



## TECHNICAL PROGRAM (Draft 31<sup>st</sup> December 2024)

The theme for the CIGRE Trondheim Symposium is **CHANGES NEEDED IN THE POWER SYSTEM for the Energy Transition**. The aim is to provide a forum for recent research results, planning and system operations experience related to the changes the power system is undergoing because of the energy transition.

The symposium is organized and supported by eleven CIGRE Study Committees: **SC A3** Transmission and distribution equipment, **SC B1** Insulated cables (*co-lead*), **SC B2** Overhead lines, **SC B3** Substations and electrical installations, **SC B4** DC systems and power electronics, **SC B5** Protection and automation, **SC C2** Power system operation and control, **SC C3** Power system sustainability and environmental performance, **SC C4** Power system technical performance (*co-lead*), **SC C6** Active distribution systems and distributed energy resources, **SC D2** Information systems telecommunications and cybersecurity.

The theme is divided into two topic streams:

### **PS1: Integration of renewable energy resources to the grid**

- Environmentally friendly power grid and its equipment
- New applications and technologies applied to AC and DC onshore and offshore grid
- AC and DC onshore and offshore grid
- AC grid development, protection of the future meshed AC and DC system
- Sector integration including hydrogen, EV, energy hubs, DER
- Services/operation applied to AC and DC onshore and offshore grid
- Monitoring the system applied to AC and DC onshore and offshore grid
- Maintenance and Services applied to AC and DC onshore and offshore grid

### **PS2: Technologies supporting the power grid for energy transition to carbon neutral energy production**

- Requirements for power grid and its equipment
- Inverter based control interacting with existing system and Converter stability issues (resonance stability, converter driven stability)
- Coordination between AC and DC networks
- Grid forming
- Multivendor interoperability
- New modelling tools
- Planning and operation of lower inertia system
- System analysis (technical)
- Black start and resilience aspects including DER integration
- Optimize and increase the capacity of the energy transmission network
- Reliability and security – critical infrastructure

This technical program covers the public sessions available to delegates to the CIGRE Trondheim International Symposium May 12–15, 2025. There are many other meetings taking place of Working Groups and Study Committees. Members of these groups will be issued a detailed program.

**Note: Titles of some of the Sessions are yet to be finalized and will be updated in future program updates.** Current Symposium paper topics are listed at the back of the program.



**Monday 12th of May : Tutorials & Workshops**

Time	Room 1	Room 2	Room 3	Room 4
08:00	<b>B2 Tutorial:</b> Forecasting Dynamic Line Ratings (WG B2.59)	<b>C4 Tutorial:</b> IBR and DER modelling and analysis	<b>C2 Tutorial:</b> The impact of offshore wind power hybrid AC/DC connections on system operations and system design (JWG C2/B4.43)	<b>D2 Tutorial</b> (to be confirmed)
10:00	<b>Coffee break</b>			
10:30	<b>B5 Tutorial:</b> Protection and Metering Advancements in the Evolving Power System (WG B5.57 & WG B5.76)	<b>C4 Tutorial:</b> Review of Phasor Measurement Unit Applications (JWG C4/C2.62/IEEE)	<b>B4 Tutorial:</b> WG B4.85 Interoperability in HVDC systems based on partially open-source software.	<b>A3/B5 Tutorial:</b> Evolution of Instrument Transformers and interaction with secondary equipment (e.g. Protection relays)
12:30	<b>Lunch</b>			
13:30	<b>B1 Tutorial:</b> Maintenance of HV cable systems TB 912	<b>B3 Tutorial:</b> Review of substation busbar component reliability (TB 930 WG B3.49)	<b>B4 Workshop:</b> InterOPERA project	<b>A3 Workshop:</b> Digitalization of information for T&D Equipment
15:30	<b>Coffee break</b>			
16:00	<b>C3 Tutorial:</b> Best environmental and socio-economic practices for improving public acceptance of high voltage substations.	<b>C6 Workshop:</b> DSO tools and practices for operating Active Distribution Networks	<b>B4 Workshop:</b> HVDC-WISE project	Tutorial (to be confirmed)
18:00	<b>Welcome reception</b>			



## Tuesday 13th of May: Technical Paper Sessions (i)

Time	Room 1	Room 2	Room 3	Room 4	Room 5
08:00	Opening Session				
09:30	Coffee break				
10:30	SC A3 (1)	SC B5 (1)	SC B4 (1)	SC C4 (1)	SC C6 (1)
12:30	Lunch				
13:30	SC A3 (2)	SC B5 (2)	SC B4 (2)	SC C4 (2)	SC C6 (2)
15:30	Coffee break				
16:00	SC C3 (1)	SC B5 (3)	SC B4 (3)	Joint SC C2/C4	SC C6 (3)
20:00	GALA DINNER				

