Study Committee C1

System Development and Economics

Chairman: Konstantin Staschus (Belgium)

Strategy and Action Plan 2010-2018
Update for 2015-2018

Submitted to and approved by Technical Committee

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1. Introduction

Within the framework set by the CIGRE statutes and rules and in particular the Technical Committee Strategic Plan 2008-2018, this strategic plan for Study Committee C1 contributes to and supports the objectives of CIGRE for system development and economics.

It specifies the TC strategies for SC C1, builds on the prior SC C1 strategic plan of 2010, and includes an updated list of current and planned working groups (WGs) as well as WG directions needed to be agreed over the coming years to fulfil the strategy.

The current October 2015 draft was edited by the Chairman of SC C1 and reflects comments from Technical Committee and SC C1 during May 2015, and is to be submitted for final approval to the SC and the Technical Committee in Fall 2015.

2. Mission

The SC C1 mission is to support electricity system planners worldwide to anticipate and successfully manage system changes to address the arising needs, opportunities and uncertainties while respecting the multiple constraints.

By providing a worldwide platform for elaboration and exchange of knowledge and information, SC C1 facilitates and promotes the progress of engineering and sound planning in the field of system development, economics, and asset management, adding value by developing recommendations for state-of-the-art practices.

3. Vision

SC C1 aims to be recognised as the leading worldwide platform for providing and exchanging knowledge and facts that help electricity system planners worldwide to anticipate and deliver a system that makes the most of change.

SC C1 aims to provide especially strong value with its recommendations on methods and descriptions of practices 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.

Unique SC C1 perspective on the paradigm shift:

The unique perspective of SC C1 is to show how this paradigm shift can be managed by emphasizing the *system* of transmission, distribution, generation and demand while emphasizing the integrative role of transmission. This system needs to be planned to deal with the changes, needs to be built taking into account economic and public acceptance difficulties, and needs to be maintained well. Making the most of the change implies supporting market participants' desire to implement innovative solutions, and emphasizes the opportunities – along with risks – which the change brings. It also implies anticipating, integrating and supporting progress. In particular there are opportunities for customer empowerment, increased penetration of distributed generation and closer transmission-distribution cooperation, taking advantage of new technologies, as well as for efficiency and sustainability improvements.

4. Scope

The scope of SC C1 work generally includes descriptions of state-of-the-art applied methods and practices for system planning, economics and asset management. To provide value to SC C1's target audience, the drivers of the on-going paradigm shift need to also partly drive the methods and practices SC C1 recommends: Smart grids and demand-side response, energy-efficient electrification of heating and transport, generation cost structure changes, especially for renewable and variable distributed generation, sustainability policies (e.g. CO_2), as well as evolving regulation and electricity market development and integration. The target audience includes electricity system planners for generation, demand response, transmission and distribution, regulators, energy policy makers, asset managers, utility executives, software, data hub and platform developers, consultants and academics, and other stakeholders of the electricity system. In fact, as energy and environmental policy gain ever more public interest worldwide, other stakeholders and the public become more important parts of the target audience of SC C1. That is why the TC strategic direction of preparing material readable for non-technical audience is especially important for SC C1 (see below).

The main areas covered by SC C1 are:

1. System planning:
    - Utilization of methods and tools for power system steady state and dynamic analysis in system planning and economic analyses;
    - Progress, new approaches and evolving stakeholder expectations in applying power system planning criteria and reliability assessment (security and adequacy of supply);
    - Planning and operational criteria targeting increased network resilience (compliance with largely variable conditions within the life-time of grid investments);
    - Planning criteria in frameworks characterised by both competitive markets (generation/demand side) and regulated services (transmission and distribution);
    - Planning methods, criteria and constraints with increased non-utility stakeholders involvement and affected by environmental reasons and public acceptance, e.g. in the context of multi-criteria cost-benefit analyses;
    - Methods and tools for gaining public acceptance;
    - Enhancing transmission capacity by using risk-based security assessment and advanced information, communication and power-electronics technology to improve system stability and dynamic performance;
    - Future requirements, sources and economics associated with the provision of ancillary services for addressing frequency and voltage control and other system needs (grid codes);
    - System planning and technology issues in specific contexts: developing countries, large urban areas, environmentally sensitive zones, off-shore wind generation integration, utilization of HVDC, etc.

