioning experience *Total*		
12:00 / 12:30	Closing		

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The following tutorials will be presented at the 13th PCIC Europe conference.

Ref	Title	Authors
BER-37	**Direct-On-Line Energization of Subsea Power Transformers** Energizing subsea variable speed drive transformers cannot be done direct-on-line due to the negative effects of the inrush current. The typical schemes used in the past are energization via a high impedance, or via a tertiary winding connected to a subsea auxiliary AC power source. These schemes require additional subsea equipment resulting in increased cost and complexity. Increased complexity often leads to reduced availability. This paper presents an alternative solution allowing direct-on-line energization without negative consequences and without the requirement of a subsea AC auxiliary power supply. Thus the number of subsea high-voltage circuit-breakers will be determined only by the process loads. The circuit- breakers supplying power to the VFD transformers are standard 36kV class devices having a 3-pole operating mechanism. The circuit-breakers are controlled in order to close at the point on the voltage waveform where the resulting inrush current is the least. The auxiliary power required for the subsea control equipment is provided by a DC link from the shore station and the control link is via optical fiber. The solution uses standard proven technology and can be implemented without any additional subsea power equipment modules thus keeping the number of penetrators and subsea connector systems to a minimum. The solution will be presented with different levels of redundancy and include a description regarding availability and maintenance. Availability and maintenance are key points for subsea systems in particular due to the difficulties and associated costs in accessing equipment. It is expected to have an end-user as coauthor.	Terence Hazel Consultant Pierre Taillefer Vizimax Energy Scott Williams OceanWorks International Richard Paes Rockwell Automation
BER-38	**How do we know? A journey of assessment and assurance** Mature companies have good standards, specifications and maybe even an electrical safety program, but do they know how well these actually work? If you check to see how your sites perform against your internal and external standards and processes, the process usually will involve an element of self-assessment and then an external assurance view. The paper will take the reader along the journey of the development of key electrical risk mitigating barriers and bowties, followed by self-assessment to verify that these barriers are in place and strong. The key concepts of how a self-assessment program may be developed will be shared as well as the assurance activities that would follow. Examples of typical findings across a large oil company will be shared to offer the reader a comparison with their sites. Finally, remedial actions and improvements will be shared to show the benefit of such a system.	Jeff McQueen BP Jason Couch BP
BER-40	**Are the IEC requirements for overpressure testing of Ex d equipment appropriate?** Since 1948 the IEC requirements for testing of Ex d (flameproof) equipment have been evolving. Complex equipment such as flameproof motors present particular challenges, especially when used at extremely low temperatures. This paper reports on an investigation into overpressure testing requirements for flameproof equipment, especially flameproof motors, at normal and extremely low ambient temperatures. Factors are introduced into such testing to provide confidence that the equipment can withstand pressures due to internal explosion. Often these factors are applied to the maximum pressures developed during pressure	Jim Munro Jim Munro International Compliance Pty Ltd

	determination testing, but other approaches are also permitted. Testing of flameproof motors becomes challenging due to their complex geometry. This can lead to much higher pressures due to pressure piling or even detonation. As temperatures drop the pressures become higher and so the situation becomes even more complex. IEC 60079-1 contains the requirements for Ex d equipment. It includes requirements for testing of motors and for testing equipment intended for use in extremely low ambient temperatures. But the amount of published information supporting some of approachesThis research could lead to proposals for changes in the standard. is limited. This paper draws conclusions from existing information and outlines proposed additional research that is planned to fill some of the gaps in the knowledge.	
BER-42	**Partial Ride-Through with Model Predictive Control** Symmetric and asymmetric dips of the grid voltage pose serious problems to gas compression stations powered by drives such as load commutated inverters (LCI). Drive control systems used in industrial practice are not capable to handle reduced grid voltage situations appropriately, and execute a ride-through procedure instead during which no drive torque is provided by the drive. Without drive torque compressors may quickly enter surge conditions, under which the gas flows rapidly back and forth, causing wear and risking damage to the equipment. In this paper we describe a novel control approach developed for load commutated inverters based on model predictive control (MPC). Model predictive control is an optimization-based control method, where a mathematical model of the system is used to determine control inputs which are optimal with respect to some objective function. With the revised control system, the drive is capable to provide partial drive torque during grid disturbances; thus resulting in robustness improvements for electrically-driven gas compression stations. In the case of a voltage dip, the compressor is still supplied with partial drive torque, decreasing the probability of the compressor diverging into surge. The paper includes experimental results executed on two real 41.2 MW LCI-fed synchronous machines each powering a gas compressor.	Thomas Besselmann ABB Corporate Research Pieder Jörg ABB Medium Voltage Drives Terje Knutsen Statoil ASA Erling Lunde Statoil RDI Tor Olav Stava Gassco AS Sture Van de Moortel ABB MV Drive
BER-44	**All-electric FPSO: onshore and offshore commissioning experience** The increasing scope of electrical equipment in an offshore facility without turbo-driven End-Users has a known impact on the design of such facilities that has been discussed in the recent years [1]. The intent of this paper is to recall the historical events and present the specificities of such project execution from Vendor delivery (equipment FAT) until start-up of the facility (first oil and ramp-up). As such project is executed in many locations changing throughout time, from Vendor to yard, then towing to offshore, we will review splitting and sequencing of testing activities at the various locations and phases of project execution. A selection of the different issues encountered and solutions implemented eventually, will be covered with highlights on the priorities leading to the decisions which were taken. Feedbacks and lessons learned from designing, commissioning, operation and maintenance team perspective will be discussed in order to propose future roadmaps' items for the industry.	Patrick Pandele Total
BER-45	**Responsible Person – Are the responsibilities fully understood?** In relation to explosive atmospheres, the IEC 60079 Standard Part 14 covers the Electrical installations design, selection and erection, with Part 17 covering the Electrical installations - inspection and maintenance in addition to the European legal requirements in the ATEX Directive 1999/92/EC (ATEX 137) that provide the minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres. Competency schemes are well established to assist employers meet their legal obligations under the ATEX Directive or appropriate in-country Regulation for Electrical and Mechanical Operatives/Technicians and Application Design Engineers, but what about the Responsible Person's competency - are these duties well understood across industry and do these Responsible Persons have access to the appropriate 'tools' to enable them to adequately carry out their responsibilities? This paper will examine the scenarios where these responsibilities have been carried out inappropriately and in some cases contracted-out to third parties, leaving both the Responsible Person and the Employer exposed to enforcement action when	Martin Jones CompEx JTLimited Paul Hague CompEx JTLimited Mike Ellis EEMUA Peter Bennett EEMUA

there is an incident in the workplace. The difficult part is getting it right in a cost effective manner and being able to demonstrate a professional attitude to embracing the spirit of both the applicable IEC Standards and the ATEX Directives to maintain both a safe workplace and protect the expensive capital assets of the major user. The paper will provide direction to assist the Responsible Person conduct their duties in this manner.

