SC C4 ‘System Technical Performance’

Sintesi attività tecniche ed Eventi futuri

Giorgio Giannuzzi– Terna

Assemblea dei soci del Comitato Nazionale Italiano cigré
29 novembre 2018 – Auditorium Terna Galbani, Roma

Organizzazione: WG & JWG attivi

SC C4 System Technical Performance

Giannuzzi Giorgio - TERNA (regular 2016)

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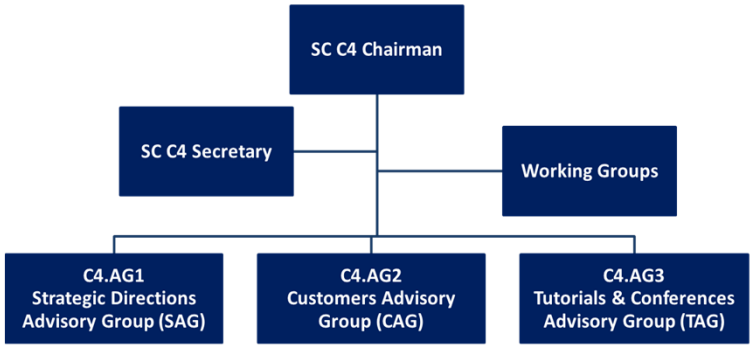

Key contacts

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a **16 Working Group**

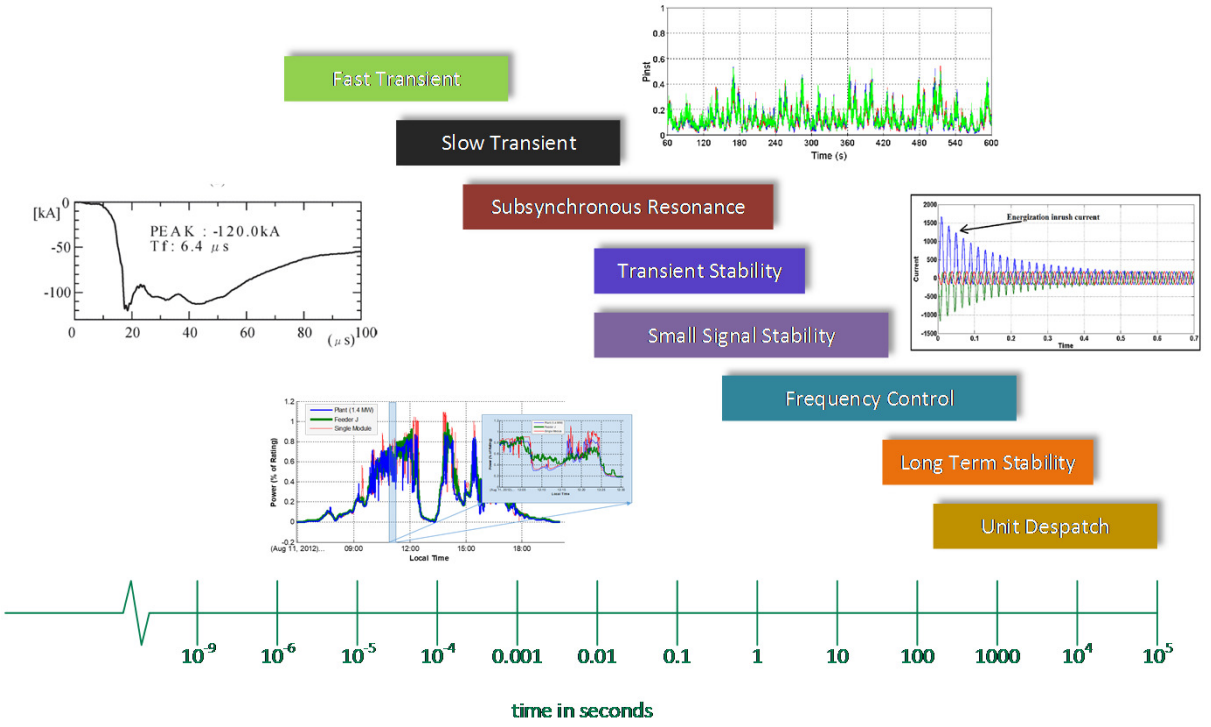
b **12 Joint Working Group** con altri SC (A1, A2, B5, B4, C1, C2 e CIRED)

Struttura e piano strategico

"The scope of SC C4 is focused on system technical performance issues across this entire range of phenomena and time frames"

- Power Quality
- Electromagnetic Compatibility and Interference (EMC/EMI)
- Insulation Co-ordination
- Lightning
- Power Systems Dynamics and Numerical Analysis