2. Asset management:
   - High level asset management strategies in defining sustainable policies and optimal practices across a range of power system assets (to complement and integrate asset-specific work in other SCs);
   - Using total life cycle cost of ownership (TCO) of assets to compare alternatives and make investment decisions.
3. Business management:
   - The impact of business models, cost-benefit-analyses and privatisation on system development (prioritisation of investments, merchant lines, public-private partnerships, etc.);
   - The impact of market design and regulation (pricing, tariffs, incentives, market design etc.) on planning scenarios, and on transmission and distribution planning and investments;
   - Scenario and methodologies definition/adoption for quantitative studies on future power systems;
   - Prioritizing investments across a multitude of projects and programs addressing different system needs.
4. Interconnections – horizontal, vertical:
   - System planning and issues and best-practices for scenarios related to long-distance/continental-scale systems (e.g. UHV lines), also in the perspective of global energy networks;
   - Interface and allocation issues in planning and delivery of multi-party/cross-jurisdiction projects;
   - Planning regulated and non-regulated transmission assets in parallel;
   - Coordinated planning with "smart" and evolving distribution systems, especially with uncertain evolution and markets for demand response, empowered customers, dynamic pricing, distributed generation and battery costs.

5. Objectives

The *Strategic Directions* indicated by CIGRE Technical Committee are listed below together with the relevant contributions by SC C1.

Shaping the electrical power system of the future

The SC C1 focus on planning, economics and asset management, and making the most of change as described above, is at the heart of preparing the electrical power system of the future. Looking at the entire system, the C1 work needs to build on the work of other SCs while adding value from the system development perspective, helping utilities and policy makers chart a proper course through the uncertainties and changes while making best use of technical innovation and economic opportunities. Indeed, several active WGs address different aspects of how to best manage changes and uncertainties. For the 2018 CIGRE session, we aim to produce a summary reference document which points to the various recent WG results on system development under uncertain changes. In addition, monitoring UHV installations worldwide, a core technology for worldwide power system planning, could be quite valuable for electric utility staff, policy makers and the public.

Making the best use of the existing system

One Advisory Group is specifically and permanently dedicated to asset management. While several other Study Committees research aspects of asset management relevant to their Study Committee, C1 was assigned the role by the Technical Committee of overseeing the common cross boundary aspects. Usually at least one active WG focuses on the most up-to-date system aspects of asset management for effective and cost-efficient sustainment of the existing asset base. In writing the technical reports from these WGs, we aim for them to be useful as summary and reference documents on these up-to-date system aspects.

Focusing on the environment and sustainability

Environmental concerns, climate protection and sustainability are among the major drivers of change for electric systems, and thus a major driver for system planning and economics. Within the terms of reference of several active WGs, these issues play a pivotal role.

Distributed generation, e.g. wind and solar energy, can have beneficial effects on environment, sustainability and also customer empowerment. In combination with battery or heat storage systems, there can be profound effects on distribution and transmission system planning. The system planning work described above aims to fully embrace the system viewpoint by capturing without prejudice and with a view on best customer benefits the benefits and costs of large interconnected systems but also microgrids. This will be one focus area within the work area Interconnections – horizontal, vertical.

Preparation of material readable for non-technical audience

To be effective for the vision of helping anticipate, plan and deliver a system that makes the most of change, not only utility staff but also regulators and policy makers, and even the general public, should become part of the target audience of C1 work products. For this the traditionally very technical contents of the reports – which can and should continue in order to address experts – should be complemented by shorter publications suitable for non-technical journals, media and/or websites. These can be thought of as summaries of the SC C1 technical reports which could use graphs to present main concepts to non-technical audiences. This could become a general rule for WGs and taken up with the Technical Committee and Central Office to discuss how this fits in with possible CO plans for a Communication Advisor. We aim to publish three such summary publications in non-technical journals until 2018.

Creating added value to members and society

C1 will ensure significant parts of the industry and world regions are represented on the SC, provide opportunities for students to participate in the SC as part of their personal development, and provide two-way communication with decision and policy makers to focus activities on their needs.

The main driver for creating widespread value is to carefully select the topics which arise from real and up-to-date concerns, problems, practices and views; in particular those topics which can best take advantage from international comparisons, discussion, examination, review or standardisation. Indeed the

unique stronghold of CIGRE is to bring together expertise from all regions of the world and from all sectors encompassing the power system, including technical, regulatory and market aspects. We will analyse the membership with a view to this mix of expertise and regions and aim to use observer membership to address any imbalances we may find.

