Virtual Centennial Session

REGISTER

cigre For power system expertise

Summary of Tutorials – Edition 3, 28 July

SC	Tutorial	Time (CEST)	Presenter(s)	Presenters' email address	Abstract
A1	**Impact of Cycling on Large Electrical Motors**	**1200 – 1400 Wednesday 18 August**	**John Doyle**	john.doyle6@esbi.ie	Market conditions require power plants to operate frequently in cycling mode with frequent starting and stopping. Reliable operation of large electrical motors in this more arduous environment is crucial to success of the plant. Based on the work of WG A1.54, the tutorial will discuss the effects on the motors of cycling operation and will make recommendations for design, manufacture, installation and operation of motors and auxiliary equipment such as starting equipment and condition monitoring and protection equipment.
A2	**On-Site Assembly, On-Site Rebuild, and On-Site High Voltage Testing of Power Transformers**	**1200 – 1400 Thursday 19 August**	**Yukiyasu Shirasaka**	yukiyasu.shirasaka.xt@hitachi.com	The aim of the working group was to address the new challenges presented by on-site assembly, onsite rebuild, and on-site high voltage testing. The following topics will be presented: Survey of international experience and best practice with on-site assembly, on-site rebuild, and on-site high voltage testing. Applications and case studies for on-site assembly. Should also include alternatives, e.g. 2x3-phase transformers in parallel or 3x1-ph transformers to reduce mass and dimensions. Design and construction issues, mainly for on-site assembly. Dis-assembly and re-assembly issues, mainly for on-site assembly but also on-site rebuild. Scope of works test etc., mainly for site-assembly. Applications and case studies for on-site high voltage testing. Should also include limits of what is possible with currently available technology. Any additional requirements for pre-commissioning and trial operation.
A3	**State of the art of DC circuit breakers in T&D**	**1400 – 1600 Thursday 19 August**	**Christian Heinrich** **Junzheng Cao**	christian.heinrich@siemens.com caojunzheng@sgepri.sgcc.com.cn	This tutorial consists of two parts. The first part covers HV DC applications. The presentation starts with the introduction of the basic topologies and main parameters for DC CB for HVDC. This is followed by the descriptions of the modeling requirements of HVDC Circuit Breakers and HVDC System in order to define to the electrical stresses applied to the circuit breakers during operations System parameters that have significant impacts on functional requirements of circuit breakers are specified. Recommended type test items and circuits for circuit breaker current interruption tests are then presented. Commercial installation of DC CBs in multi-terminal VSC-HVDC systems are briefly explained together with the on-site performance tests executed. The second part covers MV DC application. The presentation gives an overview of existing and potential applications. Several projects in planning or realization will be shown. Beside of the DC CB other switches are required and their function will be explained. Many aspects are common to HV DC CB but some differences require attention. MV DC is a new area and no product standards exist yet. Some tests have been performed in various test labs or at universities. The learnings from these tests will be shared and serve as basis for standardization teams.