## Wednesday 14th of May: Technical Paper Sessions (ii)

Time	Room 1	Room 2	Room 3	Room 4	Room 5
08:00	SC B2 (1)	SC B1 (1)	SC C2 (1)	SC C4 (3)	SC D2 (1)
10:00	Coffee break				
10:30	SC B2 (2)	SC B1 (2)	SC C2 (2)	SC C4 (4)	SC D2 (2)
12:30	Lunch				
13:30	SC B3 (1)	SC B1 (3)	SC C2 (3)	SC C4 (5)	SC D2 (3)
15:30	Coffee break				
16:00	SC B3 (2)	SC C3 (2)	SC C2 (4)	Joint SC B4/C4	SC D2 (4)
18:00	Closing				



## Thursday 15th of May: Technical Tour

Details to be announced



## **DRAFT Listing of Accepted Papers as at 31<sup>st</sup> December 2024**

*Note: this is a draft based on the currently accepted Synopses, whilst it is expected that these will be finalised as papers, due to several reasons some Synopses may not be able to progress to paper/presentation at the Symposium.*

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### **Study Committee A3 Transmission and distribution equipment**

Devices for switching, interrupting, or limiting currents including circuit breakers, load switches, re-closers, ring-main units disconnectors, earthing switches and fault current limiters wherever installed. Surge arresters, capacitors, busbar and equipment insulators, instrument transformers, bushings, and all other equipment within the substation not specifically covered under another equipment study committee's scopes.

- Traceability establishment for third harmonic leakage current measurement in surge arrester tester as per SI unit.
- Application of BS EN 1991-1-4 for Specification of Substation Equipment on Severe Wind Speed Locations.
- Long-term transient signal monitoring at inductive load switching with VCB – objectives and first experiences.
- Holistic operation and condition assessment enabling efficient usage of equipment.
- Experience and considerations in the development of C4F7N-based 420 kV, 63 kA, 60 Hz HVCB using grading capacitors and pre-insertion resistors.
- CIGRE fourth reliability survey on equipment.
- Combined Power Voltage Transformers – a Novel Product Category.
- C4FN mixtures solutions for metal-enclosed switchgear to speed up transition to carbon neutral.
- LCA for AIS /GIS Substations at Axpo Grid and the role of DSO/TSO to become carbon neutral.
- Quantifying global power transformer demand and supply for grid expansion.
- Investigation of gas mixtures with GWP < 1 in HVCB development and impact on design choices.
- Evaluation of arc clearing performance for a high voltage circuit breaker using a gas mixture with GWP < 1 for isolation and interruption.
- Impact of high-powered charging of electric ferries on distribution transformers.
- Impact factors on carbon footprint for SF<sub>6</sub> free GIS.
- Environmentally sustainable Green Circuit Breakers (SF<sub>6</sub> Free).
- Estimating the European circuit breaker population towards 2050.
- New component designs and technologies to maximize grid resilience and system lifetime.



- High Voltage Circuit Breaker Condition Monitoring Experimental Setup using Hardware-in-the-Loop.

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### **Study Committee B1 – Insulated cables**

AC and DC insulated power cable systems for power transmission, distribution and generation connections on land and in submarine applications. Power cable systems associated with microgrids and the integration of distributed resources.

- High voltage wet design power cables with aluminum conductor.
- survey of test methods and measurement performance to assess arc hazards in cable components.
- Next Generation Integrated Platform for the management of HV assets.
- Compression and bending test on a three-core HV submarine cable with SZ lay-up.
- Lifetime Estimation based on HVDC Breakdown Strength of Thin Films Peeled from Fresh and PQ-Tested 525 kV DC-XLPE Cables.
- Behaviour of Underground Cable Systems under Large Disturbances.
- "Heritage Meets Innovation: Varanasi's Power Transformation".
- Advanced Pre-Terminated Dynamic Submarine Cables for Floating Offshore Wind Energy.
- Predicting cables temperatures with probabilistic modelling.
- Active Monitoring of cable temperature to facilitate overplanting.
- Vortex Induced Vibrations (VIV) of an Export Subsea Power Cable: A Holistic Approach.
- Dynamic Profile Selection for Mitigating Dielectric Stresses in Bipolar HVDC MIND Cables.
- Breakdown field under different temporary overvoltages (TOVs) in XLPE HVDC cable insulation.
- DAS for ultra-long submarine interconnectors and cables.
- Seabed interference monitoring on power cables using DAS.
- Thermomechanical Modelling of Cables in Flexible Installations.
- Installation of underground cables through peatland and challenging terrain to support decarbonisation of a remote Scottish Island.
- Cable Monitoring Framework at the Edge with Distributed Acoustic Sensing: the Elia Modular Offshore Grid Cables Use Case.
- Real-Time Electric Fault Pinpointing on Power Cables.
- Experiences from transient overvoltage testing, considerations on standardization.
- Evaluation of PD commissioning tests for Dutch (E)HV land cable systems.
- Fault current characteristics of VSC-HVDC cable systems for earthing design purposes at the cable joint bays.
- Impact of MVDC cables on the energy transition.



- Transient Effects of DC Fault Current Interruption on HVDC Cable Performance in Multiterminal Network.
- Monitoring the shape of a subsea dynamic cable from the floater continuously in time and space.
- Novel Anomaly Detection Machine Learning Based Model for Real-Time Monitoring of Transmission Cables Using DTS.
- Experimental validation of wave propagation characteristics in EHV cables.
- Improving the reliability of MV cable networks by implementation Condition Based Maintenance.