- ❑ **Objective 1: Influence and Contribute**
- ❑ **Objective 2: Vibrant and Inclusive**
- ❑ **Objective 3: Power System of the Future**
- ❑ **Objective 4: People and Skills of the Future**



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WG & JWG attivi

Type	Number	Convener	WG Title	Created	Scheduled Disbanding
WG	C4.23	C. Engelbrecht	GUIDE TO PROCEDURES FOR ESTIMATING THE LIGHTNING PERFORMANCE OF TRANSMISSION LINES	2012	**2019**
WG	C4.25	K. Kopsidas	Issues related to ELF Electromagnetic Field exposure and transient contact currents	2011	2016
WG	C4.28	P. E. Munoz Rojas	Extrapolation of measured values of power frequency magnetic fields in the vicinity of power links	2012	**2018**
JWG	C4.31/CIRED	D. Thomas	EMC between communication circuits and power systems	2012	**2018**
WG	C4.32	W. Radasky	Understanding of the geomagnetic storm environment for high voltage power grids	2013	**2018**
WG	C4.33	S. Visacro	Impact of Soil-Parameter Frequency Dependence on the Response of Grounding Electrodes and on the Lightning Performance of Electrical Systems	2013	**2018**
WG	C4.36	M. Ishii	Winter Lightning – Parameters and Engineering Consequences for Wind Turbines	2014	**2019**
WG	C4.37	Y. Baba	Electromagnetic Computation Methods for Lightning Surge Studies with Emphasis on the FDTD Method	2014	**2019**
JWG	C4/B4.38	M. Val Escudero	Network Modelling for Harmonic Studies	2014	**2018**
WG	C4.39	K. Tsuge	Effectiveness of line surge arresters for lightning protection of overhead transmission lines	2015	**2019**
JWG	C4.40/CIRED	M. Halpin	Revisions to IEC Technical Reports 61000-3-6, 61000-3-7, 61000-3-13, and 61000-3-14	2015	2018
JWG	C4/B5.41	L. Haarla	Challenges with series compensation application in power systems when overcompensating lines	2015	2018
JWG	C4.42/CIRED	I. Papič	Continuous assessment of low-order harmonic emissions from customer installations	2015	**2019**
WG	C4.43	T. Shindo	Lightning problems and lightning risk management for nuclear power plants	2017	2020
WG	C4.44	E. Salinas	EMC for Large Photovoltaic Systems	2017	2019
WG	C4.45	S. Xie	Measuring techniques and characteristics of fast and very fast transient overvoltages in substations and converter stations	2017	**2020**
WG	C4.46	Filipe Faria da Silva	Evaluation of Temporary Overvoltages in Power Systems due to Low Order Harmonic Resonances	2017	**2021**
WG	C4.47	Malcolm van Harte	Power System Resilience (PSR WG)	2017	2020
WG	C4.48	Ivan Dudurych	Overvoltage Withstand Characteristics of Power System Equipment 35-1200 kV	2017	2020
WG	C4.49	Łukasz Kocewiak	Multi-frequency stability of converter-based modern power systems	2018	2021
WG	C4.50	Bo Zhang	Evaluation of Transient Performance of Grounding Systems in Substations and Its Impact on Primary and Secondary Systems	2018	2021
JWG	A2/C4.52	B. Gustavsen	High-frequency transformer and reactor models for network studies	2014	**2019**
JWG	A1/C4.52	N. Miller	Wind generators and frequency-active power control of power systems	2015	2018
JWG	C2/C4.37	Y. Fang	Recommendations for Systematic Framework Design of Power System Stability Control	2015	**2018**
JWG	B4/B1/C4.73	M. Saltzer	Surge and extended overvoltage testing of HVDC Cable Systems	2015	**2019**
JWG	B5/C4.61	Ray Zhang	Impact of Low Inertia Network on Protection and Control	2017	2020
JWG	C1/C4.36	V. Simoes / S. Utts	Review of Large City & Metropolitan Area power system development trends taking into account new generation, grid and information technologies	2017	2019
JWG	C2/C4.41	Mpeli Rampokanyo	Impact of high penetration of inverter-based generation on system inertia of networks	2018	2020