Virtual Centennial Session

REGISTER

cigre For power system expertise

Summary of Tutorials – Edition 3, 28 July

SC	Tutorial	Time (CEST)	Presenter(s)	Presenters' email address	Abstract
B1	**Installation of HV / EHV cable links**	**1400 – 1600 Friday 27 August**	**Søren Olsen** **Sergio Chinosi**	skrol@orsted.dk Sergio.Chinosi@prysmiangroup.com	There are many aspects of installation of HV and EHV cables that may determine the success and the correct operation of a power link. Work performed by Working Groups B1.45, B1.61 and B1.65 will be the bases of this tutorial, that would guide across design and practices of installation works for both land and submarine cables. The construction of a cable link would cover the following topics: design calculations including both rating and system calculations, cable and accessories design, installation design, laying techniques, external aspects and relevant factors. The Tutorial will focus in particular on comparison of installation methods, calculation of design parameters for cable installation, trench-less installation methods (such as Horizontal Directional Drilling, Micro tunneling/Pipe jacking, Ploughing), handling of UneXploded Ordinance (UXO), route surveys, protection methods, monitoring of installation parameters, performance of soil and backfill.
B2	**State of the art on sustainability of overhead line conductors and fittings – conductor condition assessment**	**1200 – 1400 Wednesday 25 August**	**Cécile Rozé**	cecile.roze@rte-france.com	Many overhead lines throughout the world are nearing or have gone beyond their expected life. Since the conductors (including their installation) represent a high part of the cost of the line, their condition is often dominant in the decision to replace the line or extend its life after evaluating if they are degraded. The interaction between conductors and fittings must also be considered since they are part of the same system. State of the art on degradation mechanisms, tools for appreciation of ageing and maintenance practices is the first step required before working on replacement decisions and/or any measure of prolongation recommendations. This first step is the topic of the tutorial.
B3	**Management of Risk in Substations**	**1400 – 1600 Tuesday 24 August**	**Gérald BUCHS**	gerald.buchs@bouygues-es.com	The management of risk has become an increasingly important concern at the corporate level in recent years. Attitudes in society have often changed since the creation of the original installation. Continuity and high quality of supply are all demanded and expected in this more technological age. Circumstances surrounding the original installations probably will have changed; infrastructure in the substation locality may affect the implementation of future works, not envisaged at the time of the original installation. Consideration of safety, not deemed necessary in the past, are mandatory in today's society. The objective of the established WG B3.38 was to investigate the risk management approach and the experiences of utilities associated with the management of risks in substations. The working group reviewed the feedback and experience from utilities in terms of Operation, Maintenance and Dis-mantling with a focus on extension and modification of existing substations. This Tutorial provides what is commonly referred to as Enterprise Risk Management (ERM) and is provided as a guide and a tool for businesses of all types to assist in managing the risks of impacts associated with their business activities.

Virtual Centennial Session

REGISTER

cigre For power system expertise

Summary of Tutorials – Edition 3, 28 July

SC	Tutorial	Time (CEST)	Presenter(s)	Presenters' email address	Abstract
B4	**HVDC harmonics – topical and emerging issues for AC and DC sides**	**1200 – 1400 Thursday 26 August**	**Dr. Nigel Shore** **Dr. Mats Larsson**	nigel.shore@hitachi-powergrids.com mats.larsson@hitachi-powergrids.com	**Part 1 – DC Side Harmonics and Filtering** ***Dr. Nigel Shore – "HV(not quite)DC - DC Side Harmonics and Filtering"*** *Hitachi ABB Power Grids, HVDC* This tutorial will present the new Technical Brochure 811 on the subject of DC side harmonics in HVDC. It is a comprehensive treatment of the subject, covering line-commutated and voltage-source technologies. Some parts serve as a lasting compendium of knowledge concerning DC filtering for LCC projects, as expertise in this area is diminishing. Other sections deal with issues which are of vital current interest for the many VSC projects being planned and for the refurbishment of existing LCC schemes. The presentation will focus on these aspects. These include – interference from VSC cable transmission, harmonic issues for DC grids, harmonics in hybrid VSC-LCC schemes, interaction with parallel AC lines in the same transmission corridor, and reduction or elimination of DC filters during LCC station refurbishments. **Part 2: Harmonic stability and converter interoperability** ***Dr. Mats Larsson – Harmonic stability and converter interoperability.*** *Senior Principal Scientist, Power Grids Research, ABB Power Grids Switzerland Ltd* Harmonic stability is an emerging topic in the design and engineering of converter based power systems, e.g. offshore grids formed by HVDC stations which are fed by a large number of wind converters Experience has shown that there is a potential for interaction both between the control systems of converters, that can potentially cause large harmonic disturbances far greater than predicted by classical harmonic analysis techniques. The tutorial will explain the basic mechanisms behind those interactions and their stability and give a brief review of state-of-the-art analysis methods, supported by illustrations using simple equivalent systems. Furthermore, new screening techniques for large system studies and how the analysis tools can be used to optimize control and grid analysis will be discussed. Harmonic stability is an emerging topic in the design and engineering of converter based power systems, e.g. offshore grids formed by HVDC stations which are fed by a large number of wind converters Experience has shown that there is a potential for interaction both between the control systems of converters, that can potentially cause large harmonic disturbances far greater than predicted by classical harmonic analysis techniques. The tutorial will explain the basic mechanisms behind those interactions and their stability and give a brief review of state-of-the-art analysis methods, supported by illustrations using simple equivalent systems. Furthermore, new screening techniques for large system studies and how the analysis tools can be used to optimize control and grid analysis will be discussed.