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### **Study Committee B2 – Overhead lines**

- Ice monitoring of OHLs – a methodology for critical span analysis.
- 60 Days of Excellence: Balancing Speed, Sustainability, and Success in the Neemuch-Mandsaur Transmission Line Project".
- Adaption of Electric Tower Ascender Equipment for Transmission Line Construction Work.
- Wind-induced conductor motion on a long fjord crossing – Preliminary results from a novel measurement approach.
- Study on Seismic Control Retrofit of Power Transmission Tower by Pantograph Damper.
- Development of multi-function conductor.
- Conductor Optimization for +/-350kV HVDC Transmission system for evacuation of 13 GW of RE power from renewable energy parks in Ladakh, India.
- Evaluation of Stresses in Critical Members of Transmission Line Towers During Prototype Testing Using Wired and Wireless Strain Gauges.
- Parallel Giants: The Twin Steel Monopoles in Heart of National Capital Region.
- From Weakness to Strength - Innovating Soil Strength and Corrosion Solutions for Renewable Energy infrastructure in creek salt pan area.
- A Water Balance-Based Model for Simulating In-Cloud Icing on Overhead Lines.
- Features of the implementation of a neural network-based computer vision system to improve the reliability of overhead power lines.
- Tackling Overhead Transmission Line Grounding System Challenges through Introduction of Mechanisms for Enhanced Grounding Management and Maintenance Processes.
- Navigating the Energy Transition: A Comparative Study of Aging Power Grids in India and the USA.
- Use of Monopole & Ultra Narrow base Towers in High ROW area.
- Advance Design Solution for Transmission Tower Foundations on Steep Slopes.





- Innovative Monitoring Systems for High Voltage Power Lines: Laser Sag Meter and Electric Line Ice Sag Accretion monitor.
- Overhead Line modelling: A Neural Network Approach for Enhanced Grid Resilience.
- Optimizing Overhead Line Maintenance: Splice and Connector Strategies.
- Survey of residual performance of conductors, fittings, tower components and insulators after removal of 220 kV long span overhead line across the Straits.
- Influence of Broken Wire on Multistrand Core.

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### **Study Committee B3 – Substations and electrical installations**

The design, construction, maintenance and ongoing management of substations and electrical installation in power stations excluding generators. Serves a broad range of target groups in the Electric Power Industry including the technical, economic, environmental and social aspects of this study area.

- Substation Auxiliary Power Systems - A New Approach to Supply Selection.
- Fiber Optic-based Acoustic Emission Sensing Technology to Online Detect, Monitor, and Localize Partial Discharge in 400kV Cable Terminations.
- Mapping atmospheric corrosivity in Scotland using modern meteorological and aerosol deposition data to aid in asset management practices and substation design.
- Conceptual Design of A Tension-leg Platform (TLP) Floating Offshore Substation Solution.
- Assessment of Structural Robustness for modern Gas-Insulated Switchgear in Offshore Substations.
- Installation, testing and commissioning of Optical Fiber Network within GI conduit/pipe to mitigate rodent induced vulnerabilities.
- Design considerations of floating offshore substations for renewables.
- Design and Qualification of Floating Offshore Wind Substations: Insights and Challenges.
- ENHANCING RELIABILITY AND SECURITY OF STRUCTURES USING VIBRO STONE COLUMN NETWORK TO MITIGATE LIQUEFACTION.
- Advancing the Economic Viability of Floating Offshore Wind through Subsea Substations.
- ONLINE NOISELESS ACOUSTIC DISCHARGE DETECTION IN INSULATION OF HV EQUIPMENT.
- Enhancing Reliability of Floating HVDC Substations through Monitoring and Inspections.
- A pioneer approach towards installation of Grid Scale STATCOM enhancing reliability and Security of Renewable Energy network.





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## **Study Committee B4 – DC systems and power electronics**

- Small signal analysis of grid-forming control properties
- Frequency-domain small-signal stability analysis of bipolar MMC-based HVDC grids
- Techno-economic analysis of a MVDC network connecting several DC resources to a transmission network
- From average to simplified detailed models of a branch of energy storage submodules to integrate energy storage in HVDC system
- Review of (co-)design methods for HVDC protection systems
- An Economical DC-Hub System for Large Scale Renewable Energy Integration in CHINA
- Influence of MMC control philosophies on Multi-Terminal HVDC Design and Expandability
- DC Grid Control and Communication Architecture of Master Controller
- On operation of renewable source and battery energy storage system integrated to the VSC-based HVDC technology
- Real-Time Verification of Digital Twin VSC Models for Loss Analysis by Calorimetric Measurement
- Tyrrhenian Link and Adriatic Link – Harmonized Converter Stations for Italian Underwater HVDC Connections
- Impact of Optimisation Model Simplifications on Offshore Transmission Infrastructure Needs
- Operating point dependent DC-FRT requirements in partially-selective MTDC protection - North Sea Wind Power Hub pre-FEED study
- Trends on Hardware Independent Design and Testing of HVDC Control and Protection Systems
- DC fault identification in HVDC grids using machine learning algorithms
- HVDC control system strategy for scalable simultaneously enabled LFSM/FSM controllers
- Factory system test program of LFSM/FSM controllers for an HVDC link
- Principle, Design and Electrical Testing of DC Chopper for the BorWin6 Offshore Wind Farm Integration Project
- Sensitivity Analysis in VSC-Based DC Microgrids
- Readiness of USA for 640kV HVDC, considering the most severe single contingency
- Expandability of DC Grid Control Systems for Offshore Multi-Terminal HVDC Networks – North Sea Wind Power Hub pre-FEED study
- HVDC circuit breaker reliability and availability model
- Methods for DC Fault Clearing in VSC-HVDC Transmission Systems Connected to On-Shore Islanded Renewable Generation