WG & JWG non più attivi

Number	Convener	WG Title (TB Title)	To CIGRE	Published
Disbanded in 2018				
C4.503	J. Mahseredjian	Numerical techniques for the computation of power systems, from steady-state to switching transients (Power system test cases for EMT-type simulation studies, TB736)	Aug. 2018	AUG. 2018
C4/C6.35/CIRED	K. Yamashita / H. Renner	Modelling and dynamic performance of inverter based generation in power system transmission and distribution studies (Modelling of inverter-based generation for power system dynamic studies, TB727)	May. 2018	MAY. 2018
C4.24/CIRED	F. Zavoda	Power Quality and EMC Issues associated with future electricity networks (Power quality and EMC issues with future electricity networks, TB719)	Mar. 2018	MAR. 2018
C4.27	D. Vujatovic	BENCHMARKING OF POWER QUALITY PERFORMANCE IN TRANSMISSION SYSTEMS (BENCHMARKING OF POWER QUALITY PERFORMANCE IN TRANSMISSION SYSTEMS, TB718)	Feb, 2018	FEB. 2018
A3/B5/C4.37	A. Janssen	System conditions for and probability of Out-of-Phase (SYSTEM CONDITIONS FOR AND PROBABILITY OF OUT-OF-PHASE -BACKGROUND, RECOMMENDATIONS, DEVELOPMENTS OF INSTABLE POWER SYSTEMS-, TB716)	Jan, 2018	JAN. 2018
Disbanded in 2017				
C4.30	W. H. Siew	EMC in Wind Generation Systems (EMC in wind energy systems, TB707)	Oct, 2016	NOV. 2017
C4.26	J. He	Evaluation of Lightning Shielding Analysis Methods for EHV and UHV DC and AC Transmission-lines (Evaluation of lightning shielding analysis methods for EHV and UHV DC and AC transmission lines, TB704)	Oct, 2016	NOV. 2017
C4.34	U. D. Annakkage	Application of Phasor Measurement Units for monitoring power system dynamic performance (Application of phasor measurement units for monitoring power system dynamic performance, TB702)	Oct, 2016	NOV. 2017
Disbanded in 2016				
C4/C6.29	J. Smith	Power Quality Aspects of Solar Power (POWER QUALITY ASPECTS OF SOLAR POWER, TB672)	Dec. 21, 2016	DEC. 2016
C4.305	A. S. Telento	Practices in Insulation Coordination of Modern Electric Power Systems Aimed at the Reduction of the Insulation Level	Nothing	Nothing
C4.111	M. Halpin	Review of LV and MV Compatibility Levels for Voltage Fluctuation (REVIEW OF LV AND MV COMPATIBILITY LEVELS FOR VOLTAGE FLUCTUATIONS, TB656)	May. 14, 2016	MAY. 2016

CIGRE 2018 - TUTORIAL

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CAMPAGNA ACQUISTI
WG & JWG

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CIGRE JWG C2/C4.41

Impact of high penetration of inverter-based generation on system inertia of networks

a) Review of previous (CIGRE) work relating to the current topic (e.g. TB 527 and TB 666) and the connection with on-going work (e.g. JWG C2/B4.38 and JWG C4/C6.35).
b) Survey existing practises used to determine primary frequency response requirements.
c) Define operational measures to manage the dispatch of inertia and reduce the risk when operating with low inertia on the system.
d) Quantify Primary Frequency Requirements (PFR) with increasing RES penetration

1. Demand Response (DR) requirements
2. Primary Reserves requirements
3. Fast Frequency Response (FFR) techniques and requirements
4. Trade-offs between inertia and FFR /DR techniques (checking if FFR can be a substitute for inertial response)

e) Methodology to establish rate of change of frequency (RoCoF) limits with increasing non-synchronous RES penetration levels, and the integration of the methodology into the operational environment.
f) Review existing Grid Code policy around PFR requirements in light of higher penetration levels of RES.
g) Investigate possible control strategies for inverter-based generation in order to provide wider future designs possibilities of inverters/converters and to achieve the most efficient way to use the technology. Also to work in connection with JWG C2/B4.38.
h) Survey possible/ existing mitigation techniques and increased system controllability

1. Synthetic inertia (including technologies based on voltage source converters)
2. Flywheels etc.
3. FFR
4. DR etc.

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JWG B1/C4.69

Recommendations for the insulation coordination on AC cable systems

The joint working groups will take forward a revision update of TB 189 and shall include the following cable systems, installation types and parameters:

- AC cable systems
- Solid di-electric and self-contained fluid filled cable systems
- HV and EHV cable systems
- MV cable systems, where insulation co-ordination studies may be applicable and guidance is required
- Buried - suspended in air - and submarine installations
- All over voltages as defined by IEC 60071-1
- Various network configurations (TB 189 clause 7.7) (e.g. transformer to cable; overhead line to cable; GIS to cable to GIS; syphon; capacitors to cable; etc.)

