

## Rotating Electrical Machines

The SC is focused on the development of new technologies and the international exchange of information and knowledge in the field of rotating electrical machines, to add value to this information and knowledge by means of synthesizing state-of-the-art practices and developing guidelines and recommendations.

### PRINCIPAL AREAS OF INTEREST

- Asset Management to extend the life of existing generators or to recommend their replacement.
- Machine monitoring, diagnosis and prognosis to perform maintenance when it is really required.
- Renewable generation which may be connected directly to the transmission and distribution systems or even directly to consumers setting up the microgrids.
- Enhancements in the construction of larger turbo and hydro-generators.
- High efficiency electrical machines due to the development of new materials, improving cooling and insulation in generators and motors.
- Large motors and high efficiency motors.

### CURRENT ACTIVITIES

One of the continuous drivers for the SC A1 Committee is the technological improvements in design, materials, insulation, cooling, bearings, availability, reliability, efficiency, monitoring and maintenance of electrical machines.

Assessment of electrical rotating machines management improvements in monitoring, diagnosis and prognosis systems.

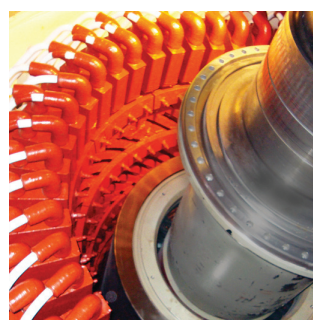
### KEY PROJECTS / FORTHCOMING EVENTS

#### SC A1 2019 Annual Meeting and Colloquium:

New Delhi, India from the 22<sup>nd</sup> to 28<sup>th</sup> of September 2019.

### OTHER SPECIFIC INTEREST

- Utilization of polymer nano-composites as near-future HV electrical insulation in rotating machines.
- Increase the number of Tutorials and the participation of young and female engineers.



### MAIN AREA OF ATTENTION

**Study Committee A1 plays** a pivotal role in the field of rotating electrical machines. Besides expanding the interests in improving the performance and efficiency of these machines, the utilization of polymer nano-composites as near-future HV electrical insulation and the influence of renewable energy machines as part of the development of smart grids, forms also part of the study field.

### SC A1 WITHIN ITS FIELD OF ACTIVITY SHALL:

**Serve all its customers involved in the process of generating electrical energy by means of:**

- Providing a forum where suppliers and users can share and exchange experiences and information.
- Being aware of customer's needs.
- Monitoring and reporting on international development.
- Promoting trends beneficial for its customers.
- Issuing guidelines and recommendations.
- Updating former reports due to recent developments in design, materials, insulation, cooling and bearings technology and improvements in efficiency and maintenance.

**Promote innovative solutions and concepts considering all relevant factors (economical, technical, environmental and others).**

**Actively promote and support international cooperation and conferences.**

**Promote Symposiums/Colloquiums during Study Committee meetings in odd years.**

**Participate in Regional Meetings with technical contributions.**

## TOPICS OF WORKING GROUPS

WG A1.33	GUIDE FOR THE PROPER STORAGE AND CLEANLINESS OF TURBOGENERATORS AND THEIR COMPONENTS
WG A1.34	TESTING VOLTAGE OF DOUBLY-FED ASYNCHRONOUS GENERATOR-MOTOR ROTOR WINDINGS FOR PUMPED STORAGE
WG A1.39	APPLICATION OF DIELECTRIC DISSIPATION FACTOR MEASUREMENTS ON NEW STATOR COILS AND BARS
WG A1.42	INFLUENCE OF KEY REQUIREMENTS ON THE COST OF HYDROGENERATORS
WG A1.43	STATE OF THE ART OF ROTOR TEMPERATURE MEASUREMENT
WG A1.44	GUIDELINE ON TESTING OF TURBO AND HYDROGENERATORS
WG A1.45	GUIDE FOR DETERMINING THE HEALTH INDEX OF LARGE ELECTRIC MOTORS
WG A1.48	GUIDANCE ON THE REQUIREMENTS FOR HIGH SPEED BALANCING / OVERSPEED TESTING OF TURBINE GENERATOR ROTORS FOLLOWING MAINTENANCE OR REPAIR
WG A1.49	MAGNETIC CORE DIMENSIONING LIMITS IN HYDRO GENERATORS
WG A1.51	MONITORING, RELIABILITY AND AVAILABILITY OF WIND GENERATORS
WG A1.52	WIND GENERATORS AND FREQUENCY-ACTIVE POWER CONTROL OF POWER SYSTEMS
WG A1.53	GUIDE ON DESIGN REQUIREMENTS OF MOTORS FOR VARIABLE SPEED DRIVE APPLICATION
WG A1.54	IMPACT OF FLEXIBLE OPERATION ON LARGE MOTORS
WG A1.55	SURVEY ON SPLIT CORE STATORS
WG A1.56	SURVEY ON LAP AND WAVE WINDING AND THEIR CONSEQUENCES ON MAINTENANCE AND PERFORMANCE
WG A1.57	THE VISUAL INSPECTION OF STATOR WINDINGS AND CORES OF LARGE TURBO GENERATORS
WG A1.58	SELECTION OF COPPER VERSUS ALUMINIUM ROTORS FOR INDUCTION MOTORS
WG A1.59	SURVEY ON INDUSTRY PRACTICES AND EFFECTS ASSOCIATED WITH THE CUTTING OUT OF STATOR COILS IN HYDROGENERATORS
WG A1.60	GUIDE ON ECONOMIC EVALUATION FOR REFURBISHMENT OR REPLACEMENT DECISIONS ON HYDRO GENERATORS
WG A1.61	SURVEY ON PARTIAL DISCHARGE MONITORING IN LARGE MOTORS
WG A1.62	THRUST BEARINGS FOR HYDROPOWER - A SURVEY OF KNOWN PROBLEMS AND ROOT CAUSES
WG A1.63	TURBO GENERATOR STATOR WINDING BUSHINGS AND LEAD CONNECTIONS – FIELD EXPERIENCE, FAILURES AND DESIGN IMPROVEMENTS

## LATEST PUBLICATIONS

TB 690	VIBRATION AND STABILITY PROBLEMS MET IN NEW, OLD AND REFURBISHED HYDRO GENERATORS, ROOT CAUSES AND CONSEQUENCES
TB 682	SURVEY ON HYDRO GENERATOR INSTRUMENTATION AND MONITORING
TB 665	GENERATOR BEHAVIOUR UNDER TRANSIENT CONDITIONS
TB 641	GUIDE ON ECONOMIC EVALUATION OF REFURBISHMENT / REPLACEMENT DECISIONS ON GENERATORS
TB 621	GENERATOR ON-LINE OVER AND UNDER EXCITATION ISSUES
TB 582	SURVEY ON HYDROGENERATOR CLEANING
TB 581	GUIDE: CORONA ELECTROMAGNETIC PROBE TESTS (TVA)
TB 574	GUIDE FOR CONSIDERATION OF DUTY ON WINDINGS OF GENERATORS
TB 573	GUIDE FOR MINIMIZING THE DAMAGE FROM STATOR WINDING GROUND FAULTS IN HYDROGENERATORS
TB 558	GUIDE FOR THE MONITORING, DIAGNOSIS AND PROGNOSIS OF LARGE MOTORS
TB 552	GUIDE OF METHODS FOR DETERMINING THE CONDITION OF STATOR WINDING INSULATION AND THEIR EFFECTIVENESS IN LARGE MOTORS
TB 551	FEASIBILITY OF UPDATING FROM CLASS F TO CLASS H THE ELECTRICAL INSULATION SYSTEMS IN ELECTRICAL ROTATING MACHINES
TB 522	GENERATOR STATOR WINDING STRESS GRADING COATING PROBLEM
TB 517	GUIDE FOR PREVENTION OF OVERFLUXING OF GENERATORS
TB 503	STATE OF THE ART AND CAPACITY FOR ROBOTIC INSPECTION OF TURBOGENERATORS
TB 491	GENERATOR END-WINDING RETAINING RINGS - A LITERATURE SURVEY AND CARE GUIDELINE
TB 454	HYDROGENERATOR FIRE PROTECTION UPDATE
TB 437	GUIDE FOR ON-LINE MONITORING OF TURBOGENERATORS
TB 480	GUIDE ON STATOR WATER CHEMISTRY MANAGEMENT
TB 470	LIFE EXTENSION OF LARGE ELECTRIC MOTORS IN NUCLEAR POWER PLANTS
TB 469	STATE OF THE ART IN EFFICIENCY OF HYDROGENERATORS COMMISSIONED SINCE 1990
TB 454	HYDROGENERATOR FIRE PROTECTION UPDATE
TB 437	GUIDE FOR ON-LINE MONITORING OF TURBOGENERATORS
WR A1.19	MOTOR FAILURE SURVEY
WR A1.21	BEARING SEGMENTS WITH PLASTIC LINING: OPERATING AND MAINTENANCE EXPERIENCE
WR A1.27	ADJUSTABLE SPEED DRIVES AND HIGH-EFFICIENCY MOTORS APPLICATIONS IN POWER PLANTS
WR A1.30	USAGE OF MAGNETIC SLOT WEDGES IN HYDROGENERATORS
WR A1.41	INVENTORY OF MAIN MAINTENANCE INTERVENTIONS ON NUCLEAR POWER PLANT TURBO-GENERATORS

WR: Working Group Report - TB: Technical Brochure.

All of the above TBs are available for download from [www.e-cigre.org](http://www.e-cigre.org)

## CONTACT

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## Power Transformers and Reactors

Within its technical field of activity, Study Committee A2 addresses topics throughout the asset management life-cycle phases; from conception; through research, design, production, deployment, operation, and end-of-life.

### PRINCIPAL AREAS OF INTEREST

At all stages, technical, safety, economic, environmental, and social aspects are addressed as well as interactions with, and integration into, the evolving power system and the environment.

All aspects of performance, specification, testing, and the application of testing techniques are within scope, with a specific focus on the impact of changing interactions and demands due to evolution of the power system. Life cycle assessment techniques, risk management techniques, education and training are also important aspects.

#### Within this framework additional specific areas of attention include:

- Theory principles and concepts, functionality, technology development, design, performance and application of materials, efficiency.
- Manufacturing, quality assurance, application guidance, planning, routing and location, construction, installation, erection, installation.
- Reliability, availability, dependability, maintainability and maintenance, service, condition monitoring, diagnostics, restoration, repair, loading, upgrading, uprating.
- Refurbishment, re-use/re-deployment, deterioration, dismantling, disposal.

### FORTHCOMING EVENTS

#### **CIGRE Workspot IX (regional colloquium):**

Foz do Iguaçu, Brazil; 25<sup>th</sup> to 28<sup>th</sup> November 2018.

#### **CIGRE – IEC colloquium on UHV and EHV (AC and DC):**

Hakodate, Japan; 24<sup>th</sup> to 26<sup>th</sup> April 2019.

#### **Joint colloquium with SCs A2, B2 and D1:**

New Dehli, India; 24<sup>th</sup> to 28<sup>th</sup> November 2019.



### MAIN AREA OF ATTENTION

#### **The technical field of activity of Study Committee A2 is:**

##### **Power transformers;**

including industrial, dc converter, and phase-shifting transformers.

##### **Reactors;**

including shunt, series, saturated, and sm ing.

##### **Transformer components;**

including bushings, tap changers and accessories.

## TOPICS OF WORKING GROUPS

JWG D1/A2.47	NEW FRONTIERS FOR DISSOLVED GAS ANALYSIS
WG A2.45	TRANSFORMER FAILURE INVESTIGATION AND POST-MORTEM ANALYSIS
JWG A2/D1.46	FIELD EXPERIENCE WITH TRANSFORMER SOLID INSULATING AGEING MARKERS
WG A2.49	CONDITION ASSESSMENT OF POWER TRANSFORMERS
JWG A2/D1.51	IMPROVEMENT TO PARTIAL DISCHARGE MEASUREMENTS FOR FACTORY AND SITE ACCEPTANCE TESTS OF POWER TRANSFORMERS
JWG A2/C4.52	HIGH-FREQUENCY TRANSFORMER AND REACTOR MODELS FOR NETWORK STUDIES
WG A2.53	OBJECTIVE INTERPRETATION METHODOLOGY FOR THE MECHANICAL CONDITION ASSESSMENT OF TRANSFORMER WINDINGS USING FREQUENCY RESPONSE ANALYSIS
WG A2.54	POWER TRANSFORMER AUDIBLE SOUND REQUIREMENT
WG A2.55	TRANSFORMER LIFE EXTENSION
WG A2.56	POWER TRANSFORMER EFFICIENCY
WG A2.57	EFFECTS OF DC BIAS ON POWER TRANSFORMERS
WG A2.58	INSTALLATION AND PRE-COMMISSIONING OF TRANSFORMERS AND SHUNT REACTORS
WG A2.59	ON-SITE ASSEMBLY, ON-SITE REBUILD, AND ON-SITE HIGH VOLTAGE TESTING OF POWER TRANSFORMERS

## LATEST PUBLICATIONS

TB 673	GUIDE ON TRANSFORMER TRANSPORTATION
TB 655	TECHNOLOGY AND UTILISATION OF OIL-IMMERSED SHUNT REACTORS
TB 646	HVDC TRANSFORMER INSULATION: OIL CONDUCTIVITY
TB 642	TRANSFORMER RELIABILITY SURVEY
TB 630	GUIDE ON TRANSFORMER INTELLIGENT CONDITION MONITORING (TICM) SYSTEMS
TB 625	COPPER SULPHIDE LONG TERM MITIGATION AND RISK ASSESSMENT.
TB 577	TRANSIENT INTERACTION BETWEEN TRANSFORMERS & POWER SYSTEM

All of the above TBs are available for download from [www.e-cigre.org](http://www.e-cigre.org)

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## Transmission and Distribution Equipment

The scope of the SC A3 covers theory, principles and concepts, functionality, technological development, design, performance and application of materials, efficiency and operation for all devices for switching, interrupting and limiting currents, load switches, re-closers, ring-main units disconnecting switches, earthing switches surges arresters, capacitors, busbars, equipment insulators and instrument transformers and all other equipment within the substation not specifically covered under another equipment study committee's scopes.