BER-46 **IEC 61850-based EMCS training simulation tools ensure operational efficiency and peace of mind.**

Yann-Eric Bouffard Vercelli
Schneider Electric

Gagan Kapoor
Schneider Electric

Guillaume Bruandet
Schneider Electric

Power system in Oil & Gas Installation requires complex and automated Energy Management and Control Systems (EMCS). Operators use different control systems (DCS, EMCS...) using different HMIs and Intelligent Electronic Devices (IEDs), controllers, sensors. Remote and actual site learning is usually not feasible, and certainly not during abnormal or crisis scenarios. EMCS architecture is composed of a hierarchy of various communication network topologies. Software-based simulation tools offer a very effective way to better understand system behaviour. Simulation can be done in two ways- Emulation which is replacing the actual devices with on Communication Simulation and Excitation which is injection by hardware simulation. Simulation can emulate most electrical data and control by emulating IEC 61850 protection or LAN concentrators. A selection of IEDs can be activated by simulated embedded hardware that allows (while keeping coherency of electrical data) to learn real IED maintenance or setting operations. A limited set of IEC devices are often used, including an EMCS HMI, DCS gateway, central automation such as iFLS, iPMS, and black start, in order to exactly replicate site behavior, settings and maintenance procedures (such as patch management, upgrades, or site evolution).
This paper presents an Operator & Maintenance Training System (OTS & MTS) solution. Its inner basis is a site EMCS IEC 61850 System Configuration Description (SCD, according to IEC naming). In EMCS simulation set-up, IEDs can be physically replicated then can be excited physically if needed, or emulated (replaced) in communication network for the majority of time. Simulator reacts to direct control or automation settings reactions in case of contingency. A trainer can specify multiple sets of electrical data and initial status, schedule events, or re-inject captured IEC data exchange of current real project EMCS. This paper describes this top-down approach of simulation and solution modularity required by end user, from real to and emulated IED, and from simple electrical behaviors to real-time dynamic load flow injection.

BER-47 **Advances in Motor Protection Relay Features**

Ricardo Abboud
SEL

Dibyendu Bhattacharya
BP

Paulo Lima
SEL

John Needs
SEL

Alejandro Rodriguez
SEL

The algorithms used by numerical relays in motor thermal protection accurately simulate the characteristics of the motor. These algorithms use the motor speed to calculate rotor heat. This results in proper starting for high-inertia loads connected to motors and minimizes the cooling time, providing quicker restarts. These algorithms are performed in a numerical relay that also performs logging and plotting of starting characteristics. An accurate record of motor performance can therefore be obtained, providing an indication of possible motor failure. Broken rotor bars cause reduced accelerating torque, increased motor heating, and increased vibrations, which can inflict severe damage on a motor. Modern numerical motor relays monitor the stator current spectrum for frequency components associated with this phenomenon and use motor current signature analysis to detect broken rotor bars. For added safety, these devices can also include arc-flash protection, allowing faults in the switchgear to be quickly detected and cleared.

BER-48 **An Innovative Performance Model for Monitoring and Diagnostics of MV Switchgear**

Simone Turrin
ABB

Luca Cavalli
ABB

Stefano Magoni
ABB

This paper illustrates an innovative performance model for monitoring and diagnostics of Medium Voltage (MV) switchgears. Scope of the performance model is to assess the current health condition of MV equipment in terms of probability of failure and, thus, to provide relevant information for any successful condition-based and preventive maintenance strategy.
The performance model presented in this paper is based on the central role of failure modes, causes and mechanisms. It is fully modular and scalable in order to take into account different scenarios of data availability (from static product nameplate data to dynamic condition monitoring and test data) and MV equipment of different

	manufacturers. In addition, the accuracy of the performance model in assessing the current health condition is calculated as depending on the actual data availability. An application of the proposed performance model in the oil, gas & petrochemical industry is presented in the second part of the paper. In a first phase, the performance model is applied based on the available data for a real industrial case. Finally, the performance model is used to highlight the benefits of advanced condition monitoring solutions in increasing the accuracy of monitoring and diagnostics of MV equipment for the considered industrial case.	
BER-50	**Alternative insulation gas for Medium Voltage Switchgear** Although the contribution of SF6 emissions from gas-insulated medium voltage switchgear to man- made global warming is very small, an eco-efficient insulation gas will contribute to a reduction in the carbon footprint of the electricity grid. Based on fluoroketone molecules an alternative to SF6 gas insulation has been developed for medium voltage switchgear applications. The alternative fluoroketone/air gas mixture combines good electrical performance with a very low global warming potential GWP < 1. Compared to the global warming potential of 22.800 from SF6, a reduction of nearly 100% can be achieved using the alternative gas. This paper presents main conclusions of the development of a medium voltage GIS using the new alternative insulation gas, including a comparison of alternative gas technologies and applying experiences from pilot projects for switchgear applications.	Maik Hyrenbach ABB Sebastian Zache ABB
BER-52	**Clarifying the voltage and current harmonic roles in the turbogenerator design** The power quality, which should be assured by turbogenerators acting in the island mode operation, is a critical requirement in industrial plants where increasingly is utilized computerized automation equipment. The voltage and current harmonics, which can be evaluated by parameters such as harmonic distortion and telephone interference factor, are some of the most significant issues related to power quality. The purpose of this article is to clarify the meaning of parameters related to the harmonics for engineers, not necessarily linked to the area, and to provide a general understanding of how each one of these parameters has influence on the electrical machine design. In general, harmonic voltage distortion factor is provided by machine manufacturers, at no load condition, according standards related. In this way, this factor is directly affected by the design constructive characteristics. The current harmonic distortion, on the other side, depends on the non-linear loads, which are fed by the generator. For reducing their effects, some limits for one of the generator reactances are established. Consequently, from different ways, both factors are affected by the generator design.	Elissa Carvalho WEG Aline Jorge Mendonça WEG
BER-53	**How to validate by simulation arc protection systems to mitigate arc effects** This paper will illustrate how the simulation can be used to assess the internal arc performance of an E-house. This one can be difficult to define for the engineer. Often, the Switchgear is classified as per the IEC 62271-200; but during the test, the pressure rise of the room (represented by two walls only) can't be measured. This point is essential in an E-House which has a compact installation, and should be assessed beyond the standard; while the possibility to test the entire EHouse is out of reach for economical reasons. Scenario simulated will look at following arrangements/options: - An E-House without any possible release of hot gases outside of the building, which is pertinent with fire blast rated, and IECEx protection requirements - Different construction technologies - AIS switchgear with standard and new absorber technologies - Internal Arc 31,5kA, durations: 1s, 300ms (standard relay), 80ms (optical relay) In addition, the paper will present experimental results, used to define the absorbers models. Conclusions will wrap up potential savings in pressure, and will highlight the benefits that can be expected in E-Houses.	Jerome Douchin Schneider Electric Anthony Brown Schneider Electric Juha Rintala Schneider Electric
BER-54	**Innovative retrofit upgrades for safety and reliability in aged switchgear** The current economic environment O&G companies are facing demands for strong investment's prioritization in electrical assets upgrade. Installed base may be several decades old, no more supported by the original manufacturer and with questionable reliability due to not available original spare parts and overall obsolescence. Safety	Carlo Gemme ABB Paola Bassi ABB