- Define the various cable system insulation layers in addition to the primary insulation. Investigate the influence of specially bonded cable systems on transient over voltages of the primary insulation (TB 189 clause 7.8) and expand this for any other insulation parts (e.g. sheath bonding system, etc.) of the cable system.
- Consider all cable system installation lengths (e.g. short or long cable systems).
- Consider the position of primary surge arresters.
- Review type tests and additional test requirements for the cable system and cable system components (TB 189 clause 7.4).
- Consider the WG B1.50 and other related WG or TB outputs.
- Review of Sheath Voltage Limiter (SVL) or alternative protection and connection methods.
- Reviews of equipment insulation withstand levels.
- Review of over voltage shielding mitigation methods (e.g. counterpoise conductors, etc.).
- Review all applicable TB's, papers and other literature.
- Verification of modelling techniques.
- Ageing effects for the installation (TB 189 clause 7.5).
- Review of the effect of multiple or regular switching events.

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C4.54

Protection of high voltage power network control electronics from the High-altitude Electromagnetic pulse (HEMP)

- Evaluate the available information from previous substation work in Study Committee C4, including TB 600 “Protection of High Voltage Power Network Control Electronics Against Intentional Electromagnetic Interference (IEMI)” and TB 535 “EMC within Power Plants and Substations” and new standardization work in the IEC dealing with HEMP.
- Evaluate the range of HEMP conducted and radiated electromagnetic environments that can reach the electronics in a HV substation.
- Evaluate categories of electronic equipment to determine their susceptibility to the HEMP induced transients.
- Determine the HEMP mitigation methods (using EMC technologies) that could be applied to raise the immunity level of the electronics to HEMP.
- Recommend EMC test methods to evaluate the sufficiency of the mitigation methods.

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JWG C4/B4.52

Guidelines for Sub-synchronous Oscillation Studies in Power Electronics Dominated Power Systems

Review of sub-synchronous oscillation/interaction phenomenon related to modern power systems:

- For conventional power systems, the issue of sub-synchronous oscillations is well understood. The conditions under which it manifests, methods of assessing the risk, and how to mitigate them are well documented in literature. There are some gaps in these study methods and procedures when it comes to heavily series compensated systems (including the situations where line tripping results in the effective level of compensation to go up). Power electronic converter based renewable energy integration also expands the field of sub-synchronous oscillations. A comprehensive review will be conducted and reported in a technical brochure. Reclassification of SSO phenomena with their complete definitions will be covered.
- Review recent industry experiences of sub-synchronous oscillation/interaction phenomenon, and remedial actions taken:
- Review of study procedures adapted by the industry and their applicability for modern power electronic dominated power systems:
- Recommend a standard procedure for assessing the risk of sub-synchronous oscillations: a. Screening Studies: simple and fast
- assessment techniques considering large number of operating conditions and contingencies (avoid false dismissals while allowing false alarms)
- Detailed Studies: In-depth analysis of sub-synchronous phenomenon for the cases screened out in step (a) above. The study procedures that can be adapted at various stages of a project (development stage and operational stage) will be proposed considering the available data and the model for the studies. The following steps will be considered.
- Mitigation measures and methods for developing them

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WG C4.51
Connection of Railway Traction Systems to Power Networks

Understanding the nature and the dynamics of the traction load and how it effects the power network and its technical performance

- Managing traction power system dynamic loading and regenerative braking
- Use of novel techniques for dynamic traction load management (dynamic load balancing, energy storage…)
- Understanding, assessment and management/mitigation of power quality issues (phase unbalance, flicker and harmonic distortion) relating to traction power systems
- Systems and special transformers to minimise phase unbalance
- Use of FACTS devices to improve traction system performance and utility interfaces
- Specific electrical protection requirements
- Understanding and managing EMC in relation to traction power systems
- Other traction system specific challenges such as management of different earthing requirements, stray current corrosion, etc.
- Determining traction system equivalents for power system studies
- Suitable ways of representing utility network for studies required to demonstrate safe and compliant operation
- Assessing network impact of multiple traction power system connections; system approach
- Managing changes in service, utility network and railway operations.