- Analysis of technical requirements on multi-terminal ready HVDC systems
- Basic Considerations - HVDC Circuit Breaker Reactor
- Feasibility Assessment of Offshore Energy Hub Topologies
- Mutual Short-Circuit Coupling of Air-Core Dry-Type Reactors in HVDC schemes
- Assessment of vulnerabilities in the transition to SF6-free coupled onshore and offshore power grids
- Offshore Wind Power Plants and Energy Hub Integration
- Planning and Performance Standards for HVDC Systems: Benchmarking of International Practice and Approach for North America
- Assessment of Grid Forming capabilities of HVDC links with analytical envelopes - Application to HVDC link with grid forming on both sides
- DC-link Overvoltage in Grid Forming HVDC-connected Offshore Wind Power Plants
- Evaluation of different market designs in Multi-Terminal DC grids: the Princess Elisabeth energy island case
- Comparison and standardization of various HVDC line configurations and HVDC topologies
- Managing Generation Uncertainties in the Design of HVDC Converter Stations
- Comparison of Two Grid-Forming Controls with Inversed Droop Controls in MTDC systems
- Application of the Baihetan-Jiangsu Topology in the Brazilian Electric System to Mitigate HVDC AC/DC Interaction Issues
- Optimizing Power Grid Infrastructure for the Energy Transition

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### **Study Committee B5 – Protection and automation**

Power system protection, substation control and automation, remote control systems and equipment, metering systems and equipment.

- Risk Management Optimization for Electric Utilities.
- Successful Testing of commercially-available AI for Protection Relay Setting Calculations.
- Protection Study Results of Blackstart using Synchronous Generators and Battery Energy Storage Systems.
- Transitioning to differential protection for offshore wind collector cables using passive sensing.
- Addressing Transmission Congestion in India's RE-Rich Grid using System Integrity Protection Schemes (SIPS).
- 132 kV power lines - Field tests - High-resistivity ground faults.
- Impact of Inverter-Based Resources on Power System Protection and Coordination in India's Renewable Energy-Rich Grid.



- Relay Protection for Offshore Export Cables, Challenges and Solutions.
- Mitigating Overreaching in Distance Relays and Addressing Mutual Coupling in Double-Circuit Transmission Lines.
- Challenges of converter-connected production for distance relay protection.
- Ongoing comparison of testbenches for the calibration of Stand Alone Merging Units.
- A Reference Implementation of IEC 61850 and 62351 based Generator Curtailment System with Non-Firm connection Agreement.
- Improving the Transmission Line Protection for Systems with High Penetration of IBRs.
- Six-phase line transmission – why do we need it and how do we do it.
- Practical implementation and experience with busbar protection utilizing process bus in existing protection and control system.
- PACS Substation Network Monitor Acceptance Tests.
- Transforming Differential Relay Communication by Several Strategies for Optimal Fiber Utilization and Reliability: Experiences From Recent Pilot Installations.
- Short-circuit Analysis for cable arrays of offshore wind power plants using VCCS and EMT models.
- Process bus and LPIT operational experiences from eight Norwegian digital substations.
- Real-Time Field Implementation of Adaptive Single-Phase Auto-Reclosing for EHV Transmission Lines: Lessons Learned.
- Revitalizing Busbar Protection: A Comprehensive Field Experience Utilizing Failure Modes and Effects Analysis (FMEA) in Large EHV Substations.
- Energy is in transit but what about Line Protection?
- EVOLUTION TO CENTRALIZED PROTECTION & CONTROL.
- Operational Experience of a Major Blackout in Southern Regional Grid of India: Methodologies, Simulation Studies, and Mitigation Techniques for Addressing Under-Frequency Relay Maloperation in the Context of Increasing Renewable Energy Penetration.
- Concept of integrating PACS Project Blueprint design and IEC 61850 Top-Down engineering.
- Development of an IEC 61850 SCD for Supervising a Photovoltaic Plant on a Hydroelectric Reservoir.
- Multivendor Interoperability in a Virtualised Protection and Control System.
- Case study of field testing of relay protection in LPIT environment.

