CIGRE Study Committee C4

System Technical Performance

2010 Annual Report to CIGRE UK

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Chairman: Carlo Alberto Nucci (Italy)
Secretary: Pouyan Pourbeik (USA)

Mission & Scope:

SC C4 deals with methods and tools for analysis related to 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. Specific issues related to the design and manufacturing of components and apparatus are not in the scopes of SC C4, as well as those specifically related to planning and operation and control, apart from those cases in which component/appartus/subsystem behaviour depends on, or significantly interacts with, the performance of the nearby power system. The fields on which the activity is carried include but are not limited to: Power Quality, Electromagnetic Compatibility/Electromagnetic Interference (EMC/EMI), Insulation Co-ordination, Lightning, Advanced Tools for the analysis of power system performance, and power system dynamic performance models and analysis.

Organisation:

The Study Committee was composed of six Advisory Groups each responsible for one of the fields of activity area. This was revised during the Paris 2010 annual meeting such that there will now be only three Advisory Groups. The first will be a strategic/technical advisory group covering all areas of technical work while the second advisory group will be responsible for liaison with other SC's and institutions (IEC, IEEE, CIRED etc). A third advisory group will be responsible for helping with the dissemination of SC C4 achievements/results by organising tutorils/workshops etc.

SC C4 has 24 Regular and 15 Observer Members representing 39 countries. Among the 41 (members plus chairman and secretary) constituent members 17 are from research organisations and universities, 12 are from utilities and 12 are from regulators/manufacturers or other entities.

In ***Power Quality*** area there are 5 Working Groups, where most are joint WGs with CIRED:

- JWG C4.105: "Benchmarking of Power Quality Performances in Transmission Systems" – (an alternative convener is sought)
- JWG C4.107 : "Economic Framework Objectives for Voltage Quality"
- JWG C4.109 : "Emission Assessment Techniques"
- JWG C4.111 : "LV and MV Voltage Fluctuation Compatibility Levels"

- WG C4.112: "Power Quality monitoring in flexible power network" (UK co-convener).

Possible future activities as new WG:

- PQ/EMC issues associated with smart grids
- Power Quality Improvement Programs
- Conducted frequencies >50th harmonic

In ***Electromagnetic Compatibility / Electromagnetic Interference*** area there are 3 Working Groups:

- WG C4.206: "Protection of the HV Power Network Control Electronics against Intentional Electromagnetic Interference"
- JWG C4.207 : "EMC of Communication Circuits, LV Systems and Metallic Structures in the Vicinity of Power Systems" (UK convener)
- WG C4.208 : "EMC Requiremenst and Solutions for HV substations and Generating Stations" (UK convener)

Proposals for new work on EMC and EMF include:

- Influence of HV power lines on 3rd party installations;
- Lightning protection of wind farms
- EMC and smart grids;
- Simplified methods for EMF assessment;
- Assessment of contact currents related to ELF electric field exposure;
- Characterization of geomagnetic environment

In ***Insulation Co-ordination*** area there are 5 active Working Groups, one of which is a joint WG with SC A2:

- WG C4.303: "Pollution and Environmental Influence on Electrical Performance of Power Systems".
- WG C4.305 "Practices in Insulation Coordination of Modern Electric Power Systems Aimed at the Reduction of the Insulation Level"
- WG C4.306: "Insulation Coordination for UHV Systems.
- WG C4.307 "Resonance and Ferroresonance in Power Networks and Transformer Energisation Studies"
- JWG with SC A2 (JWG A2/C4.39) "Electrical Transient Interaction between Transformers and the Power System".

Proposals for new working groups in this area include:

- UHV AC test methods on rain, ice and snow
- Insulation co-ordination fro GIS substations connected to overhead lines through cables

In the area of ***Lightning*** there are 4 active Working Groups:

- WG C4.407: "Lightning Parameters for Engineering Application".
- WG C4.408: "Lightning Protection of Low-Voltage Networks".
- WG C4.409: "Lightning Protection of Wind Turbine Blades".
- WG C4.410 "Lightning Striking Characteristics to Very High Structures.