	aspect in 20-40plus year old switchgear are often not up to current standards. Circuit breaker retrofit is a cost-effective modernization solution to address needs in low-budget times. Retrofit can replace phased-out circuit breakers by current production versions, mechanically and electrically engineered to adapt to the existing switchgear, thus providing a noticeable reliability and performances improvement. Spare parts from active production provides a long service life prospective. An innovative hard-bus retrofill solution is presented, easily connecting the new breaker to a wide range of existing panels, simplifying design and installation process and providing standardization across installed base. Retrofill enables the switchgear upgrade when additional constraints are in place: – other parts than the breaker (shutters, interlocks, etc.) need to be replaced; – original panel design does not allow to meet today required features and Standards – budget or operation restrictions make complete SWG renewal not-applicable ENI Power installation example describes the original circuit breakers replacement procedure while providing process continuous operation and the upgrade in switchgear features from safety of operation and interlocks point-of-view.	Diego De Martis ENI Power
BER-55	**The advantages of active arc fault protection with regards to process outage time, equipment and personnel safety** The occurrence of an arc fault is rare but it is the most serious fault within a switchgear system. The destructive impacts of such an arc flash event can lead to severe injuries of the operating personnel, to costly damages on the switchgear and long outages of the system. Especially in energy intense segments with high output, such as the oil and gas industry, these long downtimes can result in extremely high costs. Active arc elimination systems can mitigate the above-named consequences. They extinguish an internal arc by redirecting the uncontrolled energy release into a defined and controlled bolted connection of all 3 phases to earth potential. Arc elimination devices are designed to detect and quench a burning internal arc in less than one third of a cycle and therefore offer the highest degree of protection for personnel and equipment. This paper presents a general overview of different arc flash protection devices available on the market. It evaluates the possibilities and advantages of arc elimination systems with regards to process outage time, equipment and personnel safety.	Wolfgang Hakelberg ABB Laura Proelss ABB
BER-56	**Case stories of induction motors fault diagnosis based on current analysis** This work presents several case studies related to condition monitoring of induction motors operating in a chemical plant. Advanced analysis of the stator current is applied to diagnose several types of faults, especially rotor damages and mixed eccentricities. The considered current-based techniques include both the conventional method based on the analysis of the steady-state current (MCSA), as well as recently developed methodologies based on the analysis of transient currents (ATCSA). The combination of both methods enables to reach a high reliability in the diagnostics, avoiding eventual false indications of a single method. The motors considered in the paper range from small-sized machines till large motors (rated up to several MW). Also, a diversity of operation conditions is considered, including diverse loading conditions as well as different operating options (grid-connected and inverted-fed motors). The results show the powerfulness of current analysis for diagnosing a wide range of failures in asynchronous motors operating in petrochemical plants.	Jose Antonino-Daviu Universitat Politecnica de Valencia Alfredo Quijano-Lopez Universitat Politecnica de Valencia Vicente Fuster-Roig Universitat Politecnica de Valencia Carlos Nevot Ube chemical Europe
BER-57	**Impact of load-shedding reaction time on power system stability** Industrial electrical power systems are strongly depending on their electrical power supply. In the Oil & Gas industry a loss of power can generate huge financial losses. For that reason it is usual to have own power generation connected to the industrial grid. Sudden loss of generated power e.g. trip of a generator, but also loss of big load is a threat for system stability. For such contingencies a fast automatic load shedding system re-establishes the balance of generated power and loads. This paper discusses the impact of the reaction time of the load shedding after a loss of generated power or load. Compared to a public power grid the system inertia in industrial power systems is relatively small hence an imbalance of production and	Michael Eckl Siemens AG Walter Hoermann Siemens AG Dr. Edwin Lerch Siemens AG Paul Donnellan

	consumption leads quickly to a big frequency deviation. The paper shows the necessity of a fast load shedding and considers the available spinning reserve of the connected generators. Based on simulation results and practical experiences guidelines are provided how to determine the expected frequency deviation and how spinning reserve can be considered for an efficient load shedding.	Shell
BER-58	**An Optimized Technique for VAR Flow Control Using Existing Infrastructure** Increase or decrease in the reactive power (VAR) requirements of loads on any bus leads to voltage fluctuations at that bus. Hence, VAR flow control is very crucial for power systems integrity as it may lead to voltage instability or severe circulating current. The circulating current in the system will cause system stress and will reduce the generator capacity. Hence, a quick automated system is needed to control the VAR flow continually. This can be done through AVR control system in the generator and the transformer. However, a very sophisticated control system is needed for coordination between them. In this paper we will share our experience in deploying an advanced technique to coordinate between all generators and transformers AVR systems to stabilize the voltage and minimize the circuiting current. We utilized the existing Distributed Control System (DCS) infrastructure, in one of the local industrial plants, to automate the VAR control without adding any additional component. The new logic detects any voltage instability or circulating current and selects the most appropriate AVR system, whether it is a generator AVR or a transformer AVR, to correct the VAR flow.	Yousef Alrasheedi Saudi Aramco Rashed Alrasheedi Saudi Aramco
BER-59	**Commissioning of low current arc flash (optical) detection technology** An Arc detection system using an optical sensor technology was implemented at existing low voltage switchgears and respective motor control centers serving a petrochemical plant. A decision took place to install this technology at the low voltage equipment to validate its efficacy in protecting electrical workers. This paper will discuss the effectiveness of optical sensors in detecting low voltage current arc flash and isolating the associated circuit breaker in a timely manner.	Hamad Al Tuaimi Saudi Aramco Yousef Al-Rasheedi Saudi Aramco Hani Hajjar Saudi Aramco
BER-61	**Flameproof motors operating in the Artic Circle without the need for pre-heating** The first aim of the present paper is to show that we can have reliable and safe operations in frigid polar climates with the use of Flameproof Motors, for both onshore and offshore environments, without the need for pre-heating the motor before starting. The second, is to address the Design of optimal solutions on Medium and High Voltage Flameproof Motors, from small outputs up into the Megawatt range (tube and rib-cooled), prepared to withstand the effects of low temperatures and aggressive atmospheres that frequently compound the Artic regions. In this paper, we also describe the challenges, techniques and best practices for transportation, long term storage and maintenance of electric motors in these extreme locations. By example, we illustrate a case study of an application at an Oil & Gas field in Siberia.	Rui Luis Vieira Barata WEG João Pedro de Sá Cardante WEG
BER-62	**Industrie 4.0 architecture (RAMI 4.0) and its links with IEC standards for a connected world** This paper should be the follow up of the previous paper LO-90 Industrie 4.0 - What can the Oil & Gas and Petrochemical sector learn from this "Future of Manufacturing" Concept?" In 2014, the Oil & Gas and Petrochemical sector discovered various initiatives taken in the world to develop new manufacturing models in integrating digitalization technologies such as the internet of the things (IOT). In 2015, some companies, operators, engineering companies & contractors, manufacturers, started to investigate areas where this Future of Manufacturing concept coiuld bring value in process industries such as Oil & Gas and Petrochemical. Innovation, Packaging Local Content, Costs cutting, Speeding up well to wheel cycle time are as many areas where "Future of Manufacturing" values can help. This paper will review the progress made in this digitalization era and will try to assess how much the German model Industroe 4.0 is delivering according to expectations to facilitate projects development.	Jean-Charles Guilhem 2B1st Consulting Dieter Wegener ZVEI