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## **Study Committee C2 – Power system operation and control**

Developments and changes in the business of System Operators to meet the evolving environment. WAMS, WAMPS and WAMPACS and their integration within the control



centre environment. Development and use of power system analysis and security assessment functionalities within operational planning and real-time supervision, supporting system operators.

- 21 GW offshore wind power in Norwegian waters by 2040. System effects of demand elasticity and grid topology.
- A Case Study of Addressing Challenges of Renewable Energy Integration in Thailand.
- Evaluation of DLR for each span of transmission lines using wind condition estimation results - Consideration on the necessity of comprehensive wind condition assessment in DLR.
- Enhancing System Flexibility in Thailand's Power Grid to Accommodate Renewable Energy Integration.
- Robustness indicators for the Nordic power system.
- Experience from the Nordic Market for Balancing Capacity.
- Leveraging Thermal Reserves of HVDC Underground Cables in Curative System Operation.
- Optimal and Coordinated Voltage Control: Case Study on a 132kV Norwegian Grid Subsystem.
- Study on the joint operation optimization of wind-PV-storage hydrogen production system with power grid.
- Automatic Frequency Response Evaluation System.
- Modelling of distributed generation in the EMS/SCADA system.
- Outage planning in a converter dominated grid – A Finnish case study and lessons learned.
- The Distributed Control Centre Design Utilizing New Smart Grid Decision-Making and Control Agents for the Future Zero-Carbon Massive Electrification.
- Analysis of Economic Incentives and Historical Frequency Deviations in the Nordic Power System.
- Evaluation of TATL Potentials Based on Line Loading and Reaction Time.
- Inertia in the Dutch Power Grid: Trends and Implications.
- Virtual multi-camera sky images for regional solar irradiation forecasts.
- Inertia Estimation with Increasing Inverter-based Generation on the Grid.
- A global grid frequency measurement technique for operational planning studies.
- Real-time calculation and visualization of corrective actions for N-1 secured Nordic system operation.
- Transmission Scale Mini-Grid: Navigating challenges of a clean energy future.
- Machine Learning-Based Approach for Estimating of Power System Inertia Using Wide-Area Measurement Systems Data in Vietnam's Power Grid.
- A Comprehensive Solution Framework for Multi-node Optimal Power Generation Planning of Vietnam Power System to resolve Regional Grid Congestion Problem.



- Dynamic Security Assessment (DSA) application in Vietnamese power system to increase the power transfer limit and operate power system stably with a high share of renewable energy sources.
- Power System Inertia - a Call for Conceptual Clarity.
- A New Vision for HVDC Control.
- The Various Constraint Relief Strategies of South Korea's Massive Generation Surplus Areas.
- Manage Grid Uncertainties using Cloud Technologies.
- DYNLAST – Dynamic line rating.
- Optimizing Grid Performance and Risk Management: A Real-Time Dashboard for Efficient and Safe Power Operations.
- Development and Operation of a novel tool for real-time monitoring & intraday forecasting of reactive power demand & reserve in Vietnam power system.
- Strengthening SCADA and EMS Systems for a Sustainable Energy Transition: Experience in Vietnam.
- Solutions for Calculating and Monitoring Minimal Requirements Power/Configuration of Thermal Power Plants on PSS/E Software and Real-Time SCADA/EMS Systems.
- A tool built-in web platform and exchanged data with SCADA/EMS system to verificate post-operation voltage regulation of power plants in an automatical manner.
- Grid Stability Challenges with the Integration of Large Quantum of VRE in Close Proximity in the Indian Power System.
- Development of a Software Program for Capacity Adequacy Assessment in the Indian Power System.
- Integrating Stability Criteria into Power System Scheduling with High Penetration of Converter-Based Generation.
- Implementation approaches for a higher-level control structure of offshore wind farms based on mathematical optimization approaches.
- Voltage Control in Transmission Grids: A Meta-Heuristic Approach with Genetic Algorithms.
- Multi-year Evolution of the Energy Balance Supporting the Optimization of Local Remaining Capacities.
- Demand Simulator of energy transition variables for the Spanish electric power system.
- A new Data-Driven application for Secondary Voltage Regulation on Transmission Network based on Model Predictive Control for offset-free tracking.
- Unlocking the grid potential through combinatoric innovation - dynamic stability analysis and probabilistic real-time analysis of the power system security of supply in the era of AI.
- Transmission Expansion in Energy System Optimization Models - a Comparative Study
- Transition Insights into General Network Access Regime in India.





- Unlocking DSO services through Centralised and Distributed Control.
- Nordic perspective on System Integrity Protection Schemes in relation to capacity allocation.
- Transient stability behaviour in the north-south/southeast transmission corridor in Brazil under critical contingency scenarios and online global inertia monitoring.
- Prediction of Positive/Negative Error Sign of A Day-ahead Forecast of Aggregated PV Power Output.
- Methodology for valuing the flexibility attribute performed by BESS in the Brazilian Electric System.
- Understanding the Correlation Between Wind and Solar Forecast Errors and Demand Forecast Errors in Southern Regional Grid in India.