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WG C4.49

Multi-frequency stability of converter-based modern power systems

1. Review of existing literature regarding subject related stability issues including state-of-the-art converter stability aspects.
2. Definition of stability phenomenon to be covered within the technical brochure.
    a. Stability effects above the fundamental frequency, i.e. harmonic stability.
    b. Small-signal stability below the fundamental frequency, i.e. sub-synchronous stability.
    c. Clarification of definitions to avoid misinterpretation with steady-state harmonics and classical harmonic propagation analysis.
    d. Symptoms and root causes of sub-synchronous and harmonic stability phenomenon.
    e. Examples of sub-synchronous and harmonic stability phenomena observed and their impact on wider power systems.
3. The impact of grid-connected converter controllers on sub-synchronous and harmonic stability phenomenon.
    a. Classification of typical controllers used in modern converters.
    b. Evaluation of various control loops and techniques and their impact on stability, e.g. voltage control, current control, phase-locked loop.
    c. Frequency range of interest and controller interactions/couplings.
4. Overview of linear modelling and analysis methods to perform small-signal stability studies, e.g.
    a. Classical control theory approach of linear time-invariant systems, i.e. compensator and plant interactions, and possible general extension to linear time varying systems including e.g. linear time-varying periodic systems.
    b. Impedance-based stability criterion.
    c. Advantages and disadvantages of single-input single-output and multiple-input, multiple-output representation.
    d. Relevant stability evaluation methods, e.g. eigenvalue analysis, Nyquist criterion.
5. Other analysis techniques.
    a. Time-domain numerical simulations of linear and non-linear systems.
    b. Frequency and sequence coupling investigation.
    c. Stability of non-linear dissipative dynamic systems including e.g. limit cycle and bifurcation theory investigation.
6. Description of mitigation methods to overcome sub-synchronous and harmonic stability issues, e. g.
    a. Clear evaluation criteria and minimal requirements regarding the stability indices, e. g. stability margins, damping.
    b. Recommendations to address plant resonance profile at early stage during the grid-connected converter controller design.
    c. Converter coordination guidelines in modern power systems to avoid potential instability, e. g. passivity requirements.
    d. Mitigation measures incorporated in the grid-connected converter control (e.g. active damping) or within the power system electrical infrastructure (e.g. passive damping), also at later stage of project development or during operation.
7. Guidelines on general approach to such studies and the availability as well as choice of tools. Identification of limitations with the available analysis tools and suggestion of developments

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Eventi futuri SC C4

3-6 giugno 2019
in Aalborg, Denmark

- 2019 CIGRE Symposium "*Going Offshore – Challenges of the future power supergrid*"

23-26 Aprile 2019
in Hakodate, Japan

- 2019 CIGRE-IEC Conference on EHV and UHV (AC & DC)

AVANZAMENTO LAVORI
WG & JWG

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CIGRE JWG A2/C4.52

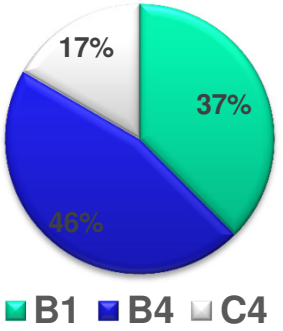
High-Frequency Transformer and Reactor Models for Network Studies

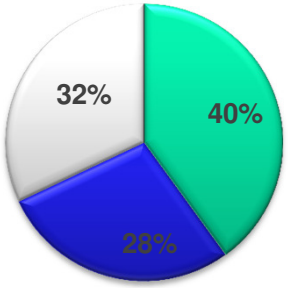
- Objective:
  - **Make available improved models of the transformer for high-frequency network studies, e.g. insulation co-ordination**
- WG Composition:
  - **Convener: Bjørn Gustavsen, Secretary: Angelica Rocha**
  - **40 members from 20 countries**
- WG Timeline:
  - **Start Date: August 27, 2014**
  - **Date for Submitting Final Report: August 27, 2019**

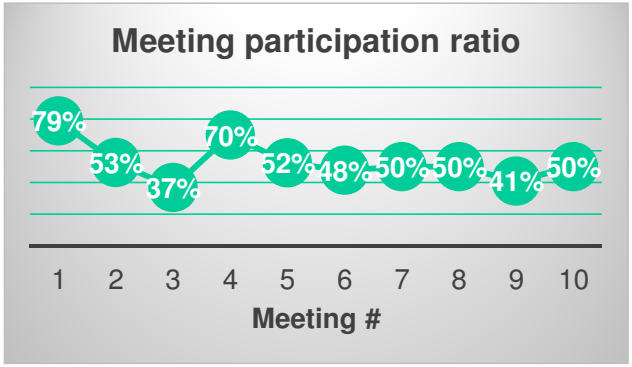
CIGRE JWG B4/B1/C4.73

Surge and extended overvoltage testing of HVDC Cable Systems

- WG Composition:
  - **Convener: Markus Saltzer**
  - **Secretary: Vincent Joubert**
- WG Timeline:
  - **Start Date: March 2016**
  - **Expected Date for Submitting Final Report to SC Chairman:**
    - Delay expected from Dec 2018 to Mar 2019
- WG Statistics:
  - **22 members (3 observers) from 10 countries**