### PRINCIPAL AREAS OF INTEREST

- Innovative technologies [e.g. dC circuit-breakers].
- Requirements for equipment in changing network conditions.
- Incorporation of intelligence into hv equipment [e.g. Controlled switching].
- Monitoring and diagnostics of transmission and distribution equipment.
- New and improved test techniques.
- Reliability assessment, end-of-life management of ageing equipment.
- Mitigation methods for overstressing and overloads.
- Difference of designs and requirements in Transmission & Distribution equipment.

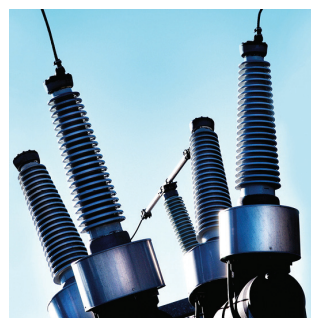
### CURRENT ACTIVITIES

Overstressing of substation equipment.  
Non-conventional instrument transformers.  
Non-intrusive condition monitoring.  
MVDC switchgears including MVDC Circuit Breakers.  
Multi-physic simulation for temperature rise test.  
9 active Working groups and 3 advisory groups.

### KEY PROJECTS / FORTHCOMING EVENTS

**2019 Cigre SC A3 Colloquium:** September or October 2019, Bucharest, Romania.

[\*] GCB: Gas Circuit Breaker - DS: Disconnecting Switch - HSGS: High Speed Grounding Switch - ES: Earthing Switch - MOSA: Metal Oxide Surge Arrester.



### MAIN AREA OF ATTENTION

**SC A3 is responsible** for the collection of information, technical evaluation of power system studies and technical analyses of both AC and DC equipment from distribution through transmission voltages.

**SC A3 provides the information** on new technologies, improved specifications, reliability, and lifecycle management of transmission and distribution equipment. This scope is well suited to the various technical needs of utilities that require technical and sustainable solutions for emerging problems and challenges in changing network conditions.

**SC A3 increases its educational** and tutorial activities on all relevant subjects not only within the CIGRE community but also to IEEE, IEC, and many related international conferences and exhibitions.

**This supports a greater internal** and external visibility of CIGRE and provides new relationships with other dealing with power engineering.

## TOPICS OF WORKING GROUPS

WG A3.30	OVERSTRESSING OF SUBSTATION EQUIPMENT
WG A3.31	NON-CONVENTIONAL INSTRUMENT TRANSFORMERS
JWG A3.32/Cired	NON-INTRUSIVE CONDITION MONITORING
WG A3.35	CONTROLLED SWITCHING
WG A3.36	MULTI-PHYSIC SIMULATION FOR TEMPERATURE RISE TEST
WG A3.38	SHUNT CAPACITOR SWITCHING IN DISTRIBUTION AND TRANSMISSION SYSTEMS
WG A3.39	FIELD EXPERIENCE WITH AND RELIABILITY OF SURGE ARRESTERS
WG A3.40	TECHNICAL REQUIREMENTS AND FIELD EXPERIENCES WITH MV DC SWITCHING EQUIPMENT
WG A3.41	INTERRUPTING AND SWITCHING PERFORMANCE WITH SF6 FREE SWITCHING EQUIPMENT
WG A3.42	CONSEQUENCE OF HIGH VOLTAGE EQUIPMENT OPERATING EXCEEDING HIGHEST SYSTEM VOLTAGES
WG A3.43	FAILURE ANALYSIS AND RISK MITIGATION FOR RECENT INCIDENTS OF AIS INSTRUMENT TRANSFORMERS

## LATEST PUBLICATIONS

TB 725	AGEING HIGH VOLTAGE SUBSTATION EQUIPMENT AND POSSIBLE MITIGATION TECHNIQUE
TB 716	SYSTEM CONDITIONS FOR AND PROBABILITY OF OUT-OF-PHASE
TB 696	MO VARISTORS AND SURGE ARRESTERS FOR EMERGING SYSTEM CONDITIONS
TB 693	EXPERIENCE WITH EQUIPMENT FOR SERIES / SHUNT COMPENSATION
TB 683	TECHNICAL REQUIREMENTS OF STATE-OF-THE-ART HVDC SWITCHING EQUIPMENT
TB 624	INFLUENCE OF SHUNT CAPACITOR BANK ON CB FAULT INTERRUPTION DUTIES
TB 602	TOOLS FOR SIMULATION OF THE INTERNAL ARC EFFECTS IN HV & MV SWITCHGEAR
TB 589	VACUUM SWITCHGEARS AT TRANSMISSION VOLTAGES
TB 570	SWITCHING PHENOMENA FOR EHV AND UHV EQUIPMENT
TB 544	METAL OXIDE (MO) SURGE ARRESTERS - STRESSES AND TEST PROCEDURES
TB 514	RELIABILITY OF HIGH VOLTAGE EQUIPMENT - PART 6: GIS PRACTICES
TB 513	RELIABILITY OF HIGH VOLTAGE EQUIPMENT - PART 5: GAS INSULATED SWITCHGEAR
TB 512	RELIABILITY OF HIGH VOLTAGE EQUIPMENT - PART 4: INSTRUMENT TRANSFORMERS
TB 511	RELIABILITY OF HIGH VOLTAGE EQUIPMENT - PART 3: DS & EARTHING SWITCHES
TB 510	RELIABILITY OF HIGH VOLTAGE EQUIPMENT - PART 2: SF6 CIRCUIT BREAKERS
TB 509	RELIABILITY OF HIGH VOLTAGE EQUIPMENT - PART 1: GENERAL MATTERS
TB 497	APPLICATIONS AND FEASIBILITY OF FAULT CURRENT LIMITERS IN POWER SYSTEMS
TB 456	BACKGROUND OF TECHNICAL SPECIFICATIONS FOR SUBSTATION EQUIPMENT > 800 kV
TB 455	APPLICATION OF COMPOSITE INSULATORS TO HIGH VOLTAGE APPARATUS
TB 408	LINE FAULT PHENOMENA AND THEIR IMPLICATIONS FOR 3-PHASE SLF/LLF CLEARING
TB 394	STATE OF THE ART OF INSTRUMENT TRANSFORMER
TB 368	OPERATING ENVIRONMENT OF VOLTAGE GRADING CAPACITORS APPLIED TO HV CIRCUIT BREAKER
TB 362	TECHNICAL REQUIREMENTS FOR SUBSTATION EQUIPMENT EXCEEDING 800 kV AC
TB 339	GUIDELINE ON THE IMPACT OF FCL DEVICES ON PROTECTION SYSTEM
TB 336	CHANGING NETWORK CONDITIONS AND SYSTEM REQUIREMENTS PART 2
TB 335	CHANGING NETWORK CONDITIONS AND SYSTEM REQUIREMENTS PART 1
TB 319	FAILURE SURVEY ON CIRCUIT BREAKER CONTROLS SYSTEMS
TB 305	GUIDE FOR APPLICATION OF IEC 62271-100 & 62271-1 - PART 1
TB 304	GUIDE FOR APPLICATION OF IEC 62271-100 & 62271-1 - PART 2

All of the above TBs are available for download from [www.e-cigre.org](http://www.e-cigre.org)

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## Insulated Cables

The scope of SC B1 covers the whole Life Cycle of AC and DC Insulated cables for Land and Submarine Power Transmission, which means theory, design, applications, manufacture, installation, testing, operation, maintenance, upgrading and uprating, diagnostics techniques.

### PRINCIPAL AREAS OF INTEREST

- HVDC Extruded Cables for LCC and VSC Systems.
- Accessories
- Installation Techniques.
- New Testing Techniques.
- New materials.

### CURRENT ACTIVITIES

Preparation of Recommendations for further Standardization by IEC.

Tutorials for Technical and Non-Technical Audiences.

### KEY PROJECTS / FORTHCOMING EVENTS

**Reference Books on Accessories and Cable Systems Design.**

### OTHER SPECIFIC INTEREST

- Modeling of Cables. Interface with GIS.
- Asset management. Service experience.
- Cable systems under disturbances.



### MAIN AREA OF ATTENTION

**The activities of CIGRE Study Committee B1** cover all types of AC and DC insulated cable systems for power transmission, distribution and generation connections on land and in submarine applications.

**Within its technical field of activity,** Study Committee B1 addresses topics throughout the asset management life-cycle phases: from conception, through research, development, design, production, deployment, operation, and end-of life. At all stages, technical, safety, economic, environmental and social aspects are addressed as well as interactions with, and integration into, the evolving power system and the environment. All aspects of performance, specification, testing and the application of testing techniques are within scope, with a specific focus on the impact of changing interactions and demands due to evolution of the power system. Life cycle assessment techniques, risk management techniques, education and training are also important aspects.

**Within this framework additional specific areas of attention include:**

- Theory, principles and concepts, functionality, technological development, design, performance and application of materials, efficiency.
- Manufacturing, quality assurance, application guidance, planning, routing and location, construction, erection, installation.
- Reliability, availability, dependability, maintainability and maintenance, service, condition monitoring, diagnostics, restoration, repair, loading, upgrading, uprating.
- Refurbishment, re-use/re-deployment, deterioration, dismantling, disposal.

**At the end of 2017,** more than 360 experts worldwide are participating to the work of SC B1.

## TOPICS OF WORKING GROUPS

WG B1.45	THERMAL MONITORING OF CABLE CIRCUITS AND GRID OPERATORS' USE OF DYNAMIC RATING SYSTEMS
WG B1.46	CONDUCTOR CONNECTORS: MECHANICAL AND ELECTRICAL TESTS *
WG B1.52	FAULT LOCATION ON LAND AND SUBMARINE LINKS (AC AND DC) *
WG B1.38	AFTER LAYING TESTS ON AC AND DC CABLE SYSTEMS WITH NEW TECHNOLOGIES
WG B1.44	WORK UNDER INDUCED VOLTAGES OR CURRENTS
WG B1.48	TRENCHLESS TECHNOLOGIES FOR UNDERGROUND CABLES
JWG B1/B3.49	STANDARD DESIGN OF A COMMON, DRY TYPE PLUG-IN INTERFACE FOR GIS AND POWER CABLES UP TO 145 kV
WG B1.50	SVL AND BONDING SYSTEMS (DESIGN, TESTING, OPERATION AND MONITORING)
WG B1.54	BEHAVIOR OF CABLE SYSTEMS UNDER LARGE DISTURBANCES (EARTHQUAKE, STORM, FLOOD, FIRE, LANDSLIDE, CLIMATE CHANGE)
WG B1.56	CABLE RATINGS VERIFICATION
WG B1.57	UPDATE OF SERVICE EXPERIENCE OF HV UNDERGROUND AND SUBMARINE CABLE SYSTEMS
WG B1.58	ASSET MANAGEMENT IN MV CABLES NETWORKS
WG B1.60	MAINTENANCE OF HV CABLE SYSTEMS
WG B1.61	INSTALLATION OF HV CABLE SYSTEMS
WG B1.62	RECOMMENDATIONS FOR TESTING DC EXTRUDED CABLE SYSTEMS FOR POWER TRANSMISSION AT A RATED VOLTAGE UP TO AND INCLUDING 800 kV
WG B1.63	ADDITIONAL RECOMMENDATIONS FOR MECHANICAL TESTING OF SUBMARINE CABLES FOR DYNAMIC APPLICATIONS
WG B1.64	EVALUATION OF LOSSES IN ARMoured THREE CORE POWER CABLES
WG B1.66	RECOMMENDATIONS FOR TESTING DC LAPPED CABLE SYSTEMS FOR POWER TRANSMISSION AT A RATED VOLTAGE UP TO AND INCLUDING 800 kV

\* For these two groups, the work has been achieved and final report will be soon available on e-cigre.