Virtual Centennial Session

REGISTER

cigre For power system expertise

Summary of Tutorials – Edition 3, 28 July

SC	Tutorial	Time (CEST)	Presenter(s)	Presenters' email address	Abstract
B5	**Protection, Automation and Control of the Evolving Grid**	**1400 – 1600 Thursday 26 August**	**Nirmal Nair,** **Alex Apostolov,** **Klaus-Peter Brand**	n.nair@auckland.ac.nz alex.apostolov@omicronenergy.com klaus-peter.brand@it4power.com	Electric power grids around the world are evolving from centralized synchronous generation-based systems towards distributed renewable generation and storage based systems. This is often associated with the use of grid-connected inverters presenting significant challenges to the traditional protection, automation and control (PAC) practices and solutions. In addition, renewable generation like in large wind parks or hydro power plants may profit from bulk power transport over HVDC transmission lines or future grids. The first part analyzes the characteristics of the evolving grid and the issues related to traditional PAC solutions. These characteristics include low levels of short circuit current, low inertia of the system during disturbances, varying output of the energy resources, and the increased meshing of the grid also at distribution level same as at transmission level. The first part analyzes the characteristics of the evolving grid and the issues related to traditional PAC solutions. These characteristics include low levels of short circuit current, low inertia of the system during disturbances, varying output of the energy resources, and the increased meshing of the grid also at distribution level same as at transmission level. The second part analyzes the functional and technical evolution in PAC systems that may help addressing the challenges of the evolving grid. The digitization of functions and communication in substations and everywhere in power system allow a variety of PAC system architectures – distributed, centralized or hybrid – tailored best for any emerging requirements in the evolving grid. Traveling waves based protection and different communication based schemes at the transmission and distribution level are examples discussed. The last part discusses the efforts how to make these evolving PAC system future-proof, i.e. how to safe-guard the investments of the owners. This may be possible by using the object-oriented approach for standardization focused on universal semantical definitions providing interoperability between IEDs inside the substation and in all other domains of the Evolving Smart Grid and offering also options for exploiting e.g. Big Data or IoT.