CIGRE JWG B5C4.61

Impact of Low Inertia Network on Protection and Control

- WG Composition:
  - **Convener: Dr. Ray Zhang**
  - **41 members from 18 countries**
- WG Timeline:
  - **Start Date: October 2017**
  - **Expected Date for Submitting Final Report to SC Chairman: December 2020**
- Highlights of Recent Activity:
  - This JWG is progress well since kick-off meeting in London, Nov 2017.
  - 2nd meeting successfully organised by Dr Koji Yamashita in Tokyo April 2018, with technical visits:TEPCO Dispatch Centre and CRIEPI Lab.
  - 3rd meeting 26-27 August 2018 (Paris Session),
  - ToR reviewed and updated at kick-off meeting to firm up and clarify the Scope of Work.
  - key deliverables and high level structure of the TR proposed/agreed, and Chapter Leaders/Contributors assigned.
  - Draft TR has got over 150 pages with a Survey questionnaire drafted,
  - liaison taking place with WG B5.48 JWG C4C6-35 etc. to avoid overlapping

CIGRE JWG C1/C4.36

Review of Large City & Metropolitan Area power system development trends taking into account new generation, grid and information technologies

- WG Composition:
  - **Convener: Stanislav Utts (RU) & Valdson Simões (BR)**
  - **37 members from 15 countries**

- WG Timeline:
  - **Start Date: March 2017**
  - **Expected Date for Submitting Final Report to SC Chairman: January 2019**

CIGRE JWG C2/C4.37

Recommendations for Systematic Framework Design of Power System Stability Control

- WG Composition:
  - **Convener: Yongjie Fang**
  - **19 Members from 14 Countries**
    - 17 full members, 1 corresponding member, 1 young member
    - 6 industry/13 R&D
    - 15 C2 and 4 C4
- WG Timeline:
  - **Start Date: October 2015**
  - **Expected Date for Submitting Final Report to SC Chairman: July 2018**

CIGRE WG C4/B4.38

Network Modelling for Harmonic Studies

- WG Composition:
  - **Convener: Marta Val Escudero**
  - **51 members from 20 countries**
- WG Timeline:
  - **Start Date: January 2015**
  - **Expected Date for Submitting Final Report to SC Chairman: October 2018**
- Highlights of Recent Activity:
  - **1st meeting January 2015 in Dublin, Ireland.**
  - **2nd meeting May 2015 in Lund, Sweden.**
  - **3rd meeting November 2015 in Gomaringen, Germany.**
  - **4th meeting May 2016 in Madrid, Spain.**

CIGRE JWG C4/B5.41

Challenges with series compensation application in power systems when overcompensating lines

- WG Composition:
  - Convener: Liisa Haarla
  - 11 members from 9 countries
- WG Timeline:
  - Start Date: May 25, 2015
  - Expected Date for Submitting Final Report to SC Chairman: 2018, Dec
- Highlights of Recent Activity:
  - Almost all chapters have a final draft except one, still a lot of work left with the final editing and harmonizing the brochure

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CIGRE WG C4.23

Guide to Procedures for Estimating the Lightning Performance of Transmission Lines

- WG Composition:
  - **Convener: Chris Engelbrecht**
  - **24 members from 14 countries**
- WG Timeline:
  - **Start Date: May 2013**
  - **Expected Date for Submitting Final Report to SC Chairman: Dec 2019**
- Highlights of Recent Activity:
  - Developed over last two year new stroke attraction model (See Rizk paper C4-206)

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CIGRE WG C4.028

Extrapolation of measured values of power frequency magnetic fields in the vicinity of power links

WG Composition:

- Convener: Patricio Munhoz-Rojas, LACTEC, Brazil
- 19 members from 12 countries: Australia, Belgium, Brazil, Canada, China, France, Ireland, Italy, Japan, Romania, South Africa, US.

WG Timeline:

- Start Date: October 2016
- Expected Date for Submitting Final Report to SC Chairman: December 2018

CIGRE WG C4.31

EMC between communication circuits and power systems

- WG Composition:
  - **Convener: David Thomas**
  - **15 members from 8 countries**
- WG Timeline:
  - **Start Date: 1st January 2013**
  - **Expected Date for Submitting Final Report to SC Chairman: December 2018 (New Date)**
- Highlights of Recent Activity:
  - Last Meeting by Skype 6th June 2018. Agreed new time line to complete by the end of the year.