## LATEST PUBLICATIONS

TB 722	RECOMMENDATIONS FOR ADDITIONAL TESTING FOR SUBMARINE CABLES FROM 6 kV (UM = 7.2 kV) UP TO 60 kV (UM = 72.5 kV)
TB 720	FIRE ISSUES FOR INSULATED CABLE INSTALLED IN AIR
TB 714	LONG TERM PERFORMANCE OF SOIL AND BACKFILL SYSTEMS
TB 689	LIFE CYCLE ASSESSMENT AND ENVIRONMENTAL IMPACT OF UNDERGROUND CABLE SYSTEMS
TB 680	IMPLEMENTATION OF LONG AC HV & EHV CABLE SYSTEMS
TB 669	MECHANICAL FORCES IN LARGE CROSS SECTION CABLE SYSTEMS
TB 652	GUIDE FOR OPERATION OF FLUID FILLED CABLE SYSTEMS
TB 640	A GUIDE FOR RATING CALCULATIONS OF INSULATED CABLES
TB 623	RECOMMENDATIONS FOR MECHANICAL TESTING OF SUBMARINE CABLES
TB 622	TESTING OF TRANSITION JOINTS BETWEEN HVDC CABLES WITH LAPPED AND EXTRUDED INSULATION UP TO 500 kV
TB 610	OFF SHORE GENERATION CABLE CONNECTIONS
TB 606	UPGRADING AND UPRATING OF EXISTING CABLE SYSTEMS
TB 605	FEASIBILITY OF A COMMON, DRY TYPE INTERFACE FOR GIS AND POWER CABLES OF 52 kV AND ABOVE
TB 560	GUIDELINES FOR MAINTAINING THE INTEGRITY OF XLPE CABLE ACCESSORIES
TB 559	IMPACT OF EMF ON CURRENT RATINGS AND CABLE SYSTEMS
TB 538	RECOMMENDATIONS FOR TESTING OF SUPERCONDUCTIVE CABLES
TB 531	CABLE SYSTEMS ELECTRICAL CHARACTERISTICS
TB 496	RECOMMENDATIONS FOR TESTING DC EXTRUDED CABLE SYSTEMS FOR POWER TRANSMISSION AT A RATED VOLTAGE ≤ 500 kV
TB 490	RECOMMENDATIONS FOR TESTING OF LONG AC SUBMARINE CABLES WITH EXTRUDED INSULATION FOR SYSTEM VOLTAGE ABOVE 30(36) TO 500(550) kV
TB 476	CABLE ACCESSORY WORKMANSHIP ON EXTRUDED HIGH VOLTAGE CABLES

All of the above TBs are available for download from [www.e-cigre.org](http://www.e-cigre.org)

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## Overhead Lines

The field of activities of Study Committee B2 covers design, construction and operation of overhead lines. This includes the mechanical and electrical design of line components [conductors, ground wires, insulators, accessories, supports and their foundations], validation tests, the assessment of the state of line components and elements, maintenance, refurbishment and life extension as well as upgrading and uprating of existing overhead lines

### PRINCIPAL AREAS OF INTEREST

- Route selection.
- Optimized line design.
- Line maintenance & service life.
- Refurbishment of existing lines.
- Design specifications.
- Wind induced vibrations and galloping of conductors.
- Increased power flow of existing lines.
- Asset management guidelines.
- Real-time monitoring systems.
- Minimizing the environmental impact of lines.

### CURRENT ACTIVITIES

Cigre Paris 2018 Session.

### KEY PROJECTS / FORTHCOMING EVENTS

#### **Cigre Colloquium on EHV/UHV:**

Hakodate, Japan, 2019 April.

#### **Cigre Symposium SCs B1,B2,B4,C1,C2,C4 “Going**

**offshore – challenges of the future power super grid”:**

Aalborg, Denmark, 2019 June.

#### **B2 annual meeting, jointly with SC A2 and SC D1:**

New Delhi, India, 2019 November.

### OTHER SPECIFIC INTEREST

- Strong emphasis on B2 tutorials.



#### **The Study Committee covers**

all aspects of overhead line design [AC and DC], construction and maintenance, including modification of existing lines and environmental considerations.

### SPECIFIC AREAS OF INTEREST

#### **Electrical Performance**

deals with utilization of new and existing overhead power lines including modification of existing lines to allow increased power flow and economic design of new lines.

#### **Towers, Insulators and Foundations**

seek to improve diagnostic tools and modeling of in-service components, both dynamic and static foundation & structure loads, repair of corrosion in structures, and evaluation of new materials for line supports.

#### **Conductors and Fittings**

covers conductor fatigue and endurance capability, protection against wind induced vibrations, assessment of aged fittings and support in the preparation of standards, e.g. for fittings, conductor self-damping and conductor fatigue.

#### **Asset management**

considers electrical and civil aspects of line reliability and availability, including climatic loads, electrical clearances and live-line working.

## TOPICS OF WORKING GROUPS

WG B2.24	QUALIFICATION OF HV AND UHV OVERHEAD LINE SUPPORTS UNDER STATIC AND DYNAMIC LOADS
WG B2.40	CALCULATIONS OF THE ELECTRICAL DISTANCES BETWEEN LIVE PARTS AND OBSTACLES FOR OVERHEAD LINES
WG B2.45	BUSHFIRE CHARACTERISTICS AND POTENTIAL IMPACTS ON OVERHEAD LINE PERFORMANCE
WG B2.50	SAFE HANDLING OF FITTINGS AND CONDUCTORS
WG B2.52	THE USE OF ROBOTICS IN ASSESSMENT AND MAINTENANCE OF OVERHEAD LINES
WG B2.53	MANAGEMENT GUIDELINES FOR OUTSOURCING OVERHEAD LINE TECHNICAL EXPERTISE
WG B2.55	CONDUCTORS FOR THE UPRATING OF EXISTING OVERHEAD LINES
WG B2.57	SURVEY OF OPERATIONAL COMPOSITE INSULATOR EXPERIENCE AND APPLICATION GUIDE FOR COMPOSITE INSULATORS
WG B2.58	VIBRATION MODELLING OF HIGH TEMPERATURE LOW SAG CONDUCTORS - SELF-DAMPING CHARACTERIZATION
WG B2.59	FORECASTING DYNAMIC LINE RATINGS
WG B2.60	AFFORDABLE OVERHEAD TRANSMISSION LINES FOR SUB-SAHARAN COUNTRIES
WG B2.61	TRANSMISSION LINE STRUCTURES WITH FIBRE REINFORCED POLYMER (FRP) COMPOSITES
WG B2.62	DESIGN OF COMPACT HVDC OVERHEAD LINES
WG B2.63	COMPACT AC TRANSMISSION LINES
WG B2.64	INSPECTION AND TESTING OF EQUIPMENT AND TRAINING FOR LIVE-LINE WORK ON OVERHEAD LINES
WG B2.65	DETECTION, PREVENTION AND REPAIR OF SUB-SURFACE CORROSION IN OVERHEAD LINE SUPPORTS, ANCHORS AND FOUNDATIONS
WG B2.66	SAFE HANDLING AND INSTALLATION GUIDE FOR HIGH TEMPERATURE LOW SAG (HTLS) CONDUCTORS
WG B2.67	ASSESSMENT AND TESTING OF WOOD AND ALTERNATIVE MATERIAL TYPE POLES
WG B2.68	SUSTAINABILITY OF OHL CONDUCTORS AND FITTINGS – CONDUCTOR CONDITION ASSESSMENT AND LIFE EXTENSION
WG B2.69	COATINGS FOR POWER NETWORK EQUIPMENT
WG B2.70	AIRCRAFT WARNING MARKERS AND BIRD FLIGHT DIVERTERS FOR OVERHEAD LINES – EXPERIENCE AND RECOMMENDATIONS
JWG C3/B2/B1.13	ENVIRONMENTAL ISSUES OF HIGH VOLTAGE TRANSMISSION LINES FOR RURAL AND URBAN AREAS
JWG D2-B2.39	DESIGN, DEPLOYMENT AND MAINTENANCE OF OPTICAL CABLES ASSOCIATED TO OVERHEAD HV TRANSMISSION LINES

## LATEST PUBLICATIONS

GREEN BOOK	TECHNICAL BROCHURE: MODELLING OF VIBRATIONS OF OVERHEAD LINE CONDUCTORS
GREEN BOOK	OVERHEAD LINES
TB 708	GUIDE ON REPAIR OF CONDUCTORS AND CONDUCTOR-FITTING SYSTEMS
TB 695	EXPERIENCE WITH THE MECHANICAL PERFORMANCE OF NON-CONVENTIONAL CONDUCTORS
TB 694	GROUND POTENTIAL RISE AT OVERHEAD AC TRANSMISSION LINE STRUCTURES DURING POWER FREQUENCY FAULTS
TB 653	SAFE DESIGN TENSION FOR SINGLE CONDUCTORS FITTED WITH ELASTOMER CUSHIONED SUSPENSION UNITS
TB 645	METEOROLOGICAL DATA FOR ASSESSING CLIMATIC LOADS ON OVERHEAD LINES
TB 643	GUIDE TO THE OPERATION OF CONVENTIONAL CONDUCTOR SYSTEMS ABOVE 100°C
TB 638	GUIDE TO OVERALL LINE DESIGN
TB 631	COATINGS FOR PROTECTING OVERHEAD POWER NETWORK EQUIPMENT IN WINTER CONDITIONS
TB 601	GUIDE FOR THERMAL RATING CALCULATIONS OF OVERHEAD LINES
TB 585	GUIDELINES FOR THE MANAGEMENT OF RISK ASSOCIATED WITH SEVERE CLIMATIC EVENTS AND CLIMATE CHANGE ON OVERHEAD LINES
TB 583	GUIDE TO THE CONVERSION OF EXISTING AC LINES TO DC OPERATION
TB 561	LIVE WORK - A MANAGEMENT PERSPECTIVE
TB 545	ASSESSMENT OF IN-SERVICE COMPOSITE INSULATORS BY USING DIAGNOSTIC TOOLS
TB 516	GEOTECHNICAL ASPECTS OF OVERHEAD TRANSMISSION LINE ROUTING - AN OVERVIEW
TB 515	MECHANICAL SECURITY OF OVERHEAD LINES CONTAINING CASCADING FAILURES AND MITIGATING THEIR EFFECTS
TB 498	GUIDE FOR APPLICATION OF DIRECT REAL-TIME MONITORING SYSTEMS
TB 485	OVERHEAD LINE DESIGN GUIDELINES FOR MITIGATION OF SEVERE WIND STORM DAMAGE
TB 482	STATE OF THE ART FOR TESTING SELF-DAMPING CHARACTERISTICS OF CONDUCTORS FOR OVERHEAD LINES
TB 481	GUIDE FOR THE ASSESSMENT OF COMPOSITE INSULATORS IN THE LABORATORY AFTER THEIR REMOVAL FROM SERVICE
TB 477	EVALUATION OF AGED FITTINGS

All of the above TBs are available for download from [www.e-cigre.org](http://www.e-cigre.org)

## CONTACT

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## Substations and electrical installations

Study Committee B3 [or SC B3] addresses a wide range of topics that are applicable to the entire life-cycle of substation assets; from conception, through research, development, design, production, deployment, maintenance, operation, and finally, end-of life and disposal. Our activities address all stages of asset life and include not only technical aspects but also safety, economic, environmental and social aspects.

### PRINCIPAL AREAS OF INTEREST

- New substation concepts including the integration of new primary and secondary technologies.
- Life-cycle management of substations, including renovation, maintenance, monitoring, reliability and sustainability issues.
- The impact of new communication standards and smart grids on new and existing substations.
- Special purpose substations such as off-shore substations and also low cost and fast deployment substations.
- The management of safety and risk in the design, installation, operation and maintenance of substations.

### CURRENT ACTIVITIES

SC B3 has more than 350 experts in 17 active Working Groups, focusing on activities in 4 different topic streams relating to the following substation technical and operational areas:

Substation Concepts and Developments.  
Gas insulated substations (includes gas insulated lines).  
Air Insulated Substations.  
Substation Management.

### KEY PROJECTS / FORTHCOMING EVENTS

**CIGRE – Springer “Major Reference Book” Series**, Greenbook: Substations, published in 2018 and the SF6 Greenbook to be published in 2019.

**CIGRE Session 47**, including the tutorial: **“Contemporary solutions for low cost substation design to be held”** on 29 August 2018, Paris; and an open discussion workshop on **“Safe working in substations to be held”** on Friday 31 August 2018.

**CIGRE Romania Conference and Colloquium on “Condition, Monitoring, Diagnosis and Maintenance (CMDM 2019)”**, 7-13 September 2019, Bucharest, Romania.

**CIGRE-IEC, UHV (AC/DC) – “New Trends of Advanced Technology for Efficient Economical and Resilient Power Systems”**, Hakodate, Japan, on 23-26 April 2019.

**Symposium and Study Committee Meeting: “Towards active, sustainable digital networks that are resilient and integrated from UHV to distribution”**, Chengdu, China,



### MAIN AREA OF ATTENTION

#### Transmission and Distribution

substations play a key role as active nodes within electrical networks, providing the ability for the network to deliver reliable energy with high availability.

**SC B3 aims to serve** a broad range of target groups in the electric power industry whose needs include the technical, economic, environmental and social aspects of substations.

#### The recently revised SC B3 mission is to:

- Facilitate and promote the progress of substation engineering and the international exchange of information and knowledge in the substations field.
- Add value to this information and knowledge by synthesizing state-of-the-art practices and developing recommendations.

**Major objectives for SC B3** include improving plant reliability and availability, optimizing substation asset management, identifying best value solutions, minimizing environmental impact while recognizing social needs and priorities in facilitating the sustainable development of substations.