BER-63	**Migration of Safety Instrumented Systems (SIS)** The migration of a safety-related system in the process industry is a question of modification with everything carefully planned, tested and approved. The essential steps and procedures are described at the example of a logic solver for a burner control system in Germany. Besides the technical aspects the management of functional safety and the qualification of the deployed staff are also considered. The trigger for the project was the approaching end of the spare part supply for the used logic solver. The request of the operating company was a one-to-one replacement of the CPU and the appropriate I/O modules during the annual plant shown over a four week period. To keep the expenditure for the continuation of operating permit as low as possible, the approach of "Provisions to Safeguard Existing Standards for Process Control System Safety Equipment" according NAMUR recommendation NE 126 was considered. Due to the complex initial situation and the ambitious time schedule a competent Functional Safety Manager (FSM) was appointed. The first measure of the FSM was the creation of the so-called Project Safety Plan, followed by a so- called impact analysis of the intended changes. Next came the adaption of the safety requirements specification (SRS), followed by the hardware design and engineering and the application software development. Parallel to this the planning of the necessary tests took place. During the annual shut down the modifications to hardware and software were carried out and the whole then tested. Finally a so-called assessment of the functional safety respectively the achieved safety integrity was carried out, involving everyone involved in the project.	Michael Stay Siemens AG
BER-64	**Study of the test base influence on the electric motor reed critical frequency** The Reed Critical Frequency (RCF) of an electric motor is defined as its first natural frequency when vertically flange mounted to a rigid base. Vertical machines manufacturers need this precise information from the electrical motors manufactures to enable an adequate dynamic project of the RCF of the whole system, avoiding resonance problems. A Finite Element Method (FEM) can minimize deviations from simple analytical models by the use of special features. The boundary condition to predict the motor RCF in a typical calculation method is to consider zero displacement at the motor flange connection to the base. In the real world the more the flange or the base moves in an experimental test, more the results differ from theoretical analysis, undermining the credibility of the calculation. For the motor manufacturer the lack of accuracy determining the RCF experimentally becomes critical as the motor size increases. Because of the large mass, huge motors present low RCF. This condition makes it difficult to design a base that present low movement and has a strong impact on the experimental results. This work focuses on the development of an accurate FEM model to predict the motor RCF and a study of the influence of the base on the deviations from the numerical to the experimental results. The base for experimental tests needs to be sized in a way to avoid any deflection or displacement in the attachment position of the motor. In order to evaluate the FEM model and the influence of the base size, three different testing bases were used to test the same electric motor. Experimental Modal Analysis (EMA) supported the FEM model evaluation by comparing the numerical modes, natural frequency and Frequency Response Functions (FRF) with their experimental peers. The adopted methodology, as well as the obtained results and conclusions are presented in this work.	Vinícius Gonçalves WEG S/A Hilton Silva WEG S/A Eduardo Schiochet WEG S/A
BER-66	**Importance of Control Engineering to Minimize Torsional Vibration in VSDS** In the Oil & Gas industrial facilities, the circuit breakers must be capable to interrupt the short-circuit currents with high DC components. Those DC components are the result of the high DC-time constant, which can be generated in networks connected to generators directly. Those circuit breakers will be facing interrupting a larger energy due to a longer current loop. Circuit-breakers are generally tested with DC time constants of 45 ms. If an application requires a higher duty DC-time constant evaluations can be made on basis of the energy consumption of the last current loop whether the circuit breaker can successfully interrupt the current with different parameters. This paper will describe reasons for high DC time constants and examine the importance of this in circuit breaker selection. The main focus of this paper is evaluation of short-circuit test results in terms of DC-time constant and IEC guidance for circuit breakers selection based on DC-time constant. *Index Terms* — DC-time	Martin Bruha ABB Switzerland