Virtual Centennial Session

REGISTER

cigre For power system expertise

Summary of Tutorials – Edition 3, 28 July

SC	Tutorial	Time (CEST)	Presenter(s)	Presenters' email address	Abstract
C1	**Development of a power system that mitigates climate change and is adapted to the change that we can't avoid**	**1400 – 1600 Friday 20 August**	**Keith Bell and others**	keith.bell@strath.ac.uk	This tutorial will focus on system development challenges in enabling transformation of an electricity to mitigate climate change, and in the system being well-adapted to changes to climate that are already happening. 1. Existing unabated fossil fuelled generation will need to close and new, low carbon sources of power accommodated while still meeting reliability of supply expectations. This will lead to potentially radically different power flows, but, ahead of time, the precise flows arising from changes to the generation background and demand are highly uncertain. However, network constraints should not stand in the way of emissions reduction. How can the need for network investment be identified and progressed in a timely manner? Outputs from C1 Working Groups concerned with scenario formation, decision making under uncertainty and policy engagement will be presented. Adaptation. Even the goals set by the Paris climate conference in 2015 to limit global temperature rise above pre-industrial levels to significantly below 2°C will bring about significant changes to the climate across the world, with increased ambient temperatures, increased frequency and severity of storms, fire hazards, and risks of flooding. These events are now sometimes being seen, but the extent of the hazard is often unclear. Drawing on expertise from a number of Study Committees, this section of the tutorial will address the following questions: in what ways should existing power systems and new investments in them be adapted for the changing climate? How can emerging principles on power system resilience inform priorities? How can investments to deal with high impact, low probability events be shown to regulators to be in electricity users' long-term best interests?
C2	**Operating strategies and preparedness for system operational resilience**	**1400 – 1600 Wednesday 25 August**	**Jens Jacobs, Chandan Kumar, Paulo Gomes, Dean Sharafi, Jochen Cremer**	jens.jacobs@amprion.net chandan@posoco.in pglinha@gmail.com Dean.Sharafi@aemo.com.au j.cremer16@imperial.ac.uk	Power systems have changed faster than ever in the last two decades. They are now increasingly accommodating new types of resources in their generation mix which are inverter-based and behave very differently from conventional generators during system contingencies. On the other hand, climate change has caused environmental impacts that are more severe and more frequent than before. These two phenomenon have created unprecedented vulnerability for power systems to High Impact Low Frequency (HILF) events. Disturbances caused by natural phenomena such as hurricanes, earthquakes, etc. have gained the focus of the industry to create measures and processes in order to enhance the resilience of power systems to these events. In addition to natural events, cyber- attacks and man-made threats are now more impactful than before due to increased digitisation and dependency of modern power systems to Information Technology and Operational Technology, which uses internet as a platform for daily operation of the power system. CIGRE C2.25 Working Group's focus has been on operating strategies and preparedness for system operational resilience. The role of system operation is classified into power system resilience. For this objective, the WG prepared two surveys and assessed the responses of the respondents to the difference in understanding of resilience and reliability, the degree to which relevant HILF events have happened in different parts of the world and the operational resilience strategies that have been used to measure and manage these situations. Furthermore, improvements in the operational resilience have been the subject of questions in the surveys.

Virtual Centennial Session

REGISTER

cigre For power system expertise

Summary of Tutorials – Edition 3, 28 July

SC	Tutorial	Time (CEST)	Presenter(s)	Presenters' email address	Abstract
C4	**Challenges with series compensation applications; the case of overcompensated lines**	**1200 – 1400 Friday 27 August**	**Liisa Haarla**	Liisa.Haarla@fingrid.fi	Series compensation is a cost-efficient way to decrease the line reactance and improve the system stability and increase the power transfer capacity for long transmission lines. Traditionally, the maximum degree of compensation has been around 80 %. When a new substation, for example due to connecting renewable generation, is installed along an existing series compensated transmission line, the result can be an overcompensated line, i.e. a line, which has an effective series reactance that becomes capacitive. An overcompensated 400 kV line known to exist between Sweden and Finland but generally there is a lack of literature on the subject matter. This tutorial focuses on the impacts of overcompensation on the following issues: • Steady-state voltage levels and voltage fluctuations that may affect the selection of basic insulation levels; • Stability and dynamic voltages; • Abnormal voltages during grid faults including transient overvoltages; • Transient recovery voltages of circuit breakers; • Ferroresonance; • Subsynchronous resonance and • Protection challenges and strategies. The tutorial focuses on the issues and conclusions related to the above and will present the finding of JWG C4/B4.31 in detail.
C5	**Application of Blockchain to Electricity Markets (TBC)**	**1200 – 1400 Friday 20 August**	**David Bowker**	dgbowker@gmail.com	The workshop will present the findings of the recently completed Working Group C5-30, which examined markets and blockchain and also early work from the follow up Working Group C5-33. The tutorial will also draw on the two workshops presented in 2020.