**In its work, SC B3 maintains** close liaison and working relationships with other study committees and constitutes a bridge between the “system” study committees (the C-committees) and the more specialized “equipment” committees (the A-committees).

## TOPICS OF WORKING GROUPS

The list of active working groups in Study Committee is continually evolving to meet the needs of our stakeholders. The current working groups include the following:

WG B3.34	EXPECTED IMPACT OF FUTURE GRID CONCEPT ON SUBSTATION MANAGEMENT
WG B3.35	SUBSTATION EARTHING SYSTEM DESIGN OPTIMISATION THROUGH THE APPLICATION OF QUANTIFIED RISK ANALYSIS
WG B3.38	MANAGEMENT OF RISK IN SUBSTATIONS
WG B3.39	IMPACT OF NCIT (OR LPIT) APPLICATIONS ON HV GAS INSULATED SWITCHGEAR
WG B3.41	MOBILE SUBSTATIONS INCORPORATING HV GIS - DESIGN ASPECTS
WG B3.42	RELIABILITY ANALYSIS AND DESIGN GUIDELINES FOR LV AC/DC AUXILIARY SYSTEMS
WG B3.43	CONTEMPORARY SOLUTIONS FOR LOW COST SUBSTATIONS
WG B3.44	SUBSTATION SERVICING AND SUPERVISION USING MOBILE DEVICES AND SMART SENSING
WG B3.45	APPLICATION OF NON-SF6 GASES OR MIXTURES IN MEDIUM VOLTAGE AND HIGH VOLTAGE GAS-INSULATED SWITCHGEAR
WG B3.46	GUIDELINES FOR SAFE WORK METHODS IN SUBSTATIONS
WG B3.47	APPLICATION OF ROBOTICS IN SUBSTATIONS
WG B3.48	ASSET HEALTH INDICES FOR EQUIPMENT IN EXISTING SUBSTATIONS
WG B3.49	REVIEW OF BUSBAR COMPONENT RELIABILITY
WG B3.50	CONCEPTS FOR ONSITE TESTING OF GIS
WG B3.51	SERVICE CONTINUITY GUIDE FOR THE MAINTENANCE, REPAIR AND EXTENSION OF HV GIS
JWG B1/B3.49	STANDARD DESIGN OF A COMMON, DRY TYPE PLUG-IN INTERFACE

Go to <http://www.cigre.org/Technical-activities/Study-Committees-Working-Groups> for latest info

## LATEST PUBLICATIONS

As each working group completes its work a Technical Brochure is produced and available for reference. These documents are a valuable resource for the industry. The most recent publications include:

TB 660	SAVING THROUGH OPTIMISED MAINTENANCE IN AIR-INSULATED SUBSTATIONS
TB 674	BENEFITS OF PD DIAGNOSIS ON GIS CONDITION ASSESSMENT
TB 686	MITIGATING THE EFFECTS OF ARCS IN MV SWITCHGEAR
TB 723	SF6 MEASUREMENT GUIDE
TBC	MANAGING RISK IN SUBSTATIONS
TBC	CONTEMPORARY DESIGN SOLUTIONS FOR LOW COST SUBSTATIONS
SPRINGER SUBSTATIONS GREENBOOK LAUNCHED IN 2018	

All of the above TBs are available for download from [www.e-cigre.org](http://www.e-cigre.org)

## TUTORIALS

SC B3 provides tutorials and expert presenters on a range of important topics. These tutorials can be delivered anywhere around the globe to add value to industry conferences and other events. The list of Tutorials is continuously growing and can be tailored for your specific event requirements. The following topics are available for your event:

SAVINGS THROUGH OPTIMISED MAINTENANCE OF AIR-INSULATED SUBSTATIONS
AIR-INSULATED SUBSTATION DESIGN FOR SEVERE CLIMATE CONDITIONS
UPGRADING AND UPRATING OF SUBSTATIONS
OBTAINING (BUSINESS) VALUE FROM ONLINE CONDITION MONITORING
STANDARDISATION VERSUS INNOVATION IN SUBSTATION DESIGN
APPLICATION GUIDELINES FOR TURN-KEY PROJECTS
CIRCUIT CONFIGURATION OPTIMISATION
RESPONSIBLE USE OF SF6 – CHALLENGES AND OPTIONS
SF6 ANALYSIS FOR AIS, GIS AND MTS SUBSTATION CONDITION ASSESSMENT
HIGH VOLTAGE OFF-SHORE SUBSTATIONS
CONSIDERATIONS FOR AC COLLECTOR SYSTEMS AND SUBSTATIONS CONNECTED WITH HVDC WIND INSTALLATIONS
CONTEMPORARY DESIGN SOLUTIONS FOR LOW COST SUBSTATIONS
SUBSTATION EARTHING SYSTEM DESIGN OPTIMISATION THROUGH THE APPLICATION OF QUANTIFIED RISK ANALYSIS
GROUNDING AND INSULATION COORDINATION

## CONTACT

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## DC Systems and Power Electronics

The scope of SC B4 covers High Voltage Direct Current systems and power electronic equipment for AC systems.

The study committee also covers DC systems and equipment and Power Electronics for other applications such as distribution, and Power Quality improvement. Overhead lines or cables, which may be used in DC systems are not included in the scope of SC B4. DC converters for energy storage are part of the activities of SC B4. The members of SC B4 come from manufacturers, utilities, transmission system operators (TSOs), distribution system operators (DSOs), consultants and research institutes. SC B4 is active in recruiting young engineers to participate in its activities. SC B4 is also expanding its activities to cover DC and power electronics applications in distribution systems.



### STATUS OF THE DC AND POWER ELECTRONICS TECHNOLOGY AND MARKETS

**The DC market** has been driven by the increasing requirement for more electrical power demand in many countries and the need to connect large scale remote wind power in Europe and North America.

It is also on the rise because of interconnections between countries.

**The HVDC technology and market encompasses**, the Line Commutated Converter [LCC] HVDC and the Voltage Source Converter [VSC] HVDC.

**The LCC** which is based on the use of Thyristor valves, has now reached  $\pm 800\text{kVdc}$ , and dc power of 8000 MW for a single transmission link. Ratings of LCC of up to 12GW, and  $\pm 1100\text{kVdc}$  on a single bipole is under construction.

**The VSC** which is based on the use of Insulated Gate Bipolar Transistors [IGBT] can be based on a Symmetrical monopole configuration or a bipolar configuration.

**The MMC** converter both as a half bridge and full bridge are being utilized. The VSC applications are increasing mainly in the area of integration of renewables mainly wind and PV. Offshore wind integration utilizing VSC converters on platforms are also increasing.

#### The Flexible AC Transmission System

**[FACTS] market** is also active with Static Var Compensator [SVC] and Static Synchronous Compensators [STATCOM] projects being implemented to support the transmission of AC power from remote wind farms, and the change of generation patterns within the ac networks.

**Another active area is the refurbishment** of both HVDC installations and FACTS installations. Several approaches are seen in the industry, complete replacement with increased ratings, and partial replacement of the critical components such as thyristor valves, control and protection, and converter transformers.

**Also to increase power transmission capability** of existing corridors, conversion of existing AC lines in to DC is being actively considered.

### KEY PROJECTS / FORTHCOMING EVENTS

**HVDC tutorial** during the session on August 27<sup>th</sup>, 2018.

#### Planned SC meetings

**SC B4, 2019 meeting, South Africa** [September 28 to October 4].

**SC B4** is participating in the **Aalborg-Denmark symposium**, between June 3<sup>rd</sup> and June 6<sup>th</sup>, 2019; and in the **Hakodate-Japan Cigre/IEC UHV and EHV** between April 23<sup>rd</sup> and April 26<sup>th</sup>, 2019.



## TOPICS OF WORKING GROUPS

JWG B4/B5.59	CONTROL AND PROTECTION OF HVDC GRIDS
WG B4.64	IMPACT OF AC SYSTEM CHARACTERISTICS ON THE PERFORMANCE OF HVDC SCHEMES
JWG C4/B4.38	NETWORK MODELING FOR HARMONIC STUDIES
WG B4.66	IMPLICATIONS FOR HARMONICS AND FILTERING OF THE STAGGERED INSTALLATION OF HVDC CONVERTER STATIONS IN PROXIMATE LOCATIONS
WG B4.67	HARMONIC ASPECTS OF VSC HVDC, AND APPROPRIATE HARMONIC LIMITS
WG B4.68	REVISION OF TECHNICAL BROCHURE 92 – DC HARMONICS AND FILTERING OF HVDC SCHEMES
WG B4.69	MINIMIZING LOSS OF TRANSMITTED POWER BY VSC DURING OVERHEAD LINE FAULT
WG B4.70	GUIDE FOR ELECTROMAGNETIC TRANSIENT STUDIES INVOLVING VSC CONVERTERS
WG B4.71	APPLICATION GUIDE FOR INSULATION COORDINATION OF VSC CONVERTER STATIONS
WG B4.72	DC GRID BENCHMARK MODELS FOR SYSTEM STUDIES
JWG B4/B1/C4.73	SURGE AND EXTENDED OVERVOLTAGE TESTING OF HVDC CABLE SYSTEMS
WG B4.74	GUIDE TO DEVELOP REAL-TIME SIMULATION MODELS (RTSM) FOR HVDC OPERATIONAL STUDIES
WG B4.75	FEASIBILITY STUDY FOR ASSESSMENT OF LAB LOSSES MEASUREMENT OF VSC VALVES
WG B4.76	DC-DC CONVERTERS IN HVDC GRIDS AND FOR CONNECTIONS TO HVDC SYSTEMS
JWG C2/B4.38	CAPABILITIES AND REQUIREMENTS DEFINITION FOR POWER ELECTRONICS BASED TECHNOLOGY FOR SECURE AND EFFICIENT SYSTEM OPERATION AND CONTROL
WG B4.78	CYBER ASSET MANAGEMENT FOR HVDC AND FACTS
TF B4.77	AC FAULT RESPONSE OPTIONS FOR VSC HVDC CONVERTERS.

## PUBLICATIONS

WG B4.58	DEVICES FOR LOAD FLOW CONTROL AND METHODOLOGIES FOR DIRECT VOLTAGE CONTROL IN A MESHED HVDC GRID TB 699
WG B4.60	DESIGNING HVDC GRIDS FOR OPTIMAL RELIABILITY AND AVAILABILITY PERFORMANCE TB 713
WG B4.61	GENERAL GUIDELINES FOR HVDC ELECTRODE DESIGN
WG B4.63	COMMISSIONING OF VSC HVDC SCHEMES TB 697
JWG B4/C1 65	RECOMMENDED VOLTAGES FOR HVDC GRIDS TB 684
JWG A3/B4.34	TECHNICAL REQUIREMENTS AND SPECIFICATIONS OF STATE-OF-THE-ART DC SWITCHING EQUIPMENT TB 683
ADVISORY GROUP B4.04	PROTOCOL FOR REPORTING OPERATIONAL PERFORMANCE OF FACTS TB 717

## CONTACT

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## Protection and Automation

The scope of the Committee covers the principles, design, application and management of power system protection, substation control, automation, monitoring, recording and metering – including associated internal and external communications and interfacing for remote control and monitoring.

### PRINCIPAL AREAS OF INTEREST

- Improved concepts of Substation Automation Systems.
- New requirements and concepts for metering and monitoring.
- Technical recommendations and applications for standard IEC 61850.
- Methods to improve the performance of protection systems.
- Protection implications of new generation technologies and system requirements.
- Wide-Area Protection, Metering and Monitoring.

### CURRENT ACTIVITIES

Analysis of protection and automation requirements for Distributed Energy Resources.

Improvement in education and tutorials for young protection and automation engineers.

### KEY PROJECTS / FORTHCOMING EVENTS

**Reference book** about standard IEC 61850.

**Standardization of tutorials** about protection and automation.

**SC B5 2019 Colloquium** in Norway.

### OTHER SPECIFIC INTEREST

- Software tools for specification, test, maintenance and operation of protection and automation.
- Remote access and managing of protection and automation.



### MAIN AREA OF ATTENTION:

#### **New technological solutions:**

Suitable technical recommendations and support for standardization process of protection and automation systems.

#### **New concepts of Protection and Automation:**

- Innovative techniques for design and testing.
- New possibilities of enhanced communications; clarification of requirements from users.
- Experience and feedback in IEC 61850; awareness of engineering roles and responsibilities.
- Implementation and exploitation of process buses.
- New requirements and specification for metering.

Reliability improvements of Protection and Automation.

Improved methods to maintain supply reliability; new approaches, tools and system to eliminate human errors; new tools and methods for protections coordination; standardization of schemes and functions of protection; and innovative methods for maintenance.

Protection implications of New Network Requirements.

Protection and automation requirements in the network of the future; and protection and automation requirements for distributed generation.