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### **Study Committee C3 – Power system sustainability and environmental performance**

- Network Planning and Decision-Making under Uncertainty.
- Mechanisms and mitigation of bird-related power outages of power grids: a case study involving herons at a substation.
- Eco-crossings, the effect of rock size and material on sprinkle layer on biodiversity in subsea power cable crossings.
- LCA and ECI as a tool for sustainable procurement.
- Principles of Sustainable Development in Multi-Criteria Selection of Tower Types for the Development of a 400 kV Transmission System Network.
- Green Substation- 100% Green Captive Power using GH2.
- THE MANAGEMENT OF ELECTRICALS LINES CORRIDORS IN SENEGAL : H-P O EXAMPLE.
- Ageing of Environmentally Friendly Insulation Gases by Partial Discharges.
- Avian interaction with powerlines.
- Exploration for Environmental Protection Management and Measures in the Construction Period of Sichuan-Chongqing UHVAC Project.
- 420 kV Retrofill: from Gas-Insulated Lines to Gas-Insulated Switchgear another Step Towards the Decarbonisation of High-Voltage Switchgear Installed Base.
- Natural & Synthetic Ester Fluid Filled Power Transformers and Reactors-A Pathway to achieve Carbon Neutrality in Electricity Transmission Sector.
- Good environmental practices: conservation and recovery of maritime habitats.
- Energy infrastructure sustainable planning using Pathfinder.
- Planning the future power grid for the energy transition: rooting through multicriterial Geographical Information Systems (GIS) modelling.
- Portuguese approach for the definition of Renewable Acceleration Areas.





- Towards a Sustainable and Resilient Power Grid: Implementing Circular Economy Principles and Practices.
- Avian collision mitigation, global best practices and technology review.

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### **Study Committee C4 – Power system technical performance**

Advanced methods and tools for analysis related to power systems. Including Power Quality Performance, EMC, Power System Dynamics, Lightning and insulation co-ordination.

- Investigation of ungrounded 72,5 kV shunt reactor switching transients.
- Enhancing Lightning Resilience: A Case Study of 400 kV Transmission Lines in the North Eastern Regional Grid of India.
- Optimal power flow control and reactive compensation.
- A Case Study on Torsional Resonance Stability Amidst Series Capacitor Upgrades in the Swedish Power System.
- Transient phenomena in an EMT grid model for dynamic performance and interaction studies.
- Black Start and Synchronization of Transmission Networks Using Grid-Forming Offshore Wind Farms.
- Mitigation of Low-Frequency Inter-Area Oscillations Using Grid-Forming Inverters.
- Evaluation of induced voltages occurring during the repair of a high-voltage cable system - A comparison between measurement and simulation.
- First Operational Experience With Vacuum Circuit Breakers in Austria - Measurements and Tests on the 110 kV Voltage Level.
- Investigation of Inertia Services on Grid Stability with Low-Inertia Systems in Victoria.
- Coordination and arbitrage related to the insertion of Renewable Energy Sources.
- Challenges faced by TSO to specify, test and integrate EMT models of IBRs to support grid stability.
- Improved Eigenvalue Sensitivity Method for Designing Power System Damping Controllers.
- Lightning Overvoltage of Hybrid Cable–Overhead Lines with Different Grounding Schemes.
- Managing Stability in the Future Converter-Dominated Swedish Power System.
- System Wide EMT Study Roadmaps.
- System strength impact on harmonic voltage management in transmission systems in relation to IBR (Inverter Based Resources) connections.
- Offshore Wind in India: A Comprehensive review of Potential, Challenges, and Grid Integration Strategies.
- Impact of extreme geomagnetical storm in the Finnish Transmission Grid.



- Experience of Installation of Controlled Switching Device on Transmission Line to overcome switching over voltages.
- Transfer Capability Increase with TCSC in the German Transmission System.
- Substation reliability when connecting large wind farms.
- A Comparative Analysis of Battery Energy Storage Systems WECC Models to Facilitate the Integration of Renewable Energy on an Island Power System.
- 3-Phase short-circuit fault current calculation method considering contribution of inverter source.
- Engineering Considerations for the Deployment of Synchronous Condensers in Inter-State Transmission System - Indian Perspective.
- A Study on the Impact of EV Chargers on Transient Stability and Root-mean-square Model.
- Stability Analysis of Grids with a High Share of IBRs – Evaluation of Parametric Interdependencies.
- Enhancing Power System Resilience in the Presence of High Proportions of Renewable Energy Using Wide-Area Monitoring Systems to verify fault ride through behaviour.
- Suitable Classification of Power System Stability Phenomena.
- Centralized Network Model in a Colombian DSO Company for Enhanced Planning and Operation.
- Process for Diagnosis of Observed Oscillations in IBR-dominant Systems.
- Validation of Transmission Line Compensation and Optimization of NGR size for Suppression of Secondary arcs effectively for successful Auto-reclose (A/R) Operations.
- A Statistical Analysis for the Lightning and Switching Overvoltages in 420 kV Siphon Underground Cable Systems. A Study Case in the Norwegian EHV Grid.
- Evaluating system wide voltage dips and voltage stability from inverters and synchronous condensers.
- How reliable are offshore transmission when RE generation power is not 100% of its capacity? - A case study for hybrid offshore wind and PV in the North Sea.
- EMT Studies for 132kV Offshore Wind Farms with HVDC Connection.
- Optimum mix of Inertia by Emulation-controls and spinning machines for weak grid conditions with High Renewable energy penetration- A case study of a part of Indian grid network.
- Compliance process for grid forming control: Best practice and way forward.
- Guidance for Initialising Inverter-based Resources in EMT AC Grid Models.
- Validation of Implemented Synthetic Swing Equation, Inertia Constant and Damping Coefficient of Grid Forming Batteries Against Conventional Synchronous Machine Swing Equation.