	constant, short-circuit current, circuit breaker, last current loop, arc energy, testing requirement.	
BER-67	**IEC tested CB interrupting capability for networks with high DC time constant** 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.	Ilya Nariyev Fluor Nils Anger Siemens Dieter Saemann Siemens
BER-68	**Using an Integrated Engineering Model to Drive Profitability and Productivity** The tumultuous nature of the global oil market has created a heightened awareness of the delicate balance between supply and demand. This increased risk, as well as tougher operating environments, has squeezed both capital and operating expenses. Given the risk and costs, how do you balance return on invested capital with operations excellence to boost productivity? The answer lies in employing a single set of integrated software tools that can be used throughout the entire lifecycle of an asset—starting with the engineering design through operations, and into optimization. This paper will look at operations in a holistic view, presenting new simulation, training, and optimization technologies that when built on top of the design model will provide greater insight and economic benefits than a segmented view. This integrated view of assets—from wells through to the processing and refining facilities—allows operators to plan, manage, and optimize production. This common interface for field planning, operations decision support, and real-time asset management has shown to reduce costs, maximize profit, and improve operational efficiencies. Several customer references will be used to demonstrate the value of advanced, real-time performance-based software solutions for rigorous asset modeling. Validated results of this implementation vary, but customers report reduced project costs up to 50%, operational cost savings of 5–20 cents per barrel, and increased profitability of 5–10%. Repeatability across the enterprise will also be demonstrated.	Livia Wiley Schneider Electric
BER-69	**DIMA- Method for the integration of modular process units** The reduction of the required effort for integration of a module into a production plant is the fundamental aim of modular plant architectures. An essential prerequisite for efficiency is to shift engineering efforts from the classical site-engineering to the engineering of plant modules. In such a scenario, the engineering of the entire system can be subdivided into two separate engineering phases, namely: a) the module supplier engineers and builds the module and b) the plant engineer uses the modules. This article shall present an architecture that simplifies the integration of modules into production plants and an information model —Module Type Package— for transferring and storing necessary engineering results during module-engineering. The efficient and effective engineering of modular production systems defines requirements concerning two aspects. First, this concerns the automation domain from a technical point of view, and second, it concerns the organizational aspect regarding the engineering workflow. The technical aspect addresses the vertical integration of modules into the Production IT, most often represented by a Process Control System (PCS), to communicate with connected modules. With respect to vertical integration, the Namur Recommendation NE 148 [1] defines two types of modules. Type one refers to a module without a programmable logic controller (PLC). This type can be used to implement simple process functions. For more complex tasks, the second type can be used. Module of this type use a PLC allowing the controlled execution of one or more process functions within the module. These functions will be accessible as services as well as the parameterization of these process functions / services. [1] Namur Recommendation 148: Automation Requirements relating to Modularization of Process Plants, Namur 2013	Ulrich Hempen WAGO Kontakttechnik GmbH & Co. KG Thomas Holm Helmut-Schmidt University Michael Obst Technische Universitat Dresden Thomas Albers WAGO Kontakttechnik GmbH & Co. KG
BER-72	**Upgrading Process Gas Chromatographs at the BP Kinneil Terminal, Grangemouth** This paper will describe the phased upgrade of 24 Multi-Stream, Multi-Component, on-line gas chromatographs at the receiving terminal for the Forties Pipeline System in	Steve Jackson Siemens Industry Allan Bryce

	Grangemouth, Scotland. The paper will cover the overall project aims of densification, enhanced redundancy and additional process knowledge. Re-deployment of the communication system to the new Ethernet type architecture will also be described.	BP North Sea - Midstream Dieter Huller Siemens AG
BER-73	**Reduce total cost of ownership via the integration of intelligent field devices** The paper will cover the benefits and methodology related to the integration of intelligent motor control and field devices into an automation control system using ethernet technology and shared device profiles to reduce the initial integration and total cost of ownership of the system. Automated integration helps suppliers, integrators, EPC`s and end users, to reduce time and costs throughout the lifecycle of the equipment starting with engineering, continuing through commissioning and start-up, and long term operation of the equipment. These improvements are realized due to factory testing, increased accuracy in terms of programming and tagging, improved troubleshooting and many other benefits associated with the approach.	Richard Paes Rockwell Automation Jack Ostrzenski Fluor Canada David Fordney Rockwell Automation Ian Wrigley Rockwell Automation
BER-74	**Power-i A significantly improved approach to explo. protect. by Intrinsic Safety** The type of protection Intrinsic Safety (´i ´) is one of the most important protection concepts for electrical equipment. The main disadvantage is the limitation in the power level to values of below 3 W. Now Power-i technology enables the use of intrinsically safe active power output levels of up to 50 W (for Ex ib IIC) in areas where explosion risks are present. This technology meets the essential safety-relevant requirements and is based on the dynamic recognition and mastering of safety-critical conditions. As this technology also brings about an increase in the active power, new fields of application open up for the type of protection intrinsic safety (´i ´). Power-i allows the replacement of explosion protection methods such as flameproof enclosures ('d'), increased safety ('e') or pressurization ('p') with this intrinsically safe solution. As these other methods are more expensive to implement, their replacement with intrinsic safety would have significant economic advantages, especially in process industries. Since June 2015 this technology is applicable at the international level, based on the Technical Specification IEC TS 60079-39 „Intrinsically safe systems with electronically controlled spark duration limitation" and enables global interoperability among different manufacturers, as well as an easy proof of intrinsic safety.	Udo Gerlach Physikalisch-Technische Bundesanstalt Braunschweig Thomas Uehlken Physikalisch-Technische Bundesanstalt Ulrich Johannsmeyer Physikalisch-Technische Bundesanstalt
BER-75	**Discover and leverage the potential of digitalization in the Process Industry** Industry 4.0 is a future-oriented project led by the German industry and supported by the German Government and the European Community (Horizon2020/ Digital Agenda in the Europe 2020 strategy). To bundle and coordinate the digitalization within relevant Industries, different collaboration platforms and technology initiatives have been established with the main focus on manufacturing industries. However these new opportunities can have a big impact on process industries as well. This paper covers the following aspects of digitalization in the Process Industry: • Challenges in the Process Industry • Opportunities in the Process Industry / Escaping the price trap with digitalization • Best Practice examples of digitalization from other industries • Critical Success Factors of digitalization The paper will be developed / presented in cooperation with the innovative German Company Wittenstein. The Company Wittenstein is a key driver for Industry 4.0 in the German Mittelstand.	Thomas Friedmann Siemens AG Patrik Hug Wittenstein
BER-76	**Safety Instrumented Systems Field Data Feedback - A Decade of Experience** The further development of the safety standards IEC61508 and IEC61511 gives field experience and prior use information much greater focus particulary in the selection of equipment or for the proof of the safety integrity. Since 2002, the NAMUR, an international user association of automation technology in process industries, gathers SIS reliability data based on field experience. The paper describes how this approach is implemented in a multinational company and was improved over the time. Analysis results will be shown, discussed and compared with other industry resources. The tools used as well as the experience gained with will be presented too.	Dirk Hablawetz BASF SE