## TOPICS OF WORKING GROUPS

WG.B5.24	PROTECTION REQUIREMENTS ON TRANSIENT RESPONSE OF VOLTAGE AND CURRENT DIGITAL ACQUISITION CHAIN
WG.B5.41	INVESTIGATION OF POSSIBILITIES TO IMPROVE METERING SYSTEMS FOR BILLING PURPOSES IN SUBSTATIONS
WG.B5.47	NETWORK PROTECTION PERFORMANCE AUDITS
WG.B5.48	PROTECTION FOR DEVELOPING NETWORK WITH LIMITED FAULT CURRENT CAPABILITY OF GENERATION
WG.B5.50	IEC 61850 BASED SUBSTATION AUTOMATION SYSTEMS – USERS EXPECTATIONS AND STAKEHOLDERS INTERACTIONS
WG.B5.51	REQUIREMENTS AND USE OF REMOTELY ACCESSED INFORMATION FOR SAS MAINTENANCE AND OPERATION
WG.B5.52	ANALYSIS AND COMPARISON OF FAULT LOCATION SYSTEMS IN SUBSTATION AUTOMATION SYSTEMS
WG.B5.53	TEST STRATEGY FOR PROTECTION, AUTOMATION AND CONTROL (PAC) FUNCTIONS IN A FULL DIGITAL SUBSTATION BASED ON IEC 61850 APPLICATIONS
WG.B5.54	PROTECTION AND AUTOMATION ISSUES OF ISLANDED SYSTEMS DURING SYSTEM RESTORATION/BLACK START
WG.B5.55	APPLICATION OF TRAVELLING WAVE TECHNOLOGY FOR PROTECTION AND AUTOMATION
WG.B5.56	OPTIMIZATION OF PROTECTION AUTOMATION AND CONTROL SYSTEMS
WG.B5.57	NEW CHALLENGES FOR FREQUENCY PROTECTION
WG.B5.58	FASTER PROTECTION AND NETWORK AUTOMATION SYSTEMS: IMPLICATIONS AND REQUIREMENTS
WG.B5.59	REQUIREMENTS FOR NEAR-PROCESS INTELLIGENT ELECTRONIC DEVICES
WG.B5.62	LIFE CYCLE TESTING OF SYNCHROPHASOR BASED SYSTEMS USED FOR PROTECTION, MONITORING AND CONTROL
WG.B5.63	PROTECTION, AUTOMATION AND CONTROL SYSTEM ASSET MANAGEMENT
WG.B5.64	METHODS FOR SPECIFICATION OF FUNCTIONAL REQUIREMENTS OF PROTECTION, AUTOMATION, AND CONTROL
WG.B5.65	ENHANCING PROTECTION SYSTEM PERFORMANCE BY OPTIMISING THE RESPONSE OF INVERTER-BASED SOURCES
WG.B5.66	CYBERSECURITY REQUIREMENTS FOR PACS AND THE RESILIENCE OF PAC ARCHITECTURES
JWG C4/B5.41	SUB-SYNCHRONOUS RESONANCE IN EXISTING AND FUTURE NETWORKS - DETECTION AND MITIGATION
JWG A3/B5/C4.37	SYSTEM CONDITIONS FOR AND PROBABILITY OF OUT-OF-PHASE
JWG B5/D2.67	TIME IN COMMUNICATION NETWORKS, PROTECTION AND CONTROL APPLICATIONS - TIME SOURCES AND DISTRIBUTION METHODS

## LATEST PUBLICATIONS

TB 716	SYSTEM CONDITIONS FOR AND PROBABILITY OF OUT-OF-PHASE
TB 711	CONTROL AND AUTOMATION SYSTEMS FOR ELECTRICITY DISTRIBUTION NETWORKS (EDN) OF THE FUTURE
TB 687	EXPERIENCE CONCERNING AVAILABILITY AND RELIABILITY OF DIGITAL SUBSTATION AUTOMATION SYSTEMS (DSAS)
TB 664	WIDE AREA PROTECTION & CONTROL TECHNOLOGIES
TB 637	ACCEPTANCE, COMMISSIONING AND FIELD TESTING TECHNIQUES FOR PROTECTION AND AUTOMATION SYSTEMS
TB 629	COORDINATION OF PROTECTION AND AUTOMATION FOR FUTURE NETWORKS
TB 599	EDUCATION, QUALIFICATION AND CONTINUING PROFESSIONAL DEVELOPMENT OF ENGINEERS IN PROTECTION AND CONTROL
TB 628	DOCUMENTATION REQUIREMENTS FROM DESIGN TO OPERATION TO MAINTENANCE FOR DIGITAL SUBSTATION AUTOMATION SYSTEMS
TB 613	PROTECTION OF DISTRIBUTION SYSTEM WITH DISTRIBUTED ENERGY RESOURCES
TB 587	SHORT CIRCUIT PROTECTION OF CIRCUITS WITH MIXED CONDUCTOR TECHNOLOGIES IN TRANSMISSION NETWORKS
TB 603	APPLICATION AND MANAGEMENT OF CYBER SECURITY MEASURES FOR PROTECTION & CONTROL SYSTEMS
TB 432	PROTECTION RELAY COORDINATION
TB 431	MODERN TECHNIQUES FOR PROTECTING BUSBARS IN HV NETWORKS
TB 427	THE IMPACT OF IMPLEMENTING CYBER SECURITY REQUIREMENTS USING IEC 61850
TB 424	NEW TRENDS FOR AUTOMATED FAULT AND DISTURBANCE ANALYSIS
TB 421	THE IMPACT OF RENEWABLE ENERGY SOURCES AND DISTRIBUTED GENERATION ON SUBSTATION PROTECTION AND AUTOMATION
TB 411	PROTECTION, CONTROL AND MONITORING OF SERIES COMPENSATED NETWORKS
TB 404	ACCEPTABLE FUNCTIONAL INTEGRATION IN HV SUBSTATIONS
TB 479	INTERNATIONAL GUIDE ON THE PROTECTION OF SYNCHRONOUS GENERATORS
TB 465	MODERN TECHNIQUES FOR PROTECTING AND MONITORING OF TRANSMISSION LINES
TB 463	MODERN TECHNIQUES FOR PROTECTING, CONTROLLING AND MONITORING POWER TRANSFORMERS
TB 448	REFURBISHMENT STRATEGIES BASED ON LIFE CYCLE COST AND TECHNICAL CONSTRAINTS
TB 466	ENGINEERING GUIDELINES FOR IEC 61850 BASED DIGITAL SAS
TB 464	MAINTENANCE STRATEGIES FOR DIGITAL SUBSTATION AUTOMATION SYSTEMS
TB 584	IMPLICATIONS AND BENEFITS OF STANDARDISED PROTECTION AND CONTROL SCHEMES
TB 546	PROTECTION, MONITORING AND CONTROL OF SHUNT REACTORS
TB 540	APPLICATIONS OF IEC 61850 STANDARD TO PROTECTION SCHEMES
TB 539	LIFE-TIME MANAGEMENT OF RELAY SETTINGS

All of the above TBs are available for download from [www.e-cigre.org](http://www.e-cigre.org)

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## Power System Development and Economics

The SC's work includes issues, methods and tools related for the development and economics of power systems, including the drivers to: invest in expanding power networks and sustaining existing assets, increase power transfer capability, integrate distributed and renewable resources, manage increased horizontal and vertical interconnection, and maintain acceptable reliability in a cost-efficient manner. The SC aims to support planners to anticipate and manage change guidelines and recommendations.

### PRINCIPAL AREAS OF INTEREST

- Methods and practices for system development.
- Business investment.
- Interface and allocation issues in multi-party/cross-jurisdictional projects.
- Asset management.

These are particularly needed during the on-going electricity system paradigm shift brought about by rapid evolution in generation patterns and economics, demand response, ICT, and in social, environmental and regulatory frameworks and expectations.

### CURRENT ACTIVITIES

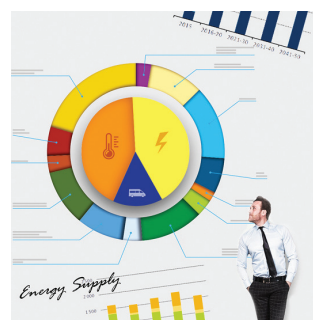
- System planning and securing investment in transmission and distribution networks against a backdrop of increasing uncertainty.
- Reviewing best practice in the management of interface and allocation issues in multi-party/cross-jurisdictional projects.
- Reviewing the application of enhanced asset management methodologies and the role of valuation in asset management decisions.
- Global electricity network feasibility study.
- Planning coordination between SO, TO and DSO.
- Review of Large City & Metropolitan Area power system development trends.
- With contributions from other Study Committees, coordination of a Green Book on 'asset management'.

### KEY PROJECTS / FORTHCOMING EVENTS

**Symposium "Towards active, sustainable, digital networks that are resilient and integrated from UHV to distribution",** Chengu, China, September 20-25, 2019.

### OTHER SPECIFIC INTEREST

To inform a broad stakeholder group on issues, challenges and solutions relating to power system planning, investment, development and asset management.



### MAIN FOCUS AREAS

#### System planning

- System planning and technology issues in specific contexts e.g. off-shore wind, large surpluses/deficits in available RES, and power exchange with distribution systems.
- Methods and tools for steady state and dynamic analysis in system planning.
- Power system planning under increasing uncertainty and with increasingly active distribution systems.
- Impact of increased interaction between transmission and distribution systems on definitions of reliability, adequacy and security.
- Power system development trends in large city and metropolitan areas.

#### Asset management

- High level asset management strategies in defining sustainable policies and optimal practices.
- Using total life cycle cost of asset ownership to inform investment decisions.
- Risk-based analysis aimed at identifying existing assets that require attention.
- Application of ISO Series 55000 to utility businesses.

#### Business management

- Impact of business models on system development (investment prioritisation across projects/programs, merchant lines, public-private partnerships).
- Development of demand and energy forecasts to support system planning.
- Scenarios and methodologies for quantitative studies on future power systems.
- Timely engagement of stakeholders in investment decision processes.

#### Interconnections – horizontal/vertical

- System planning issues and best practice for scenarios related to long-distance/continental-scale systems.
- Interface and allocation issues in planning and delivery of multi-party/cross-jurisdiction projects.
- Planning regulated/non-regulated transmission assets in parallel, optimal sizing of interconnectors.
- Coordinated planning with evolving smart and active distribution systems.

## TOPICS OF WORKING GROUPS

WG C1.22	NEW INVESTMENT DECISION PROCESSES AND REGULATORY PRACTICES REQUIRED TO DEAL WITH CHANGING ECONOMIC DRIVERS
WG C1.23	TRANSMISSION INVESTMENT DECISION POINTS AND TREES
JWG C1/C3.31	INCLUDING STAKEHOLDERS IN THE INVESTMENT PLANNING PROCESS
WG C1.33	INTERFACE AND ALLOCATION ISSUES IN MULTI-PARTY AND/OR CROSS-JURISDICTION POWER INFRASTRUCTURES PROJECTS
WG C1.34	ISO SERIES 55000 STANDARDS: GENERAL PROCESS ASSESSMENT STEPS AND INFORMATION REQUIREMENTS FOR UTILITIES
WG C1.35	GLOBAL ELECTRICITY NETWORK FEASIBILITY STUDY
JWG C1/C4.36	REVIEW OF LARGE CITY & METROPOLITAN AREA POWER SYSTEM DEVELOPMENT TRENDS TAKING INTO ACCOUNT NEW GENERATION, GRID AND INFORMATION TECHNOLOGIES
WG C1/C6/Cired.37	OPTIMAL TRANSMISSION AND DISTRIBUTION INVESTMENT DECISIONS UNDER GROWING UNCERTAINTY.
WG C1.39	OPTIMAL POWER SYSTEM PLANNING UNDER GROWING UNCERTAINTY
WG C1.38	VALUATION AS A COMPREHENSIVE APPROACH TO ASSET MANAGEMENT IN VIEW OF EMERGING DEVELOPMENTS.
WG C1-40	PLANNING COORDINATION BETWEEN SYSTEM OPERATORS, TRANSMITTERS AND DISTRIBUTORS: FRAMEWORKS, METHODS, AND ALLOCATION OF COSTS AND BENEFITS.

## LATEST PUBLICATIONS

TB 666	TECHNICAL RISKS AND SOLUTIONS FROM PERIODIC, LARGE SURPLUSES OR DEFICITS OF AVAILABLE RENEWABLE GENERATION
TB 670	ESTABLISHING BEST PRACTICE APPROACHES FOR DEVELOPING CREDIBLE ELECTRICITY DEMAND AND ENERGY FORECASTS FOR NETWORK PLANNING
TB 681	PLANNING CRITERIA FOR FUTURE TRANSMISSION NETWORKS IN THE PRESENCE OF A GREATER VARIABILITY OF POWER EXCHANGE WITH DISTRIBUTION SYSTEMS
TB 684	RECOMMENDED VOLTAGES FOR HVDC GRIDS
TB 701	REVIEW OF DRIVERS FOR TRANSMISSION INVESTMENT DECISIONS
TB 715	THE FUTURE OF RELIABILITY - DEFINITION OF RELIABILITY IN LIGHT OF NEW DEVELOPMENTS IN VARIOUS DEVICES AND SERVICES WHICH OFFER CUSTOMERS AND SYSTEM OPERATORS NEW LEVELS OF FLEXIBILITY
WGR 293-1 2017	THE GLOBAL ELECTRICITY NETWORK - CONCEPT OF STUDY
RP 293-1 2017	NETWORK LOSSES

All of the above TBs are available for download from [www.e-cigre.org](http://www.e-cigre.org)

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## System Operation and Control

The scope of the SC C2 covers the technical, human resource and institutional aspects and conditions for a secure and economic system operation of power systems in a way that is in compliance with requirements for network security, against system disintegration, equipment damages and human injuries, and security of electricity supply. The members of C2 mainly come from transmission system operators. The SC is encouraging young members to participate in its activities.