- Comparison Between Synchronous Condensers and Grid Forming BESS in Providing System Strength Support to IBRs in Weak and Strong Power Systems Using EMT Simulation.
- Large-scale Electromagnetic Transient Simulation of the French grid: Challenges and Solutions.
- The role of the Grid Forming technology in the decarbonisation of the Italian electricity grid.
- Optimizing Transmission for Renewable Integration - Indian Perspective.
- Design considerations on short-circuit impact of HVDC converter and other IBR with grid forming control.
- Use of Inherent Damping Capability of Thyristor Controlled Series Compensators to Mitigate Wind Sub-Synchronous Controller Interactions in Heavily Series Compensated Networks.
- Suitability of ESCR as a potential dynamic stability indicator in a gigawatt-scale off-grid power-to-gas-demand unit.
- Indicator-based identification of critical grid situations for voltage stability analyses in future transmission grids.
- Application of the IEC harmonic allocation framework in an interconnected transmission system: Experiences and Lessons learned.
- Impact of Voltage Difference between IBRs and Point of Interconnection on Design and Performance of Renewable Plants.
- Wavelet-Transformation-Based Determination of Sub-Transient Short-Circuit Current Equivalents of IBRs.
- Investigation of Non-Linear and Linear Optimal Reactive Powerflow Models for Voltage Control in Future Transmission Grids.
- Enhancing Power System Simulation Interoperability: Application of Functional Mock-up Interface for Model Exchange.
- Failure Investigation Analysis for Switching Overvoltage Stresses in a Cross-Bonding Joint of a 380kV Siphon Underground Cable System in the Netherlands.
- Voltage Control Stability of Grid Forming Wind Turbines During Faults.
- Performance Verification of the First Grid Forming STATCOM in the US for South Fork Offshore Wind Farm.
- Overhead Transmission Geometry for Increased Reliability and Voltage Stability.
- Offshore wind electrical balance of plant optimisation under uncertainty.
- Electromagnetic interference (EMI) filters used to prevent failure of power electronics device of Sub-Station..
- A framework for identifying critical operating points based on system strength assessment.
- Optimal Power Supply Strategy for a Near Shore Archipelago in NEOM.



- Overview of new transient phenomena arising in power system due to energy transition – EMT analysis of resonance in HVDC-MMC link connected to AC grid.
- Dogger Bank wind farm – HVDC converter control interaction studies.

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### **Study Committee C6 – Active distribution systems and distributed energy resources**

Integration of DER, storage technologies, electric vehicles, multi-energy systems, smart cities, rural electrification, microgrids, virtual power plants, customer integration and empowerment, demand response, advanced metering systems and MV/LV DC systems.

- Evaluation of voltage fluctuations due to PV output fluctuations in a distribution system with low voltage stability.
- Development of Distribution System and Market Operations in South Africa.
- Utilization of Grid Storage Batteries in Rural Microgrid Areas.
- Influence of grid topology on the Operating Envelope using three phases unbalanced Optimal Power Flow with Second-Order Conic relaxation.
- Current state of dynamic hosting capacity allocation in Australia.
- Modelling Market Participation of Energy Storages in a Renewable Power System Through Loop Block Orders.
- Cognitive Robust Optimization for Resilient Energy Storage Operation in Ports: A Case Study from Hirtshals.
- Surge in EV Adoption Among Danish Households: Challenges for the Low-Voltage Distribution Grid.
- Value of demand-side flexibility by reducing grid loss costs.
- Sector integration including hydrogen, EV, energy hubs, DER.
- Leveraging Household Flexibility to Optimize Microgrid Efficiency and Resilience.
- Current protective coordination in off-grid supplied from inverter power sources.
- Building Future-Proof Grids.
- Resilient Microgrids by using Grid Forming Inverters with Rooftop Solar PV and Battery Energy Storage Systems (BESS).
- Voltage Droop Control Using Probabilistic and Sensitivity Analysis in AC/DC Hybrid Distribution Network.
- Enabling adoption of offshore wind coupled with Green Hydrogen innovation.
- A Case Study of Protection of an LV Microgrid.
- Green Grid Initiative: Assessing the Readiness of India's Transmission System for Rapid Renewable Energy Integration.
- A Convex MPC Approach for the Optimal Management of BESS, Hydrogen Production and Economic Dispatch of RES within Active Distribution Systems.
- Lessons from DER Integration in Australia.