CIGRE WG C4.32

Understanding of the Geomagnetic Storm Environment for High Voltage Power Grids

- WG Composition:
  - **WG Convener: W. A. Radasky**
  - **11 full members from 9 countries**
  - **There are 8 corresponding members**
- WG Timeline:
  - **Start Date: 1 January 2013**
  - **Expected Date for Submitting Final Report (TB) to SC Chairman: 31 July 2018**

CIGRE WG C4.33

Impact of Soil-Parameter Frequency Dependence on the Response of Grounding Electrodes and on the Lightning Performance of Electrical Systems

- WG Composition:
  - **Silvério Visacro (Convener);**
  - **Number of members: 16 (includes 3 correspondent);**
  - **Representative of 11 countries;**
  - **11 members from University and 5 from Industry.**

- WG Timeline:
  - **Start Date: February 28, 2013**
  - **Expected Date for Submitting Final Report: Aug./Sept. 2018**

CIGRE WG C4.36

Winter Lightning – Parameters for Engineering Consequences for Wind Turbines

- WG Composition:
  - Convener: Prof. Dr. Masaru Ishii
  - 26 members from 11 countries
- WG Timeline:
  - Start Date: October 2014
  - Expected Date for Submitting Final Report to SC Chairman: March 2019
- Highlights of Recent Activity:
  - 6th meeting on April 11, 2017 in Joetsu, Japan
  - 7th meeting on October 1, 2017 in Natal, Brazil
  - 8th meeting on March 11, 2018 in Fort Lauderdale, USA

CIGRE WG C4.37

Electromagnetic Computation Methods for Lightning Surge Studies with Emphasis on the FDTD Method

- WG Composition:
  - **WG Convener:** **Yoshihiro Baba**
  - **Number of members:** **17**
  - **Number of corresponding members:** **4**
    - Number of countries represented: 16
    - Number of members from industry: 3
    - Number of members from university/R&D: 18
- WG Timeline:
  - **Start Date:** **July 2014**
  - **Expected Date for Submitting Final Report to SC Chairman:** **June 2019**
- Highlights of Recent Activity: The 6th and 7th meetings were held during 2017 SIPDA (October. 2017), Brazil and during 2018 Joint IEEE EMC & APEMC Symposium (May 2018), Singapore, respectively.

CIGRE WG C4.39

Effectiveness of line surge arresters for lightning protection of overhead transmission lines

- WG Composition:
  - **Convener: Kenji Tsuge**
  - **30 members from 16 countries, including 5 correspondents**
    - 19 members from industry
    - 11 members from university / R&D

- WG Timeline:
  - **Start Date: April 2015**
  - **Expected Date for Submitting Final Report to SC Chairman: December 2019**

CIGRE WG C4.40

Revisions to the IEC Technical Reports 61000-3-6, -7, -13, and -14

- WG Composition:
  - **Convener: Mark Halpin**
  - **26 members from 14 countries**
- WG Timeline:
  - **Start Date: September 2015**
  - **Expected Date for Submitting Final Report to SC Chairman: December 2018**
- Highlights of Recent Activity:
  - WG is beginning to prepare document edits based on consensus reached so far
  - WG has developed modification plans across all documents
  - Focus is now on making agreed changes rather than evaluation of new contributions

CIGRE JWG C4.42/CIRED

Continuous assessment of low-order harmonic emissions from customer installations

- WG Composition:
  - **Convener: Igor Papič**
  - **29 members from 20 countries**
    - Number of members from industry: **15**
    - Number of members from university/R&D: **14**
- WG Timeline:
  - **Start Date: December 2015**
  - **Expected Date for Submitting Final Report to SC Chairman: end of 2019**

CIGRE WG C4.43

Lightning problems and lightning risk management for nuclear power plants

- WG Composition:
  - **Convener: Takatoshi Shindo**
  - **16 members from 9 countries**
- WG Timeline:
  - **Start Date: Jan. 2017**
  - **Expected Date for Submitting Final Report to SC Chairman: 2020**
- Highlights of Recent Activity:
  - 4th WG meeting was held in May 2018 in Singapore. In the meeting, responses to questionnaires on lightning protection design were presented from some countries and discussion was made.
- Future Activity:
  - 5th and 6th WG meetings will be held in Sep. 2018 in Rzeszow, Poland and in April 2019 in Hakodate, Japan, respectively.