### PRINCIPAL AREAS OF INTEREST

- Real-time System Operation and Control.
- System Operational Planning and Performance Analysis.
- Control Centre Infrastructure and Human Resources for System Operation.

### CURRENT ACTIVITIES

Managing new challenges in operational planning and real-time operation of power systems with increasing levels of power electronics interfaced generation.

Emerging operational Issues for Transmission and Distribution interaction, including operator training.

### KEY PROJECTS / FORTHCOMING EVENTS

**Publication:** Reference Paper on Power System Restoration.

**Workshop:** Large Disturbances during CIGRE Session, Paris, 27 August 2018.

**Tutorial:** System Operation Emphasising DSO/TSO Interaction and Coordination, Paris, 29 August 2018.

**Symposium:** CIGRE International Symposium, Aalborg, Denmark: 3-6 June 2019.



### MAIN AREA OF ATTENTION

**SC C2 focuses on the control**, monitoring and switching of equipment, management of ancillary services, such as voltage and frequency control, monitoring of operational limits and actions to maintain network security and to avoid congestion [e.g. short-term planning and coordination of capacity calculation].

**Developments and changes** in the business of System Operators and its integration in the evolving environment: energy transition impact, integration of new technologies, operation and management of new solutions [e.g. large-scale energy storage and transition to hybrid AC/DC systems], including cross-border interconnection, and common and coordinated activities.

**Evaluation and benchmarking** of the system's performance in terms of disturbance frequency, power interruptions, power quality, operational and outage planning efficiency, both from the technical and economical points of view. To this end, attention is given to emergency management, restoration practices, resilience enhancement strategies, and also to interactions and coordination between active players in the power system.

**The integration of PMU-based WAMS** within the control centre environment and its contribution to power system analysis and security assessment functionalities is one of the recent attention points within the SC. Furthermore, continued efforts are made to document requirements, methods, tools and performance indicators for control centres and training of system operators, as these are specific to and essential for System Operation.



## TOPICS OF WORKING GROUPS

WG C2.17	WIDE AREA MONITORING SYSTEMS – SUPPORT FOR CONTROL ROOM APPLICATIONS
WG C2.24	MITIGATING THE RISK OF FIRE STARTS AND THE CONSEQUENCES OF FIRES NEAR
WG C2.25	OPERATING STRATEGIES AND PREPAREDNESS FOR SYSTEM OPERATIONAL RESILIENCE
WG C2.39	OPERATOR TRAINING IN ELECTRICITY GRIDS AT DIFFERENT CONTROL LEVELS AND FOR DIFFERENT PARTICIPANTS/ACTORS IN THE NEW ENVIRONMENT
WG C2.40	TSO-DSO Co-OPERATION – CONTROL CENTRE TOOLS REQUIREMENTS
JWG C2/C5-05	DEVELOPMENTS AND CHANGES IN THE BUSINESS OF SYSTEM OPERATORS
JWG C2/C6.36	SYSTEM OPERATION EMPHASISING DSO/TSO INTERACTION AND COORDINATION
JWG C2/C4.37	RECOMMENDATIONS FOR SYSTEMATIC FRAMEWORK DESIGN OF POWER SYSTEM STABILITY CONTROL
JWG C2/B4.38	CAPABILITIES AND REQUIREMENTS DEFINITION FOR POWER ELECTRONICS BASED TECHNOLOGY FOR SECURE AND EFFICIENT SYSTEM OPERATION AND CONTROL

## LATEST PUBLICATIONS

C2/C4	REFERENCE PAPER ON EFFECTS OF INCREASING POWER ELECTRONICS BASED TECHNOLOGY ON POWER SYSTEM STABILITY: PERFORMANCE AND OPERATIONS
TB 677	POWER SYSTEM OPERATOR PERFORMANCE: CORPORATE, OPERATIONS AND TRAINING GOALS AND KPI'S USED
TB 688	DEVELOPMENTS OF RELIABILITY STANDARDS AND MARKET RULES
TB 700	CHALLENGES IN THE CONTROL CENTER (EMS) DUE TO DISTRIBUTED GENERATION AND RENEWABLES
TB 712	SYSTEM RESTORATION PROCEDURE AND PRACTICES

All of the above TBs are available for download from [www.e-cigre.org](http://www.e-cigre.org)

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## System Environmental Performance

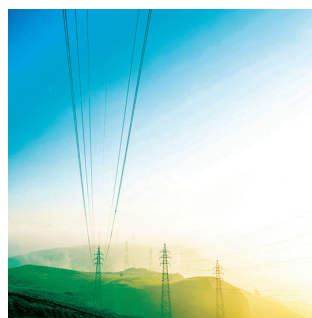
The mission of this Study Committee is to facilitate and promote the progress of engineering and the international exchange of information and knowledge in the field of system environmental performance, and to add value to this information and knowledge by means of synthesizing state-of-the-art practices and developing recommendations.

### PRINCIPAL AREAS OF INTEREST

- Environmental impacts of power system development and operation, sustainable development vs economic development, risk assessment and the economics of impact containment, power system efficiency and the environment.
- Stakeholders engagement and communication, effective communication with the public And regulatory authorities, public acceptance of power system infrastructure.
- Tools and measures for quantifying, controlling and mitigating the environmental impact such as life-cycle assessment (LCA), environmental product declarations (EPD), global benchmarking, etc.
- Global environmental changes relevant to the power system, awareness of the activities of global organisations in the environmental field and establishing appropriate co-operations and liaisons.

### OTHER SPECIFIC INTEREST

- Environmental implications of energy storage technologies.
- Sustainability of the system, CIGRE's responsibility.



### MAIN AREA OF ATTENTION

**The scope of the study committee C3** covers the identification, assessment and management of the interactions between the natural and social environments, and the end-to-end electric power system, recognising the importance and influence of a wide range of stakeholders and communities. Recommendations for appropriate monitoring, management and control measures in fields such as greenhouse gases (like SF<sub>6</sub>), air, soil and water pollution, electromagnetic fields, noise, visual amenity, land use and consequences for flora and fauna.

## TOPICS OF WORKING GROUPS

WG C3.01	EMF AND HEALTH
WG C3.05	ENVIRONMENTAL IMPACT OF DISPERGED GENERATION (DISBANDED 2017)
WG C3.08	EXTERNAL COSTS FOR POWER LINES (DISBANDED 2016)
WG C3.09	CORRIDOR MANAGEMENT (RE-LAUNCHED 2018)
WG C3.12	METHODOLOGIES FOR GREENHOUSE GAS INVENTORY AND REPORTING FOR T&D UTILITIES
JWG C3.13/ B1/B2	ENVIRONMENTAL ISSUES OF HIGH VOLTAGE TRANSMISSION LINES FOR RURAL AND URBAN AREAS
WG C3.14	IMPACT OF ENVIRONMENTAL LIABILITY ON TRANSMISSION AND DISTRIBUTION ACTIVITIES
WG C3.15	BEST ENVIRONMENTAL AND SOCIO-ECONOMIC PRACTICES FOR IMPROVING PUBLIC ACCEPTANCE OF HIGH VOLTAGE SUBSTATIONS
WG C3.16	GRID AND WILDLIFE
WG C3.17	INTERACTIONS BETWEEN WILDLIFE AND EMERGING RENEWABLE ENERGY SOURCES AND ASSOCIATED INSULATED CABLES
WG C3.18	ECO-FRIENDLY APPROACHES IN TRANSMISSION AND DISTRIBUTION
WG C3.19	RESPONSIBLE MANAGEMENT OF THE ELECTRIC AND MAGNETIC FIELD ISSUE

## LATEST PUBLICATIONS

TB 616	EXTERNALITIES OF OVERHEAD HIGH VOLTAGE POWER LINES
TB 650	SUSTAINABLE DEVELOPMENT PERFORMANCE INDICATORS FOR ELECTRIC POWER GENERATION
TB 679	ENVIRONMENTAL IMPACT OF DISPERGED GENERATION
TB 548	STAKEHOLDER ENGAGEMENT STRATEGIES IN SUSTAINABLE DEVELOPMENT - ELECTRICITY INDUSTRY OVERVIEW
TB 487	STRATEGIC ENVIRONMENTAL ASSESSMENT FOR POWER DEVELOPMENTS
TB 383	SUSTAINABLE DEVELOPMENT PERFORMANCE INDICATORS FOR TRANSMISSION SYSTEM OPERATORS
TB 340	UTILITIES PRACTICES TOWARD SUSTAINABLE DEVELOPMENT

Reference paper: «Living with electric and magnetic fields [EMF]» in *Electra* June 2017.

Article *Electra* August 2016: «50-60 Hz magnetic fields and cancer, forty years of research: it is time to reassure».

All of the above TBs are available for download from [www.e-cigre.org](http://www.e-cigre.org)

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## System Technical Performance

The scope of SC C4 covers system technical performance phenomena that range from nanoseconds to many hours. SC C4 has been engaged in the following topics: Power Quality, EMC/EMI, Electromagnetic Transients and Insulation Coordination, Lightning, Power Systems Dynamics Performance, and Numerical Analysis. Study Committee C4 deals with methods and tools for analysis related to the technical performance of power systems, with particular reference to dynamic and transient conditions and to the interaction between the power system and its apparatus/sub-systems, between the power system and external causes of stress and between the power system and other installations.

### PRINCIPAL AREAS OF INTEREST

- Power Quality, Electromagnetic Compatibility and Electromagnetic Interference (EMC/EMI).
- Lightning, Electromagnetic Transients and Insulation Coordination.
- Power System Dynamics Performance and Numerical Analysis.

### CURRENT ACTIVITIES

- Power Quality and EMC – Modelling, Assessment and Standardization.
- Power System Resilience.
- Evaluation of Lightning Performance of Power Systems.
- Evaluation of Overvoltages and their Withstand Characteristics.

### KEY PROJECTS / FORTHCOMING EVENTS

**CIGRE Aalborg Symposium 2019**,  
as the lead Study Committee.

### OTHER SPECIFIC INTEREST

- Evaluation of System Technical Performance of Traditional Power Systems.
- Development of Advanced System Analysis Tools for Smart Grids.



### MAIN AREA OF ATTENTION

The SC C4 scope covers system technical performance phenomena that range from nanoseconds to many hours, in the following fields:

**Power Quality Performance:** Continuity of end-to-end electric power supply and voltage waveform quality (magnitude, frequency, symmetry). Analysis covers emission assessments from disturbing installations, measurement and simulation methods, identification of quality indices, monitoring techniques, immunity of sensitive installations, and mitigation techniques taking into account a coordinated approach across all voltage levels.

**Electromagnetic Compatibility (EMC):** High frequency disturbances on the end-to-end electricity supply and all disturbances (HF or LF) reaching equipment other than through the electricity supply. Studies include measurement and simulation methods.

**Insulation Co ordination:** Methods and tools for insulation co-ordination and electromagnetic transient analysis (eg. ferroresonance, temporary overvoltages, transformer energization) in electric power systems and equipment, contributing to optimisation of their cost and reliability.

**Lightning:** Analysis of lightning characteristics and interactions of lightning with electric power systems and equipment, including lightning protection of MV and LV networks, lightning protection of renewable energy systems, and their standardization.

**Power System Dynamics and Numerical Analysis:** Development of advanced tools, new analytical techniques for assessment of power system dynamic/transient performance, security, design of controls and modelling of existing and new equipment, real time stability evaluation and control. Numerical techniques for the computation from steady state to very fast front transients; modelling unsymmetrical conditions of power systems.