Virtual Centennial Session

REGISTER

cigre For power system expertise

Summary of Tutorials – Edition 3, 28 July

SC	Tutorial	Time (CEST)	Presenter(s)	Presenters' email address	Abstract
C6	**Rural electrification**	**1200 – 1400 Monday 23 August**	**Kurt Dedekind** **Jacqui Mills** **Michael Ross** **Debajit Palit** (These may change pending availability to present at these timeslots)	dedekivk@eskom.co.za Jacqui.Mills@aemo.com.au mross@yukonu.ca debajitp@teri.res.in	The tutorial provides an overview of grid-tied and off-grid electrification solutions for rural areas. It not only covers the technical aspects, but also provides a synopsis of regulations, markets and business ownership models that may be considered for rural communities.
C6	**Multi-energy system interactions in distribution grids**	**1200 – 1400 Tuesday 24 August**	**Birgitte Bak-Jensen**	bbj@et.aau.dk	Multi-energy systems are integrated schemes from different energy vectors, sectors and networks such as electricity, gas, heating, cooling, transport, etc. These systems are key to generating new types of energy flexibility as well as techno-economic and environmental opportunities for reliable operation and least-cost planning of future smart electricity grids. There is a significant potential to be exploited from the synergies between the electricity grids and different sectors of energy. It is therefore essential to understand the close interaction at the energy level between the electricity and other energy sector technologies, infrastructures and functions in order to develop smarter electricity networks and communities. The tutorial will present the findings of WG C6/C1.33 that studied the configurations, impacts and prospects of multi-energy systems that enable enhanced solutions for intelligent electricity systems, energy storages and demand side management in the electricity grids with an increasing share of distributed energy resources (DER).

Virtual Centennial Session

REGISTER

cigre For power system expertise

Summary of Tutorials – Edition 3, 28 July

SC	Tutorial	Time (CEST)	Presenter(s)	Presenters' email address	Abstract
D1	**Dielectric Testing of Gas-Insulated HVDC Systems**	**1400 – 1600 Monday 23 August**	**Claus Neumann**	neumann.claus@t-online.de	Due to the growing demand for DC transmission systems there is also a particular interest in gas-insulated HVDC systems. As no standard for dielectric testing was currently in place, JWG D1/B3.57 was created to develop testing procedures. After consideration and discussion of the relevant phenomena adequate testing should be established to prove the capability of the gas-insulated HVDC system to be able to withstand these phenomena. The Tutorial will first consider the basic phenomena in gas-insulated HVDC systems under DC and overvoltage stress. Subsequently, the general test methods to withstand these stresses are dealt with. Among others the insulation system test is described which shall demonstrate a satisfactory electrical performance of the insulation system consisting of surface charged DC-insulators in the gas-insulated environment. Furthermore, adequate PD testing is considered to prove the efficiency of mitigation measures for improving insulation performance against metallic particles. All tests are summarized in "Recommendations for dielectric testing of gas-insulated HVDC systems". Finally, to give guidance to the user, test equipment and test procedures based on testing experience will be presented with special regard to testing with superimposed impulse voltages and prototype installation tests.
D2	**Enabling Future Transmission and Distribution Interoperability with Enhanced Information and Data Exchange**	**1400 – 1600 Wednesday 18 August**	**Gareth TAYLOR**	Gareth.Taylor@brunel.ac.uk	The proposed tutorial will identify enhanced information and data exchange processes as required for future Transmission and Distribution system interoperability with regard to formally defined business and use cases as based on IEC 62559 standard and the Common Information Model (CIM) as defined in the IEC 61970/61968/62325 standard series; Explain developments of novel information systems and data exchange to support integrated modelling procedures to enhance whole system modelling and analysis, thereby providing the appropriate level of modelling accuracy required for fully coordinated operational planning; Introduce innovative designs for secure, scalable and standardised information systems and data exchange platforms to enable enhanced Transmission and Distribution system interoperability.