- Evaluation on contribution of DERs to distribution networks dealing with the effect of energy transition.
- Optimization of supermarket consumption using cooling machine flexibility.
- Smart Energy Meters: a tool for near Real-Time Monitoring of Voltage Stability in Low Voltage Grid with Distributed Energy Resources.
- Advanced Control System Development for Distributed Energy Storage Systems.
- Leveraging AI techniques to deploy ACOPF as a routine operational practice in the distribution network: A state-of-the-art analysis.
- Assessing Urban E-Truck Fleet Flexibility for Potential Enhancements in Active Distribution Network Operations.
- Sizing Methodology for Batteries and Ultra-Capacitors connected to renewable energy based on dynamic performance and Grid Support Services.
- Simulating Degradation Costs in Li-ion Battery Dispatch: Impacts on Investment and Operational Strategies.
- Systematic literature review for application of BESS as grid forming: current issues, challenges, and future trends.
- Loss-of-Mains Protection for DER in Australia.
- Enabling Large Scale Deployment of LV (Low-Voltage) Connected Solar on the Distribution Network in Ireland.

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### **Study Committee D2 – Information systems telecommunications and cybersecurity**

ICT equipment, architectures, security and governance including consideration of fundamental principles, design, specification, testing engineering, commissioning, performance, operation and maintenance aspects. ICT applied to digital networks, communication solutions, interoperability and data exchange, IT systems in Asset Management.

- Cybersecurity in renewable evacuation interconnections.
- Leveraging MQTT and cloud technology for effective continuous online condition monitoring of transformers.
- On the utilization of wireless transport in mission-critical packet-based operational networks for power utility.
- Security of Wide-Area Monitoring, Protection, and Control Systems: Evaluation of Stealthy Data Integrity Attacks.
- Teleprotection for DER over cellular networks.
- Verification of wide-area wireless communication technology using Wi-Fi HaLow.
- DCDIAS: Decentralized cross-domain identity authentication scheme for numerous power terminal equipment.





- Encrypted Traffic Identification in Power IoT based on One-Dimensional CNN with Batch Normalization.
- Construction and operation of a multivendor IP network for integrated legacy analog signals.
- Concept of “Local data & Innovation centres” in Power Sector.
- The Quest for Five 9s: Maximizing Uptime - The Strategic Role of Spares Management in Utility Telecommunications Networks.
- The Design of a 300km OTN/DWDM 100Gbit/s link without midspan amplification.
- High resilience of power communication using Non-Terrestrial Networks (NTNs), including Low Earth Orbit (LEO) satellites and High Altitude Platform Stations (HAPS).
- Advancement of Demand and Supply Forecasting Technology in Renewable Energy.
- Utilizing Generative AI and RAG for Knowledge Transfer in the Electric Power Industry.
- Sustainable Grid Growth through Migration to an MPLS-TP Packet-based Network.
- Digital technology for analysing the correctness of relay protection and automation operation in real time.
- PG IMPACT: Accelerating Renewable Energy Integration into India’s Transmission System Through Unified Control and Big Data Integration.
- AI-ML-Based Project Health Indexing Framework for Fast-Tracking Renewable Energy Transmission Projects.
- Requirements for Digital Transformation in Power Grids, Especially for Digital Twins.
- Information Security Laboratory at Power Grid Corporation of India Limited.
- Asset Inventory Management for Information Security Preparedness.
- Dataset Manipulation for Cross-Substation Transfer Learning: A Promising Path to Enhanced Cybersecurity.
- DC System Upgrades for Optical Transport Network Deployment.
- Secure time and time transfer.
- Telecoms Modelling Tools in Carbon Neutral Power Generation.
- Quantum-resistant grid communications with enhanced MACsec.
- An Advanced Cyber-Physical System Security Testbed for Substation Automation.
- General approaches to the development of advanced power system modelling tools.
- Intelligent Inspection of Substation Assets and Use of Augmented Reality in POWERGRID.
- Building Digital Twins for Consumers: Requirements and Challenges.
- Change Control Management Process for a Telecommunications Business Unit Servicing a Power Utility.
- Securing Power Utilities: Why Directory Services Are Critical for OT/ICS Integration.
- Demystifying IT-OT Convergence: Strengthening Critical Infrastructure Security Through DMZ Implementation and Cross-Domain.
- Enhancing Security in Transmission Substations: The Role of Intrusion Detection Systems (IDS) in Substation Automation Networks.





- Virtual Reality and gamification as tools for operation and maintenance of Power Transmission Lines - A practical case.
- Implementation of the Security Information and Event Management (SIEM) System in ANDE's OT Network.
- Hyperconvergence in OT Networks: Implementation in ANDE's SCADA Systems and Feasibility of Operating with Virtualized Protection and Control IEDs in Substations.
- Monitoring the performance of 2.4GHZ ISM band wireless communication technologies for power grid IoT applications.
- Unified Network Management System (UNMS)-an amalgamation of multivendor communication systems into a single centralized monitoring system..