## TOPICS OF WORKING GROUPS

WG C4.503 TRANSIENTS	NUMERICAL TECHNIQUES FOR THE COMPUTATION OF POWER SYSTEMS, FROM STEADY-STATE TO SWITCHING
WG C4.23	GUIDE TO PROCEDURE FOR ESTIMATING THE LIGHTNING PERFORMANCE OF TRANSMISSION LINES
WG C4.25	ISSUES RELATED TO ELF ELECTROMAGNETIC FIELD EXPOSURE AND TRANSIENT CONTACT CURRENTS
WG C4.28 POWER LINKS	EXTRAPOLATION OF MEASURED VALUES OF POWER FREQUENCY MAGNETIC FIELDS IN THE VICINITY OF
JWG C4.31/CIREN	EMC BETWEEN COMMUNICATION CIRCUITS AND POWER SYSTEMS
WG C4.32	UNDERSTANDING OF THE GEOMAGNETIC STORM ENVIRONMENT FOR HIGH VOLTAGE POWER GRIDS
WG C4.33	IMPACT OF SOIL-PARAMETER FREQUENCY DEPENDENCE ON THE RESPONSE OF GROUNDING ELECTRODES AND ON THE LIGHTNING PERFORMANCE OF ELECTRICAL SYSTEMS
JWG C4/C6.35/CIREN	MODELLING AND DYNAMIC PERFORMANCE OF INVERTER BASED GENERATION IN POWER SYSTEM TRANSMISSION AND DISTRIBUTION STUDIES
WG C4.36	WINTER LIGHTNING – PARAMETERS AND ENGINEERING CONSEQUENCES FOR WIND TURBINES
WG C4.37	ELECTROMAGNETIC COMPUTATION METHODS FOR LIGHTNING SURGE STUDIES WITH EMPHASIS ON THE FDTD METHOD
JWG C4/B4.38	NETWORK MODELLING FOR HARMONIC STUDIES
WG C4.39	EFFECTIVENESS OF LINE SURGE ARRESTERS FOR LIGHTNING PROTECTION OF OVERHEAD TRANSMISSION LINES
JWG C4.40/CIREN	REVISIONS TO IEC TECHNICAL REPORTS 61000-3-6, 61000-3-7, 61000-3-13, AND 61000-3-14
JWG C4/B5.41	CHALLENGES WITH SERIES COMPENSATION APPLICATION IN POWER SYSTEMS WHEN OVERCOMPENSATING LINES
JWG C4.42/CIREN	CONTINUOUS ASSESSMENT OF LOW-ORDER HARMONIC EMISSIONS FROM CUSTOMER INSTALLATIONS
WG C4.43	LIGHTNING PROBLEMS AND LIGHTNING RISK MANAGEMENT FOR NUCLEAR POWER PLANTS
WG C4.44	EMC FOR LARGE PHOTOVOLTAIC SYSTEMS
WG C4.45	MEASURING TECHNIQUES AND CHARACTERISTICS OF FAST AND VERY FAST TRANSIENT OVERVOLTAGES IN SUBSTATIONS AND CONVERTER STATIONS
WG C4.46	EVALUATION OF TEMPORARY OVERVOLTAGES IN POWER SYSTEMS DUE TO LOW ORDER HARMONIC RESONANCES
WG C4.47	POWER SYSTEM RESILIENCE
WG C4.48	OVERVOLTAGE WITHSTAND CHARACTERISTICS OF POWER SYSTEM EQUIPMENT 35-1200 kV
WG C4.49	WIDEBAND STABILITY OF GRID-TIED CONVERTER-BASED MODERN POWER SYSTEMS
WG C4.50	EVALUATION OF TRANSIENT PERFORMANCE OF GROUNDING SYSTEM IN SUBSTATION AND ITS INFLUENCE ON SECONDARY SYSTEM
JWG A2/C4.52	HIGH-FREQUENCY TRANSFORMER MODELS FOR NON-STANDARD WAVEFORMS
JWG A1/C4.52	WIND GENERATORS AND FREQUENCY-ACTIVE POWER CONTROL OF POWER SYSTEMS
JWG C2/C4.37	RECOMMENDATIONS FOR SYSTEMATIC FRAMEWORK DESIGN OF POWER SYSTEM STABILITY CONTROL
JWG B4/B1/C4.73	SURGE AND EXTENDED OVERVOLTAGE TESTING OF HVDC CABLE SYSTEMS
JWG B5/C4.61	IMPACT OF LOW INERTIA NETWORK ON PROTECTION AND CONTROL
JWG C1/C4.36	REVIEW OF LARGE CITY & METROPOLITAN AREA POWER SYSTEM DEVELOPMENT TRENDS TAKING INTO ACCOUNT NEW GENERATION, GRID AND INFORMATION TECHNOLOGIES

## LATEST PUBLICATIONS

TB 719	POWER QUALITY AND EMC ISSUES WITH FUTURE ELECTRICITY NETWORKS
TB 718	BENCHMARKING OF POWER QUALITY PERFORMANCE IN TRANSMISSION SYSTEMS
TB 707	EMC IN WIND ENERGY SYSTEMS
TB 704	EVALUATION OF LIGHTNING SHIELDING ANALYSIS METHODS FOR EHV AND UHV DC AND AC TRANSMISSION LINES
TB 702	APPLICATION OF PHASOR MEASUREMENT UNITS FOR MONITORING POWER SYSTEM DYNAMIC PERFORMANCE
TB 672	POWER QUALITY ASPECTS OF SOLAR POWER
TB 656	REVIEW OF LV AND MV COMPATIBILITY LEVELS FOR VOLTAGE FLUCTUATIONS

All of the above TBs are available for download from [www.e-cigre.org](http://www.e-cigre.org)

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## Electricity Markets and Regulation

Analysis of the impacts on the planning and operation of electric power systems of different market approaches and solutions; and of new structures, institutions, actors and stakeholders. The role of competition and regulation in improving end-to-end efficiency of the electric power system.

### CURRENT ACTIVITIES

**Changes in regulatory roles** and jurisdiction related to the interaction between the transmission system and the distribution system.

**The role of Markets regarding:**

- the integration and coordination of Distributed Energy Resources;
- the impact on wholesale market price formation caused by non-wholesale market participants;
- the need for and development of Distribution Service Providers.

**The impact of emerging technologies** on system operations.

**Market clearing procedures**, techniques and principles used to take advantage of the flexibility of aggregating large numbers of end-users.

**Potential Market rule changes** to address changes in traditional Ancillary Service products.



### MAIN AREA OF ATTENTION

**Market structures** and products such as physical and financial markets and the interaction between them, contracts, internationally integrated markets.

**Techniques and tools** to support market actors such as demand and price forecasting profit estimation, financial risk management etc.

**Regulation and legislation** such as regulation objectives, extension and limits, price regulation of transmission, and ancillary services, transmission/distribution coordination and interactions, international harmonization, environmental and regulatory objectives etc.

**Evolution** of markets and regulation from wholesale transmission focus to include retail distribution. The increasing interaction between regulation and markets throughout the electric power system value chain and the ability of markets and regulation to cater to rapid evolutions in dynamic / variable generation, demand and storage technologies and behaviours.

**Coordination** of regulation, funding and trading arrangements for new assets and technologies expansion in new market structures, including the trend of decentralization of operations with distributed applications; the remaining assets coexisting with the retirement of other in utilities; the consideration of legacy trading arrangements in the new market arena.

**TOPICS OF WORKING GROUPS**

WG C5.22	THE MANAGEMENT OF SYSTEMIC MARKET RISK IN ELECTRICITY MARKETS
WG C5.23	WHOLESALE MARKET PRICE CAPS
WG C5.24	EXPLORING THE MARKET-BASED VALUE OF SMART GRID DEVELOPMENTS
WG C5.25	REGULATION & MARKET DESIGN PERSPECTIVES RAISED BY NEW STORAGE TECHNOLOGIES
WG C5.26	AUCTION MARKETS AND OTHER PROCUREMENT MECHANISMS FOR DEMAND RESPONSE SERVICES
WG C5.27	MARKET DESIGN FOR SHORT-TERM FLEXIBILITY
WG C5-28	ENERGY PRICE FORMATION IN WHOLESALE MARKETS
JWG C2/C5.05	DEVELOPMENTS AND CHANGES IN THE BUSINESS OF SYSTEM OPERATORS

**LATEST PUBLICATIONS**

TB 710	IMPACTS OF ENVIRONMENTAL POLICY ON POWER MARKETS
TB 709	DRIVERS FOR MAJOR CHANGES TO MARKET DESIGN
TB 692	MARKET PRICE SIGNALS AND REGULATORY FRAMEWORKS FOR COORDINATION OF TRANSMISSION INVESTMENTS
TB 688	DEVELOPMENT OF RELIABILITY STANDARDS AND MARKET RULES

**All of the above TBs are available for download from [www.e-cigre.org](http://www.e-cigre.org)**

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## Active Distribution Systems and Distributed Energy Resources

SC C6 facilitates and promotes the progress of engineering, and the international exchange of information and knowledge in the field of distributions systems and distributed energy resources [DER]. The experts contribute to the international exchange of information and knowledge by means of synthesizing state of the art practices and developing recommendations.

### PRINCIPAL AREAS OF INTEREST

Assessment of the technical impacts which a more widespread adoption of distributed energy resources could impose on the whole energy system and of enabling technologies and innovative solutions for DER integration in active distribution systems.

### CURRENT ACTIVITIES

Working groups develop technical recommendations and best practices for above topics with focus on technologies and solutions for distributed energy resources, impact of energy storage on the distribution system, demand side integration and customer empowerment, multi-energy applications in urban infrastructures including electric vehicles, MVDC systems, smart metering and rural electrification.

### FORTHCOMING EVENTS

**CIGRÉ International Symposium “GOING OFFSHORE - Challenges of the future power grid “;**  
Aalborg, Denmark, June 3-6, 2019.

**CIGRÉ International Symposium “Towards active, sustainable digital networks that are resilient and integrated from UHV to distribution“;**  
September 20 - 25, 2019, Chengdu, China.

### MEMBERSHIP PROFILE

- Distribution system operators, mainly engineers from asset management, system planning and system operation.
- Power and system consultants.
- Technology providers.
- Rural electrification experts.
- Information and communication technology experts.
- Academia on respective topics.



### MAIN AREA OF ATTENTION

**Enabling technologies for renewable and distributed energy resource integration and application:** active network management, micro-grids, virtual power plants, distribution management systems, DER monitoring and control, aggregation systems, platforms.

**Innovative solutions for DER and distribution technology deployment:** smart inverters and power electronic interfaces and interconnection device applications, MV/LV DC supply systems, distribution system modernization.

**Storage technologies:** deployment of various storage technologies such as electrochemical electric battery energy storage systems, flywheels, flow batteries, and new storage technologies, hydropower, hydrogen, multi-energy solutions (with thermal storage), power2X applications (power to heat, power to gas...), electric vehicles.

**New approaches to configure distribution systems for enhanced reliability and resilience:** islandable grid connected micro-grids, power exchange between micro-grids.

**Consumer integration and empowerment:** Demand side integration and participation, demand response, load management, smart load, new customer sectors such as electric vehicles, smart home and smart meter applications with impact on distribution systems.

**Smart cities:** integrated distribution system technologies, power, control and information and communication technology deployment for flexibility, integration of multi-energy systems. Rural Electrification, islanded power systems and individual customer off-grid systems and solutions

**TOPICS OF WORKING GROUPS**

WG C6.22	MICROGRIDS
WG C6.28	HYBRID SYSTEMS FOR OFF-GRID POWER SUPPLY
WG C6.31	MEDIUM VOLTAGE DIRECT CURRENT (MVDC) GRID FEASIBILITY STUDY
JWG C6/D2-32	UTILIZATION OF DATA FROM SMART METER SYSTEM
WG C6.33	MULTI ENERGY SYSTEMS
WG C6.34	FLEXIBILITY AND GRID SERVICES FROM DER
WG C6.35	DER AGGREGATION PLATFORMS FOR THE PROVISION OF FLEXIBILITY SERVICES
JWG C6.B4.37	MEDIUM VOLTAGE DC DISTRIBUTION SYSTEMS
WG C6.38	RURAL ELECTRIFICATION
WG C6.39	DER CUSTOMER EMPOWERMENT

**LATEST PUBLICATIONS**

TB 635	MICROGRIDS 1 ENGINEERING, ECONOMICS, & EXPERIENCE
TB 672	POWER QUALITY ASPECTS OF SOLAR POWER
TB 678	SMART METERING, REGULATORY ASPECTS, STANDARDS AND DEVELOPMENT STATUS
TB 711	CONTROL AND AUTOMATION SYSTEMS FOR ELECTRICITY DISTRIBUTION NETWORKS (EDN) OF THE FUTURE
TB 721	THE IMPACT OF BATTERY ENERGY STORAGE SYSTEMS ON DISTRIBUTION NETWORKS
TB 726	ASSET MANAGEMENT FOR DISTRIBUTION NETWORKS WITH HIGH PENETRATION OF DISTRIBUTED ENERGY RESOURCES
TB 727	MODELLING OF INVERTER BASED GENERATION FOR POWER SYSTEM DYNAMIC STUDIES

All of the above TBs are available for download from [www.e-cigre.org](http://www.e-cigre.org)

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## Materials and Emerging Test Techniques

The scope of Study Committee D1 covers new and existing materials for electrotechnology, diagnostic techniques and related knowledge rules, as well as emerging test techniques with expected impact on power systems in the medium to long term.

### PRINCIPAL AREAS OF INTEREST

- Insulating gases and gaseous insulation systems.
- Liquid and liquid impregnated insulation systems.
- Solid materials.
- High voltage and high current testing and diagnosis

### CURRENT ACTIVITIES

- Characterization of materials and electrical insulation systems (EIS).
- Study of emerging test and diagnosis techniques for HVDC.
- Development of diagnostic tools and related knowledge rules.

### KEY PROJECTS / FORTHCOMING EVENTS

**A2, B2, D1 Colloquium & SC D1 Meeting,**  
2019 in New Delhi.

### OTHER SPECIFIC INTEREST

- Give guidance in the performance and use of materials in electrical insulation systems.
- Dissemination of knowledge, e.g. by tutorials.



### MAIN AREA OF ATTENTION

**The Study Committee deals** with the performance of materials and electrical insulation systems (EIS) with respect to electrical, thermal, mechanical, chemical and environmental stresses. Based on this knowledge, test and measurement procedures are evaluated and developed, if necessary.

**These procedures can be applied** to generate new diagnostic tools for asset management of electrical apparatus to aid the work of equipment, subsystem and system committees. Special attention is paid to the area of emerging UHVAC and UHVDC technologies.

**The Study Committee strives** to facilitate and promote the progress of engineering and the international exchange of information and knowledge. This is achieved through the synthesis of state-of-the-art practices and developing recommendations and guidelines.