BER-78	**Challenges of Networking the Smart Oil Field** Gas networks will continue to grow in both size and complexity. Cross-continental pipelines will increase the global transfer of energy, as well as the complexity of metering, monitoring and control systems commonplace in the "Smart Oil Field." In parallel with the developed world's reinvestment in smart oil, the growth of the modular oil field has grown and shows no sign of slowing down. These satellite oil and gas networks compliment large-scale upstream and midstream systems by supporting remote extraction operations. By their very nature, these oil sites were once considered too remote and small to justify capital investment. A migration from closed-source hardwired systems to more open and flexible wireless networks are leading an Age of Oil into and Age of Energy. Here's how.	Thomas Nuth Moxa, Inc.
BER-79	**Digitalized Copper – the comparison of a traditional power and process automation control system set-up vs. an integrated control system using IEC 61850** The safe and reliable supply of electricity for ensuring a continuously running process, and the feedback and data exchange from the one side to the other, is of crucial importance to the Oil & Gas Segment. It is typical that Transformers, HV, MV and LV distribution equipment as well as the wells, field compressor stations and central processing plants with their motors and pumps are physically spread across a large area. Traditionally, ensuring a safe, reliable and continuously running plant, came hand in hand with a large amount of hardwired cabling and the site ending up with two or more automation system for process control and power distribution, with several protocols and interfaces. Although IEC 61850 is well known a standard, it has just recently emerged as and will take further steps in fully enfolding its benefits via the seamless connection of the electrical and the process side. The unification of both power and process automation via one Ethernet Standard enables one centralized and optimized main control system for monitoring and protecting an entire plant. This tutorial compares two model project set-ups – one using the traditional power and process automation approach, the other based on a common IEC 61850 technology – In terms of safety and flexibility, performance and reliability, time and costs.	Laya Sathyadevan ABB Janne Starck ABB Shailesh Chauhan Shell
BER-80	**The importance of NFC tracking system for MV & LV Switchgear** Commissioning, care and maintenance of three-phase electrical switchgear for an efficient and safe operation of the processes, improving record of reliability and performance. Commissioning planning begins in the design stage. It should form a part of the specifications for theequipment purchased and installed, and it must address the electrical and mechanical aspects of the installation. During commissioning careful review of construction's drawings and bills of material for the supplied switchgears will help operation and maintenance issues avoiding conflicts in the field. The test results form a baseline on the initial condition of the equipment. The process should ensure the equipment: • is assembled and connected correctly • has the proper ratings • has devices which are calibrated, and the overall system will perform as designed • the documentation handed over to client is complete and updated All this information along with tracking and monitoring of the maintenance activities performed on the switchgear are of vital use for the costumers. The NFC technology provides one of the best opportunities to monitor the entire lifetime of the switchgears.	Claudio Capritta Skema SpA Elisabetta Cerveglieri Skema SpA
BER-81	**Redundancy communication architectures and the benefits for the O&G industry** IEC 61850 has become a firmly established standard in substation automation. But it is now also more than just an Ethernet-based protocol. With Edition 2, the protocol has expanded into additional power supply areas, because it defines the engineering process, the data and service models, the conformity test, and all the communications functions for substations. This expands the range of applications for protection devices. Multifunction devices are there designed for protecting, automating, measuring, and monitoring high- voltage and medium-voltage networks. The standard enables the use of data from different manufacturers devices. In addition redundant data transmission within the grid is standardized. For realization there are two new Ethernet redundancy	Holger Heine Siemens Milan Petrovic Siemens

protocols – HSR (high-availability seamless redundancy) and PRP (parallel redundancy protocol). These protocols were designed for mission- and time-critical applications in which communication interruptions or delays may not occur. Both protocols comply with the IEC 62439-3 standard for high-availability industrial Ethernet communications networks. HSR and PRP allow the systems to continue operating even in the event of a malfunction: A communication path remains in place between the two protection devices even if a network error occurs. This is important in industries like O&G to prevent system outages.
The article outlines the redundancy architectures and benefits for the O&G industry.

BER-82 **Transformerless Topologies for Medium Voltage Converters**

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The medium voltage adjustable speed drives are a trend for high power applications. The products released in the last decade showed maturity of the technology and brought more confidence to use medium voltage converters in industry applications. Besides high power capability, some segments require optimized footprint for the machines installed inside the plant site. This factor is pushing the development of a branch of new voltage source converters, called *Transformerless* VSDs. These converters bring the possibility to operate the system without phase shift transformers in the connection with the power supply. This paper discusses the well-known topologies applied to medium voltage high power converters, their characteristics, requirements and drawbacks of them. In addition, it is discussed the recent presented topologies applied for transformerless converters, with their challenges and recent developments, pointing a best understand of this new branch of converters. It is also discussed the control, modulation and operation of a low voltage prototype for transformerless adjustable speed drives based on modular multilevel topology.

BER-84 **OLPD Condition Monitoring of Complete Networks in Oil & Gas Facilities**

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This paper provides an overview of the development and case studies from installations of Online Partial Discharge (OLPD) Condition Monitoring (CM) systems for complete MV/HV networks in the Oil & Gas industry. This includes cables, switchgear, motors and generators. OLPD monitoring indicates degradation in electrical insulation and can be used to avert unplanned outages and inform intelligent asset management decisions.
The range and number of assets and geographical spread coupled with problems of restricted access and security present a particular set of challenges for the installation of such systems. PD sensors can be located remotely from the plant monitored (at the switchgear for monitoring of motors) or adjacent to the asset under test (at the machine terminals). The advantages and disadvantages of these two sensors deployment methodologies are made plain, including detailed time and frequency domain observations. It is important for online PD monitoring to separate noise from PD and identify the different types of PD which can be detected. This is achieved by using multiple PD sensors and the monitoring system's signal analysis software.A software architecture solution is presented explaining a client/server system that integrates with a SCADA network whilst maintaining the richness of data required to make diagnostic decisions.

BER-86 **Electrical System Management in Preparation and During Decommissioning. Offshore**

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According to industry body Oil and Gas UK, there are some 475 installations, 10,000 kilometres of pipelines, 15 onshore terminals and 5,000 wells will eventually to be decommissioned in the UK Oil and Gas industry. Brent Delta removal, the first of the iconic Brent platforms, is the biggest North Sea decommissioning project to date. There are another three to follow soon Alpha, Bravo and Charlie. They are all at various stages of their end of field life, from approaching cessation of production (COP) in 2-3 years' time to post COP, plug and abonnement (P&A) and final decommissioning / removal. This paper summarises various aspects when platform is being prepared for decommissioning. Those aspects sometimes may become contradicting to each other. For example, on a maintenance front, power generation / electrical system availability and reliability figures need improvement to support wells plug and abandonment while most downstream electrical distribution components can get those figures lowered. Moving away from hydrocarbon production creates opportunity to revisit hazardous areas classification. Special attention is required for management of electrical safety competences, due to gap creation with experienced personnel

moving on. This is paramount when methods of isolations are developed for redundant equipment. The paper is intended to aid electrical engineers, both design and maintenance, to support assets being prepared for decommissioning.

