

# SC C1 Annual Report, 2014

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## System Development and Economics

### Overview

Study Committee (SC) C1 is focused on issues related to the development and economics of power systems. It examines the drivers for investment in power network facilities, decision processes and tools that support them. This covers investments to increase the power transfer capability of a network, to integrate distributed and renewable resources and to maintain acceptable system reliability of facilities. In this regard, asset management and risk assessment in respect to existing facilities are key activities.

The impact on system development of new solutions and technologies is of major interest. For example, the rate of development of renewables, distributed generation and demand management in some countries has been very significant to the extent that traditional forms of power system design are being challenged. This provides an opportunity to learn from the experiences of these countries and share potential solutions. New tools and methods are required to deal with the uncertainty that these new developments bring and this has been a key area of research.

Traditionally electricity demand has tended to keep pace with population and economic growth and this has led to strong growth in the need for distribution and transmission grids. However, the development of smart homes and distributed generation can lead to lower kWh energy transportation needs in both transmission and distribution systems, while the kW peak demands on transmission and distribution may keep increasing with the underlying load growth. New technologies such as distributed storage are evolving to allow some control over peak loads. As experience with electric vehicles, smart homes, distributed generation and smart grids improves, the ability to assess these changes will become a necessity for both transmission and distribution system operators and this is an important aspect of the economics part of SC C1's work.

On the other hand large-scale renewable generation options are also evolving including off shore wind farms and concentrated solar installations. These generation sites require suitable transmission connection and the use of HV DC is becoming more prevalent. Cooperation between SC C1 and B4 on the high level aspects of this topic is critical, particularly in relation to HV grids. In recent times this has involved two joint working groups that are described later in this report.

The challenges that individual power systems face vary from country to country. For example, newly and often rapidly developing countries are faced with meeting massive load growth. Others are providing electricity to areas that previously had no supply. Planning issues for these topics can vary from long distance UHV transmission and international interconnections to new low level supplies from local generation.

The aspects described above can lead to considerable uncertainty on the timing of major investment decisions and make the decision frameworks important to ensure that various scenarios are properly assessed. This has also been an area

of continued research and discussion covering areas such as decision trees, investment drivers and load forecasting.

This year the annual C1 meeting was held in Cape Town, South Africa followed by a Colloquium with C2 and C5 and the South African 2013 Regional Conference. The overall topic was “Innovations and good practices to support the reliable, efficient and sustainable supply of electricity”. The events were very well supported. In addition C1 coordinated a tutorial on wind turbine modelling, facilitation of renewables, integration of renewables with market design and, potential market / regulatory mechanisms to ensure investment in reliable resources. The tutorial was extremely well attended with over 200 registrations. A technical tour was organised by ESKOM to see their “invisible tower” which overcame environmental restrictions to allow a transmission line to go over a mountain.



At the Colloquium, the opportunity was taken to present Riaz Vajeth with his Technical Committee Award. This was in recognition of his outstanding effort as Chair of WG C1.09 that produced an extensive overview of all the power systems in Africa.



Over the last twelve months, a concerted effort has been made to conclude a number of long-running Working Groups, which has resulted in the publication of eight Technical Brochures (TB). These TB's cover some of the issues described above and include aspects of system development, business investment and asset management.

At the same time a number of new working groups have commenced which continue to address the challenges described above. One of these is a joint Cigre / Cired working group which deals with planning criteria for transmission in the presence of active distribution systems. Another is a joint working group with B4 that deals with recommended voltages for HVDC grids. A third is a working group that will research best practice approaches for developing credible electricity demand and energy forecasts for network planning. All of these working groups are described in more detail below.

SC C1 also has the responsibility of maintaining a broad overview of asset management across all aspects of the power system. To this end, it convenes working groups that draw on experts from a wide cross section of Study Committees. This has resulted in production of a number of very useful TB's. Most recently this has included TB 541 entitled, "Asset Management Decision Making using different Risk Assessment Methodologies". While an extensive report, it did not address all aspects of the scope of works and Working Group C1.25 is currently producing a second report entitled "Transmission Asset Risk Management - Progress in Application". This should be completed by August 2014. The two reports will provide a comprehensive overview of leading practices in relation to asset risk management and the link to overall business strategies.