**To support the development** of international standards the Study Committee seeks to establish close cooperation with standardization bodies and provides the relevant technical information as well as the scientific background.

## TOPICS OF WORKING GROUPS

JWG D1/A2.47	NEW FRONTIERS OF DISSOLVED GAS ANALYSIS (DGA) INTERPRETATION FOR POWER TRANSFORMERS AND THEIR ACCESSORIES
WG D1.48	PROPERTIES OF INSULATING MATERIALS UNDER VLF VOLTAGES
JWG D1/B1.49	HARMONIZED TEST FOR THE MEASUREMENT OF RESIDUAL INFLAMMABLE GASES IN INSULATING MATERIALS BY GAS CHROMATOGRAPHY
WG D1.50	ATMOSPHERIC AND ALTITUDE CORRECTION FACTORS FOR AIR GAPS AND CLEAN INSULATORS
WG D1.52	MOISTURE MEASUREMENT IN INSULATING FLUIDS AND TRANSFORMER INSULATION - AN EVALUATION OF SOLID STATE SENSORS AND CHEMICAL METHODS
WG D1.53	AGEING OF UPGRADED CELLULOSE AND CELLULOSE IMPREGNATED IN ESTER LIQUIDS AND OTHER LIQUIDS (REVISION OF TECHNICAL BROCHURE No 323)
WG D1.54	BASIC PRINCIPLES AND PRACTICAL METHODS TO MEASURE THE AC AND DC RESISTANCE OF CONDUCTORS OF POWER CABLES AND OVERHEAD LINES
WG D1.56	FIELD GRADING IN ELECTRICAL INSULATION SYSTEMS
JWG D1/B3.57	DIELECTRIC TESTING OF GAS-INSULATED HVDC SYSTEMS
WG D1.58	EVALUATION OF DYNAMIC HYDROPHOBICITY OF POLYMERIC INSULATING MATERIALS UNDER AC AND DC VOLTAGE STRESS
WG D1.59	METHODS FOR DIELECTRIC CHARACTERIZATION OF POLYMERIC INSULATING MATERIALS FOR OUTDOOR APPLICATIONS
WG D1.60	TRACEABLE MEASUREMENT TECHNIQUES FOR VERY FAST TRANSIENTS
WG D1.61	OPTICAL CORONA DETECTION AND MEASUREMENT
WG D1.62	SURFACE DEGRADATION OF POLYMERIC INSULATING MATERIALS FOR OUTDOOR APPLICATIONS
WG D1.63	PARTIAL DISCHARGE DETECTION UNDER DC VOLTAGE STRESS
WG D1.64	ELECTRICAL INSULATION SYSTEMS AT CRYOGENIC TEMPERATURES
WG D1.65	MECHANICAL PROPERTIES OF INSULATING MATERIALS AND INSULATED CONDUCTORS FOR OIL INSULATED POWER TRANSFORMERS
WG D1.66	REQUIREMENTS FOR PARTIAL DISCHARGE MONITORING SYSTEMS FOR GAS INSULATED SYSTEMS
WG D1.67	DIELECTRIC PERFORMANCE OF NEW NON-SF <sub>6</sub> GASES AND GAS MIXTURES FOR GAS-INSULATED SYSTEMS
WG D1.68	NATURAL AND SYNTHETIC ESTERS – EVALUATION OF THE PERFORMANCE UNDER FIRE AND THE IMPACT ON ENVIRONMENT
WG D1.69	GUIDELINES FOR TEST TECHNIQUES OF HIGH TEMPERATURE SUPERCONDUCTING (HTS) SYSTEMS
WG D1.70	FUNCTIONAL PROPERTIES OF MODERN INSULATING LIQUIDS FOR TRANSFORMERS AND SIMILAR ELECTRICAL EQUIPMENT
WG D1.71	UNDERSTANDING AND MITIGATION OF CORROSION
WG D1.72	TEST OF MATERIAL RESISTANCE AGAINST SURFACE ARCING UNDER DC
WG D1.73	NANOSTRUCTURED DIELECTRICS: MULTI-FUNCTIONALITY AT THE SERVICE OF THE ELECTRIC POWER INDUSTRY
JWG A2/D1.46	FIELD EXPERIENCE WITH TRANSFORMER SOLID INSULATING AGEING MARKERS
JWG A2/D1.51	IMPROVEMENT TO PARTIAL DISCHARGE MEASUREMENTS FOR FACTORY AND SITE ACCEPTANCE TESTS OF POWER TRANSFORMERS

## LATEST PUBLICATIONS

TB 646	HVDC TRANSFORMER INSULATION: OIL CONDUCTIVITY
TB 654	UHF PARTIAL DISCHARGE DETECTION SYSTEM FOR GIS: APPLICATION GUIDE FOR SENSITIVITY VERIFICATION
TB 661	FUNCTIONAL NANOMATERIALS FOR ELECTRIC POWER
TB 662	GUIDELINES FOR PARTIAL DISCHARGE DETECTION USING CONVENTIONAL (IEC 60270) AND UNCONVENTIONAL METHODS
TB 676	PARTIAL DISCHARGES IN TRANSFORMERS
TB 691	POLLUTION TEST OF NATURALLY AND ARTIFICIALLY CONTAMINATED INSULATORS
TB 703	INSULATION DEGRADATION UNDER FAST, REPETITIVE VOLTAGE PULSES
TB 705	GUIDELINES FOR ALTITUDE CORRECTION OF POLLUTION PERFORMANCE OF INSULATORS
TB 706	GUIDELINES FOR THE USE OF STATISTICS AND STATISTICAL TOOLS ON LIFE DATA

All of the above TBs are available for download from [www.e-cigre.org](http://www.e-cigre.org)

## CONTACT

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**Secretary:** Johannes Seiler - [johannes.seiler@siemens.com](mailto:johannes.seiler@siemens.com)



## Information Systems and Telecommunication

The scope of this SC is focused on the fields of information systems and telecommunications for power systems. SC D2 contributes to the international exchange of information and knowledge, adding value by means of synthesizing state of the art practices and drafting recommendations.

### PRINCIPAL AREAS OF INTEREST

- ICT applied to digital networks from UHV to distribution [smart meter, IoT, big data, EMS, etc.].
- Communication solutions for information exchange in the smart delivery of electrical energy.
- Interoperability and data exchange [file format, frequency, etc.] between network operators, market players, off-grid premises.
- Cyber security issues from field equipment to corporate IT [Governance constraints, system design, implementation, testing, operation and maintenance...].
- Technologies and architecture to ensure business continuity and disaster recovery.
- IT systems to support the decision-making process in Asset Management.

### CURRENT ACTIVITIES

SC D2 has over 250 experts in 10 active Working Groups, focusing on activities in 3 different topic streams relating to ICT: business application, cyber security and telecommunications.

### KEY PROJECTS / FORTHCOMING EVENTS

**Helsinki Colloquium**, on 12<sup>th</sup> and 13<sup>th</sup> June 2019.

**Joint SC C1/C3/C6/B3/B5/D2 colloquium on “Towards active, sustainable digital networks that are resilient and integrated from UHV to distribution”**, from 20 to 25 September.



### MAIN AREA OF ATTENTION

**Studying and considering** the evolution of information and telecommunication technologies to cope with the new requirements of Distributed Energy Resources [Software Defined Network, Industrial Internet of Things, LORA, 5G, Block chain...]. Other aspects such as Technologies and architecture to assure business continuity and disaster recovery are also being assessed.

**Overcoming security threats** is a key issue in the deployment of the networks of the future and especially in the future Smart Grids. Assessing security risks, defining the proper security framework, architecture and best practices in the scope of legal requirements and other internal practices of the power utility is a key area of international standards and their applicability to Power Utilities is also an aspect to be considered as well as issuing recommendations to tackle their maintenance.

## TOPICS OF WORKING GROUPS

JWG.D2/B2.39	DESIGN, DEPLOYMENT AND MAINTENANCE OF OPTICAL CABLES ASSOCIATED TO OVERHEAD HV TRANSMISSION LINES
WG.D2.40	CYBER RISKS AND CYBER SECURITY FOR THE NEXT GENERATION OF DIGITAL SYSTEMS IN ELECTRICAL POWER UTILITIES
JWG.D2/C2.41	ADVANCED UTILITY DATA MANAGEMENT AND ANALYTICS FOR IMPROVED SITUATIONAL AWARENESS OF EPU'S OPERATIONS
JWG.C6/D2.32	UTILIZATION OF DATA FROM SMART METER SYSTEM
WG.D2.42	SYNCHRONIZATION AND TIME DISTRIBUTION IN COMMUNICATION NETWORKS FOR TIME-SENSITIVE DISTRIBUTED OPERATIONAL APPLICATIONS IN THE POWER GRID
WG.D2.43	ENABLING SOFTWARE-DEFINED NETWORKING FOR ELECTRIC POWER UTILITIES' TELECOM APPLICATIONS
WG.D2.44	USAGE OF PUBLIC OR PRIVATE WIRELESS COMMUNICATION INFRASTRUCTURES FOR MONITORING AND MAINTENANCE OF GRID ASSETS AND FACILITIES
WG.D2.45	IMPACT OF GOVERNANCE REGULATIONS AND CONSTRAINTS ON EPU SENSITIVE DATA DISTRIBUTION AND LOCATION OF DATA STORAGE
WG.D2.46	CYBER SECURITY: FUTURE THREATS AND IMPACT ON ELECTRIC POWER UTILITY ORGANIZATIONS AND OPERATIONS
JWG.D2/C6.47	ADVANCED CONSUMER SIDE ENERGY RESOURCE MANAGEMENT SYSTEMS

## LATEST PUBLICATIONS

GREEN BOOK TB-685	UTILITY COMMUNICATION NETWORKS AND SERVICES COMMUNICATION SOLUTIONS FOR INFORMATION EXCHANGE IN THE SMART DELIVERY OF ELECTRICAL ENERGY.
TB-698	FRAMEWORK FOR EPU OPERATORS TO MANAGE THE RESPONSE TO A CYBER-INITIATED THREAT TO THEIR CRITICAL INFRASTRUCTURES.

All of the above TBs are available for download from [www.e-cigre.org](http://www.e-cigre.org)

## CONTACT

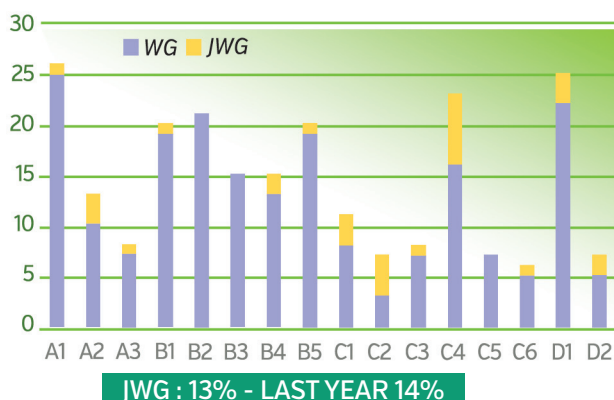
**Incoming Chairman:** Olga V. Sinenko - [sinenko\\_ov@rtsoft.msk.ru](mailto:sinenko_ov@rtsoft.msk.ru)

**Outgoing Chairman:** Philippe Quenaudon - [philippe.quenaudon@rte-france.com](mailto:philippe.quenaudon@rte-france.com)

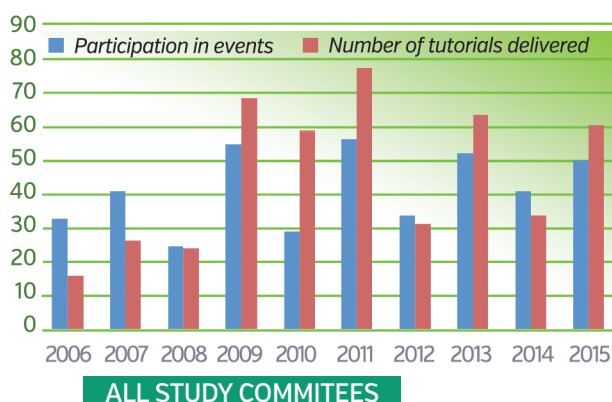
**Incoming Secretary:** Joël Nouard - [joel.nouard@rte-france.com](mailto:joel.nouard@rte-france.com)



## Distribution of WGs on Study Committees



## Participation in events



In a nutshell, on January 1, 2018 CIGRE was 232 Working bodies split into 202 Working Groups and 30 Joint Working Groups involving several Study Committees [22] or CIGRE and CIRED [8].

Involving near 4000 experts coming from 71 different countries representing over 5400 positions in the Working Bodies as some experts are involved in more than one Working Group. Since 2016, several new countries joined the CIGRE Working Groups, mostly from Africa.

Publishing over 40 unbiased Technical Brochures per year.

The 230 Conveners leading these Working Bodies come from 34 different countries.

In 2017, the 16 Study Committees participated in over 50 international events all around the world during which they delivered 60 tutorials.

Women presently make up 8% of CIGRE's expertise – 336 experts – and are also represented by 2 SC Chairwomen, 3 SC Secretaries, 23 WG Conveners.

**Yves Maugain,**

Technical Council Secretary

## Synthesis of the 2017 review



## Working Group Conveners' origins