BER-87

A novel solution for the reliable OLPD monitoring of large VSD-operated HV motor

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Most of the large (>20MW), high voltage (>3.3kV) motors in the oil & gas industry are variable speed drive (VSD) operated. In order to maintain availability of these critical machines, on-line condition monitoring (CM) technology is required. This paper describes a novel solution to making reliable, on- line partial discharge (OLPD) stator winding insulation condition measurements on VSD motors. Tri- band, inductive sensors were used to provide a power frequency synchronization signal alongside the OLPD measurements to produce phase resolved PD (PRPD) patterns at all of the operating frequencies of the VSD.
Monitoring partial activity within the stator windings of VSD motors is often very difficult due to electromagnetic (e/m) interference from the power electronics switching within the VSD. The data acquisition technology in the new solution deploys a 24-channel 'smart' multiplexer with 6-channel synchronous data acquisition and 'pulse precedence' measurements to differentiate between genuine PD pulses and e/m noise pulses (from the VSD power electronics).
The paper concludes with a Case Study from a project in Norway where a 5.9kV, 40MW VSD-operated HV Motor was successfully monitored for OLPD whilst discriminating against the electromagnetic (e/m) switching 'noise' from the VSD's power electronics. These OLPD monitoring results show that only around 1 pulse in 1000 detected by the monitor is a PD pulse, the remaining 999 being noise caused by VSD switching.

BER-89

Different Protection Modes of EX LED Luminaires

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First LED (Light Emitting Diode) was developed in early 1960s and from that moment on, this technology grew exponentially. Today, LED light sources are at the forefront in the EX world representing the state-of-the-art solution in lighting market applied in hazardous locations. For this reason, as often happens when a new technology comes up, a lot of different solutions appear on the market creating confusion among the end users.
The scope of this paper is to highlight the different types of protection used in LED light sources making a complete overview of what is actually present on the market; the paper analyses the different advantages and disadvantages of all type of protection.In particular, this paper aims to identify, and clarify from different points of view, all the Ex protections applied on LED lighting giving the reader a fully comprehensive understanding of the best solution which fits at best users' needs, describing all the advantages and disadvantages of each solution both from technical and economic points of view: indeed the knowledge and the correct use of appropriate LED lighting solutions allow to obtain numerous advantages compared with the use of traditional ones such as a lower power consumption and a higher number of operating hours. Key-Words: Lighting, Luminaires, Energy saving, Luminous efficiency, Thermal dissipation, Potential Explosive Atmospheres, Power LED, Ex, ATEX, IECEx, Mode of protection.

BER-90

MARTIN LINGE world longest Power From Shore Oil&Gas development

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In May 2015, the 161km long Martin Linge submarine cable was successfully energized and tested, setting the world record for the longest High Voltage AC cable.The Martin Linge field development comprises a power from shore system (onshore installation and subsea cable), a platform with a jack up rig and a Floating Storage Offloading unit.
This paper discusses power from shore criteria to consider and select a power from shore concept for Martin Linge field instead of an offshore Gas Turbine power plant which is the current practice in the offshore Oil and Gas industry.Since in a first approach, for such long step-out distance, the choice of power from shore would be to select a DC transmission line, the paper discusses the design and the main technical challenges of this long step-out AC transmission development. Finally, the paper gives feedbacks and lessons learned of this success.

BER-91	**Process data analytics: improving operations and maintenance in the process industry** Compared to other economic sectors, collection and availability of large amounts and variety of data is not a novel situation in the process industry. Still, most owners of these datasets don't exploit them at their full potential and common practice is the focus on a small data subset e.g., the more recently collected data. State of the art industrial process analytics tools rely on a service infrastructure segmented by asset class, i.e. control loops, electrical motors and drives, rotating equipment, utility assets, etc. This infrastructure is able to automatically collect appropriate information from the process and condition monitoring system, to schedule analysis for KPIs (assets Key Performance Indicators) evaluation and to store the obtained results. Such approaches allow detecting a process asset malfunction, implanting the appropriate corrective action and most importantly sustain a level of asset performance by mean of a continuous asset performance tracking. While these solutions are satisfactory from a maintenance perspective, they fail in systematically inform the production team about the impact of asset performance degradation on process runnability and end product quality allowing proper operational decision making. This impact is far from being trivial as nowadays, industrial plants become increasingly complex and the trend to recycle by-products of the production process and to reuse energy increases the number of dependencies between assets in the plant making the task of troubleshooting the running of process control systems more complicated because process disturbances can easily propagate through the plant. Therefore, troubleshooting an abnormal process situation will remain a challenging task for the process operator as long as these large amounts of collected data for each monitored asset are still handled independently from each other. To successfully operate and maintain production plants, a new generation of advanced analytics methodologies must be provided to automate complex and error-prone tasks like the search for the root cause of a plant failure or the first alarm inside an alarm flood sequence. This tutorial will illustrate how combining standard data analysis methods can help detecting unintended deviations from the normal process operation and identifying the root cause of process abnormal behaviors.	Dr. Moncef Chioua ABB Corporate Research Center Heiko Petersen ABB Automation GmbH Dr. Chaojun Xu, ABB Automation GmbH
BER-92	**Impact Profitability and Safety Through Effective Operator Qualification** As operators and personnel switch jobs and/or migrate between various operations, technology holds the key to engaging the next generation of operators. This paper will look at the impact of several training strategies, including Operator Training Simulators (OTS) and 3D Immersive Training Systems (ITS), has on operator effectiveness. It has been prepared as an aggregate of several projects scoped, implemented and rolled out at BP, Shell, DOE, ChevronPhillips, among others. These training methods support the capture and knowledge transfer of best practices, increasing efficiency and reducing costly errors or maintenance. The 10 customer examples show the true effect advanced training simulators have on profitability and safety across an enterprise.	Livia K. Wiley SimSci by Schneider Electric
BER-93	**Specifying Process Gas Chromatographs and Selecting Optimum Design Criteria** Specifying Multi-Stream, Multi-Component, on-line, process gas chromatographs (GC) for the oil & gas/petrochemical/chemical industry is a specialised task that requires much process knowledge. This paper will cover the information required to correctly design the analyser incorporating the sample system, and what should be considered when determining which signals are measured to be transmitted to the advance process control system or quality control system. The paper will also discuss the optimum design criteria for the GC – that is whether to focus on cost, repeatability, speed of response or maintainability.	Harald Mahler Siemens AG
BER-96	**Virtual Commissioning in a virtual environment** Modern process plants are becoming more and more complex with high demands placed on design, engineering and operation. Throughout the life-cycle of process plants there is always the typical conflict involving costs, time and quality. One way of resolving this conflict is to employ simulation technology as it can be used to answer questions relating to engineering and operation earlier and with lower risks. A global online survey reveals deep insides about the current and future use of simulation within the process industries. Today simulation is already an accepted technology to	Mathias Oppelt Siemens

support engineering and operational decision making. Thus today a scattered use across the life-cycle is state of the art, with the four main use cases of *design simulation*, *virtual commissioning*, *operator training* and *optimization*. Simulation often is used by domain experts like automation engineers as supporting technology.
The expectations within the process industry are that simulation will gain major importance over the next years and the target is a continuous use along the life-cycle.Further in future simulation will be used systematically as an integrated part of the normal engineering and operational workflows along the entire plant life-cycle.
For a safe and demand sufficient production the automation system of a production plant is mission critical. Within the *virtual commissioning* the automation software is tested against a virtual plant model. Usually *virtual commissioning* is used as a step at the end of the automation engineering, as proposed by VDI 4499. Benefits of the proposed workflow are that errors can be detected immediately after the implementation and the use of the virtual plant model could be extended to engineering workflows.