CIGRE WG C4.44

EMC for Large PV Systems

- WG Composition:
  - **Convener: Ener Salinas**
  - **21 members from 11 countries:** 9 Power companies, 8 Universities, 3 Research institutes and 1 Government organization
- WG Timeline:
  - **Start Date: May 2017**
  - **Expected Date for Submitting Final Report to SC Chairman: December 2019**
- Highlights of Recent Activity:
  - **The 1st WG meeting was held on May 27th 2017 in conjunction with the CIGRE Symposium Dublin**
  - **The 2nd WG meeting took place in Upington, South Africa, 18th to 20th Nov 2017. The structure for the Technical Brochure (TB) was stablished. Three technical visits were arranged: 1) Abengo CSP Khi Solar; 2) Upington solar PV plant; and 3) Kakamas mini-hydroplant. The local host was John Van Coller**

CIGRE WG C4.45

MEASURING TECHNIQUES AND CHARACTERISTICS OF FAST AND VERY FAST TRANSIENT OVERVOLTAGES IN SUBSTATIONS AND CONVERTER STATIONS

- WG Composition:
  - **Convener: Shijun Xie**
  - **16 members from 8 countries**
- WG Timeline:
  - **Start Date: March 2017**
  - **Expected Date for Submitting Final Report to SC Chairman: August 2020**

Assemblea dei soci del Comitato Nazionale Italiano cigré
29 novembre 2018 – Auditorium Terna Galbani, Roma

CIGRE JWG C2/C4.37

Recommendations for Systematic Framework Design of Power System Stability Control

- WG Composition:
  - **Convener: Yongjie Fang**
  - **19 Members from 14 Countries**
    - 17 full members, 1 corresponding member, 1 young member
    - 6 industry/13 R&D
    - 15 C2 and 4 C4
- WG Timeline:
  - **Start Date: October 2015**
  - **Expected Date for Submitting Final Report to SC Chairman: July 2018**

CIGRE WG C4.46

Evaluation of Temporary Overvoltages in Power Systems due to Low Order Harmonic Resonances

- WG Composition:
  - **Convener: Filipe Faria da Silva (DK)**
  - **21 members from 13 countries**
- WG Timeline:
  - **Start Date: February 2018**
  - **Expected Date for Submitting Final Report to SC Chairman: July 2021**
- Highlights of Recent Activity:
  - 1 physical meeting (starting meeting) and 1 online meeting have been held. 2nd physical meeting during Paris session
  - Many young engineers, but few senior members
  - Very good representation from TSOs and consultants, but lacking members from manufacturers (we are trying to solve this issue)
  - So far, people are doing good work and it is going smoothly

CIGRE WG C4.47

Power System Resilience

- WG Composition:
  - **Convener: Malcolm Van Harte (ZA)**
  - **39 members from 19 countries:** *17 Power companies, 12 Universities, 15 Research institutes and 2 Young members (not all at WG)*
- WG Timeline:
  - **TOR approved on:** 11 Aug 2017
  - **Start Date:** 15 Feb 2018
  - **Expected Date for Submitting Final Report:** Dec 2020
- Highlights of Recent Activity:
  - *PSR WG is utilizing the KMS system to share information*
  - *Regular* **WebEx session** *and two roundtable discussion conducted*
  - *In an attempt to manage the number of interested parties, we propose the clustering of membership into three (3) task teams reporting to C4.47 working group*
  - *International Survey on practices on power system resilience has been sent to various entities on 23/05/2018*

CIGRE WG C4.48

"Overvoltage Withstand Characteristics of Power System Equipment 35-1200 kV"

- WG Composition:
  - **Convener: Ivan**
  - **18 members from 14 countries, 3 corresponding members**
- WG Timeline:
  - **Start Date: October 2017**
  - **Expected Date for Submitting Final Report to SC Chairman: October 2020**
- Highlights of Recent Activity:
  - Inaugural meeting 22-23 January 2018 in Dublin
  - Tasks and responsibilities are established
  - May 2019 First Draft Questionnaire (jointly with WG C4.46) – to be finalized in August 2018

CIGRE WG C4.49

Multi-frequency Stability Of Converter-based Modern Power Systems

- WG Composition:
  - **Convener: Łukasz H. Kocewiak**
  - **Secretary: Christoph Buchhagen**
  - **22 members from 13 countries (June 2018)**
- WG Timeline:
  - **Start Date: March 2018**
  - **Expected Date for Submitting Final Report: March 2021**
- Highlights of Recent Activity:
  - The WG has just been established and the WG scope is defined.
- Future Activity:
  - The kick-off meeting will be in August in Paris.
- Other Items:
  - The WG will deliver a TB with guidelines how to analyze the stability of grid converters in power systems.

CIGRE WG C4.50

Evaluation of Transient Performance of Grounding Systems in Substations and Its Impact on Primary and Secondary Systems

- WG Composition:
  - **Convener: Bo Zhang**
  - **15 members from 10 countries**
- WG Timeline:
  - **Start Date: July 2018**
  - **Expected Date for Submitting Final Report to SC Chairman: 2021**
- Highlights of Recent Activity:
  - First WG meeting is going to be held in August 2018 in Paris, and the scope and plans for future work of this WG will be discussed.
- Future Activity:
  - Second WG meetings will be held in Apr. 2019 in Xi'an, China.