Proposals for new working groups in this area include:

- Issues on grounding at highly resistive soil
- Interaction with surge characteristics of a transmission tower

In ***Advanced Tools for the Analysis of Power System Performance*** area there are 3 Working Groups:

- WG C4.501: "Numerical Electromagnetic Analysis and Its Application to Surge Phenomena".
- WG C4.502: "Power System Technical Performance Issues Related to the Application of Long HVAC cables".
- WG C4.503 "Numerical Techniques for the Computation of Power Systems, from Steady-State to Switching Transients".

There is just one proposal for a new working group on "Guide to procedures for estimating the lightning performance of transmission lines".

In ***Power System Dynamic Performance Models and Analysis*** area there are currently 3 Working Groups:

- WG C4.603 : "Analytical Techniques Co-ordinated Voltage Control in Transmission Networks"
- WG C4.605 "Modelling and Aggregation of Loads in Flexible Power Networks" (UK convener)
- JWG with C1/B4/C4.604: "Influence of Embedded HVDC Transmission on System Security and AC Network Performance".

Proposals for new working groups in this area include:

- WG on "active grids" (WAMS, WACS concepts, high level grid control, etc)
- WG on "benchmark systems" (models, data)

Preferential Subjects for Paris 2012

PS1: New generation technologies and their connection to the transmission and distribution system: modelling and case studies

- The impact of new generation technologies on power quality of the network; this includes passive and active impacts; positive and negative impacts; dynamic and transient performance.
- Power quality and EMC issues in the transmission and distribution system related to the massive use of power electronics (this includes power electronics in the transmission system as well as large numbers of power electronics in the distribution system) and external agents.

PS2: New and improved tools and techniques for power system performance analysis with particular reference to stochastic methods

- Incorporating risk in analysis through probabilistic tools and assessment in light of the increasing complexity of future networks
- Advanced numerical methods

PS3: Lightning protection and insulation coordination as it relates to new generation and transmission technology

- Wind turbines
- UHV systems
- HVDC systems
- Models for the calculation of lightning performance of transmission lines

Annual Meetings and Other Events

The 2010 annual meeting took place in conjunction with CIGRE General Session in Paris.

The next SC C4 meeting will take place in Recife, Brazil in April 2011 in conjunction with the International Symposium on "Assessing and Improving Power System Security, Reliability and Performance in Light of Changing Energy Sources" supported by Study Committee's C1 and C2.

Positive feedback was received from two events suported by Study Committee C4:

- Colloquium in Kuala Lumpur, Malaysia on "Lightning and Power System" in May 2010 with 70 participants and 34 papers.
- International Colloquium on "Power Frequency Electromagnetic Fields – ELF/EMF" in Sarajevo, Bosnia & Herzegovina in June 2009 with 44 papers and 82 registered attendees.

Other Business

Out of the ten technical issues identified by the Network of the Future work sponsored by CIGRE Technical Committee, SC C4 is involved in six of those technical issues:

1) Modeling of new generation technologies
2) Addressing technical challenges with more embedded AC cables and HVDC systems
3) Lightning protection of wind turbines
4) Insulation co-ordination issue for UHV transmission systems
5) Advanced/improved tools and techniques for simulation
6) Power quality issues related to the massive use of power electronics

To support the initiative there is an International Symposium orginised by CIGRE Technical Committee on "The Electric Power System of the Future – Integrating Supergrids and Microgrids" in Bologna, Italy, 13-15 September 2011.

UK Liaison Meeting

The UK liaison meeting is planned to take place during January 2011 jointly with SC B4, C1, C2, C3, C5, C6 and D2 at Imperial College, London.

For more information

See www.cigre-c4.org

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