BER-98 **Holistic Alarm Management Throughout the Plant Lifecycle**

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Alarm management helps the petroleum and chemical industry to run their production efficiently, and reduces the impact of health, safety and environmental accidents in a preventive manner. The new global standard IEC 62682 "Management of Alarm Systems for the Process Industries" reinforces a more holistic lifecycle approach. Management of Change (MoC) is a central requirement and must be supported both by process automation systems and engineering systems. The EC Seveso III directive explicitly calls for alarm management but contains no specifics on requirements. IEC 62682 defines a common framework and a common language for alarm management. It helps suppliers and operators to gain a clearer understanding of relative obligations and expectations concerning complex projects where multiple organizations are involved and alarm management is often seen as someone else's responsibility or something that can be "bolted-on" during commissioning or subsequent operations. The continuous improvement process, whether applied during the engineering or operations phase is not focused purely on alarm data but also on the processes and resources which have created it. The emphasis on lifecycle reminds us that alarms should not be considered as something that is engineered once and never touched again after commissioning. As business operations, process characteristics and equipment evolve over time, the alarm management system (hardware, software, procedures and people) need to be adapted accordingly. Continuous improvement is important and needs to be adequately supported by the system. Good tools that holistically manage changes throughout the complete lifecycle allow confident implementation of identified improvements. This paper will show how such holistic alarm management can be implement with ABB AlarmInsight.

BER-99 **Cyber Security Standards in Energy Automation Systems**

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The increased interconnectedness and use of standardized communication protocols in energy automation systems ensures efficient operation in smart grid environments. At the same time, this leads to a strong increase in exposure of systems interconnected through highly standardized communication interfaces. This changing threat landscape results in real threats and potentially far-reaching consequences of successful attacks. To address this with appropriate security controls, organizational and process driven measures, cyber security standards and regulation are increasingly pushed by the industry end-users and suppliers, and by governments.
This paper discusses major security threats and gives an overview about existing and upcoming cyber security standards and regulatory frameworks in the energy automation domain. These are structured based on their applicability to and consequences for product vendors, system integrators and operators. Implementation examples for selected security requirements are given.

BER-100 **Automation Security: Innovation Barrier or Technology Enabler**

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Automation security has grown very much in importance in process automation in the last years. Availability and reliability, sustainability and security of investment. These are the core requirements that every application, solution or system needs to fulfil if it is to be successful- ly operated in process industry. Innovation and standards which succeed in IT also drive trends in automation. IT and automation engineering generally are using the same basic technologies. Isolated solutions in production plants are more or less obsolete. For Software as well as for hardware solutions vendors prefer to set up of these developments that are also used successfully in IT.

Almost naturally they base platforms for modern automation systems on modern standard PC's and use technologies such as Windows. Individual systems or components then com- municate with each other via standard IT or network technologies. The innovative strength of transparent and uniform communication platforms is described in headlines such as Cloud Computing Industry 4.0. Instead of vertical or horizontal integration of proprietary systems, the focus in future probably will be on the use of available open communication standards. So Automation Security has to be an integral development and design goal for automation systems. Functions of a standard operating systems should be hardened by additional measures such as password or lifecycle management.
Users, on the other hand, need an adequate degree of competence and know how to identi- fy the limits of different technologies and which framework conditions have to be considered. The meaning of security requirements in automation technology will continue to grow at a quickly. The driving force behind this is the increased integration of all automation technolo- gy in overall business processes.

BER-101 **Hydrocarbon Process, Single and Multi-layer Level Measurement**

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Based on IOGP Report 547 the tuturial aim to
- provide upstream oil and gas industry guidance in the provision of level measurement from an instrumentation perspective
- be in the form of an IOGP format that is publically available not contradict any existing IEC/ISO/API standards, but to provide further clarification on the commonly used technologies used in the context of upstream oil and gas
- make it easier for Product Manufacturer and Asset Owners to deliver level measurement devices proven in use and suitable for specific applications.

Scope
- This RP covers the selection and installation of instruments used for single and multi-layer level measurement that are encountered in upstream hydrocarbon facilities.
- This includes the overall and interface hydrocarbon process level measurement for liquids, recognizing the need to cater for emulsion and foaming issues.
- Excluded from scope: LNG (including Tank Gauging), cryogenic and refrigerated storage, legal metrology (i.e. fiscal or custody transfer) or solid (pellet or sulphur silos, coke chambers, etc.) applications.

BER-102 **Assessing Energy Saving Potential for Electric Motors in Petroleum&Chemical Ind.**

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Despite the global growth on energy demand, its efficient use and consumption have been extremely important objectives and a requirement for sustainability strategies in the petrochemical industries worldwide for various different fields or applications. One of these fields is the use of VSDs in motor applications. This Tutorial attempts to assess the energy efficiency potential associated with the VSDs in motor applications. It also evaluates the fact of such potential asserting values and reliability the way they are described for the industry to guarantee efficiency and savings. In addition, it aims to define the right approach of applying such potential for optimum use.

BER-103 **Magnetic resonance technology: another way of multiphase flow measurement**

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Real-time measurements of multiphase flow in upstream oil and gas industry are getting more and more important for well reservoir management optimization and proper allocation purposes. This type of applications requires a robust, accurate and reliable multiphase flow measurement technology. Compared to existing technologies magnetic resonance technology has multiple advantages (one single measurement principle, measurement performed from outside the pipe with no intruding sensors, full bore design and high sensitivity at high water liquid ratios). This article briefly describes the principles of magnetic resonance as well as its application to a multiphase flowmeter. The industrialized magnetic resonance flowmeter has been extensively tested at various flow laboratories. A field test has been carried out at a real oil production location. The experience that has been gained as well as the lessons learned will be addressed in this paper.

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