In light of the changing international trends, C1 is continuing to review its overall program. Furthermore, in establishing study priorities and ultimately Working Groups, C1 members consider the technical aspects of the power systems, the requirements and expectations of customers, new technologies that lower cost or improve performance, total asset lifetime issues and overall business impacts.

### **Strategic Direction**

SC C1 focuses on providing unbiased, useful information for system development practitioners and planners, as well as for policy makers, across the world. While the position, nature and role of system development and planning continue to evolve, SC C1 has mostly aligned its work with the Cigre Strategic Plan 2010-2020.

The work of SC C1 is generally broken down into the following areas: system development, business investment and asset management. The emphasis of each of these three areas is refreshed every two years at the Paris SC meeting. However, from ongoing consultation with the C1 Advisory Groups and input from C1 members worldwide, it is apparent that these basic categories of C1 work remain relevant. The asset management work is focussed on broad, high-level issues that cut across a number of Study Committees. As such, there tends to only be one or two Working Groups in this area, in operation at any one time.

### **Working Groups and Recent Publications**

A summary and brief description of ongoing and recently completed, Working Groups and Technical Brochures is as follows:

#### **System Development**

- **TB 547 Planning Issues for Newly Industrialised and Developing Countries:** Issues, methods and approaches to power system planning in developing and newly industrialised countries within Africa are documented, and a technical summary for each country is provided.
- **TB 523 System Complexity and Dynamic Performance:** Voltage stability aspects are a particular focus, including how active and passive compensation devices (FACTS) can help to improve voltage stability.
- **TB 527 Performance Coping with Limits for Very High Penetrations of Renewable Energy:** The impacts of an increasing global penetration of renewable energy sources (RES) are investigated, particularly the impact of variable non-synchronous renewable generation on power systems. The study assesses industry's readiness to manage the effects of greater RES integration based on survey responses from 18 countries and

recommends how system operators can better prepare for these developments.

- **TB 536 Influence of Embedded HVDC Transmission on System Security and AC Network Performance:** This TB follows on from previous work on the application of HVDC and examines special control features of HVDC systems, overload capabilities and other issues.
- **TB 579 Green field network, designing future networks ignoring existing constraints:** Without considering the constraints of existing infrastructure, this TB explores the design of future power systems for the long term and considers the implications for the planning of today's power systems.
- **WG C1-20 Accommodating high load growth and urban development in future plans:** This WG is reviewing the methodologies and processes followed to formulate and prepare the development plans of transmission networks that supply high density urban areas within different countries.
- **WG C1.27 Definition of reliability in light of new developments in various devices and services which offer customers and system operators new levels of flexibility:** This WG will determine if there is a need for a modified or expanded definition of adequacy in light of the expected new devices and services.
- **WG C1.29 Joint Cired/Cigre WG. Planning criteria for transmission networks in the presence of active distribution systems.** Previous transmission planning criteria has been based on very little use of distributed energy resources with small evolutionary modifications made to planning standards to cater for distributed resource growth. This is changing in some parts of the world and this WG will investigate the growth of distributed energy resources and highlight the implications for planners. The end product will be a booklet about "future-proof" demand planning criteria for Transmission Networks.
- **JWG B4/C1.65 Recommended Voltages for HVDC Grids:** For steady state Pole-to-Ground and Pole-to-Pole DC voltages, this JWG will assess the technical limits in HVDC grids and will study the economic case for voltage harmonisation.

## **Business Investment**

- **TB 564 Review of the transmission planning access requirements:** The different approaches to transmission planning access requirements in a number of countries are examined.
- **TB 572 Tools for developing Optimum Network Development Plans:** This TB studies the need for new tools and techniques to assist in the development and economic justification of long-term transmission plans.
- **WG C1-15 Review the drivers for transmission investment decisions and the role of technical planning criteria in transmission investment:** This WG reviews the rationale used for transmission investment decisions, establishes the role of technical planning criteria in investment decisions and identifies trends in investment drivers.
- **WG C1-22 New investment decision processes and regulatory practices required to deal with changing economic drivers:** Decision processes in a changing environment will be reviewed and the WG will propose orientations for future processes.

- **WG C1-23 Transmission investment decision points and trees:** This WG is establishing if and how target networks are being used, and if they are used to generate decision trees and key decision points. In particular, it is investigating processes used to determine the timelines of the decision points in the different countries and the methods used.
- **WG C1.32 Establishing best practice approaches for developing credible electricity demand and energy forecasts for network planning.** Changing economic circumstances coupled with evolving government policies on energy efficiency and a rapid uptake of renewables and demand management are making production of accurate load forecasts more and more difficult. This working group aims to examine the demand and energy forecasting techniques currently being employed by network companies around the world to address these challenges and to determine the techniques that appear to deliver the greatest accuracy.

### **Asset Management**

- **TB 541 Asset Management Decision Making using different Risk Assessment Methodologies:** This TB provides insight into the application of Asset Management (AM), risk management and the information needed to prepare for future AM challenges. The TB overviews Cigre's work on AM and provides cases demonstrating AM decision making including environmental impacts, quantitative evaluation of risk treatment plans and application of risk indicators in transmission systems.
- **WG C1-25 Transmission Asset Risk Management - Progress in Application:** This WG has already published TB 541, and will produce another TB by August 2014. It will provide an insight into the current and future application of asset management, risk management and the information needed for these processes in electricity transmission companies as we prepare for future challenges.

### **Technical Committee**

In addition to the above, a Position Paper was produced on behalf of the Technical Committee. A summary of this paper is published in the August 2014 Electra and is titled, "Disaster recovery within a Cigre strategic framework: Network resilience, trends and areas of future work." The paper seeks to highlight the importance of developing a strategic approach for disaster recovery within the context of other Cigre projects concerning various aspects of disaster response. It analyses a number of case studies to illustrate the main lessons learned from different utilities and organisations coping with disaster responses and makes a number of recommendations for future work.

### **Future work**

Future C1 work is aligned with the objectives outlined above and will ultimately be categorised into system development, business investment and asset management. The latter will particularly consider the implications of the activities on asset management strategies and methods. The work is also guided by two Technical Committee projects "Electricity Supply Systems of the Future"

and “Energy Efficiency”. Both projects have helped elevate broader, system-wide issues. In addition, the TC position paper on disaster recovery described above has a range of Cigre-wide implications that will potentially influence future work.

The August 2014 Paris session C1 Special Report is specifically targeted at the increase in the level of uncertainty attached to long term system planning, infrastructure investment and asset management. The three preferential subjects are: Improvement in system and asset performance through application of enhanced Asset Management methodologies, New system solutions and planning techniques and Securing investment in transmission networks with increasing RES. It is expected that the discussion generated at this session will also influence the future work of the Study Committee.

### **Meetings and events**

- Paris session, August 23 - 29, 2014
- Symposium, "Across Borders - Integrating Systems And Markets" in Lund, Sweden supported by Study Committees C1, C2, C4 and B4 together with the C1 Meeting, May 25 - 29, 2015

### **Thank You Message**

This will be my last annual report as I hand over to the new Chairman Konstantin Staschus at the end of the Paris session. My time as Chairman has been a wonderful experience for me as I have made many good friendships and learnt from the outstanding group of dedicated experts from across the world that make up the C1 Study Committee. I would particularly like to thank my untiring secretary Peter Roddy, my management team of David Alvira, Alan Croes, Eric Rijks and Keith Bell and the numerous working group chairmen that have led our core work over recent years. I am very confident that Konni will provide excellent leadership for SC C1 as we face the continued challenges that confront the global power industry.

Further information can be obtained by contacting the SC Secretary, Peter Roddy or the SC Chairman, Phil Southwell. Contact details can be found on the C1 website.