To fully engage all stakeholders in the electricity enterprise

Some WGs address how to best involve stakeholders in system planning processes. Also the publications aimed at policy makers are expected to support this goal. Finally, the SC and WG members carry an important role in their countries for communicating CIGRE results.

C1 will aim to also increase stakeholders' engagement through selected new kinds of work products, and publications targeting policy makers. We plan to survey the members of SC C1 and its WGs every two years to build successively better engagement and dissemination strategies based on feedback how each member uses and disseminates the SC C1 work products in his or her country.

Increasing the recognition of CIGRE

This is achieved by the quality and timeliness of the outcomes of CIGRE activities, so efforts will be made to maintain, and, where necessary, increase the quality standards of the works carried out. Extra readability checks during the completion stage of each WG's technical report, and the summaries described above for non-technical audiences, will be concrete steps in this direction.

Strengthening support and cooperation between National Committees and the Central Office

Besides promoting the installation of a Communications Advisor in Central Office, SC C1 will also continue to provide materials suitable for use by National Committees, and to engage National Committees in various symposia and conferences. One example is the Colloquium of the USA National Committee "Power Network Planning Codes – Generation Connection, Economic and Reliability Drivers", growing out of the TC discussions on needs and expectations of customers towards the network and organised in cooperation with several other SCs (Philadelphia, PA, USA, 2-3 Nov. 2016). For the Symposium "Experiencing the Future Power System Today", Dublin (Ireland), 29 May-2 June 2017, SC C1 is leading the preparation together with the Irish National Committee. We plan to use the regular member surveys described above to monitor and improve the relevance of the C1 work for the National Committees.

6. Focus of work over 2014/2018 period

As mentioned in the mission, vision and scope sections above, the SC C1 theme proposed and adopted in the August 2014 meeting for the next years is: **Anticipate and plan a system that best fits the paradigm shift.** Drivers of change are smart grids and demand side response, energy-efficient electrification of heating and transport, generation cost structure changes (especially for renewable and fluctuating distributed generation), sustainability policies (e.g. CO_2), and market development and integration. The changes are driven partly by technological innovation, partly by policies, and the nature and outcome of the changes is highly uncertain.

These changes have five things in common: Most need a strong grid which many recent planning studies for different continents have shown to need more large-scale transmission investments or interconnections; most bring unprecedented transmission-distribution interdependence; most struggle with the usual business case justifications based e.g. on long depreciation times; most present drivers and opportunities for improved utilization of transmission and distribution infrastructure; and they all therefore strongly affect the SC C1 topics of system planning, asset management, and economics.

Many of the current and recent past SC C1 WGs already address some of these changes, and how to make the most of them. New WGs are being defined to examine how the changes affect system planning and economics. To make the most of these changes, worldwide mutual learning is key, particularly since the paradigm changes of CO_2 reduction, market integration, UHV transmission and the smartening of the distribution grids strongly affecting system planning in new and parallel ways worldwide. System development is the central, neutral activity which must anticipate, and often support, the various changes, and is overall central to the paradigm change. Through the work and exchange of knowledge in SC C1 and through cooperation and proactive communication with other SCs and other worldwide associations, CIGRE can help shape the systems' future.

In particular, new WGs are being formed in the advisory groups within the SC theme's context. Research areas already identified fall broadly under the headings assigned to the advisory groups and can be summarised as follows:

- Risks and solutions for surpluses and deficits of RES
- Application of ISO 55000 Asset Management standards in transmission systems
- Stakeholder engagement in long-term transmission planning
- Interface and allocation issues in planning and delivery of multi-party/cross-jurisdiction interconnections
- Global energy network feasibility study

These new WGs will maintain or even stretch the resources which have been dedicated to the SC's work in recent years. Additional topics to shed further light on how the paradigm shift drivers affect system planning, economics and asset management will be identified in the SC meeting in August 2016 to start new WGs to keep the work load roughly constant as other current WGs complete their work.

7. Structure of SC C1 and WG governance

The organisation of the work in C1 is critical to successfully focusing on current topics of interest in the industry and to communicating with decision-makers (target groups) in the industry. This is achieved through a permanent Strategy Advisory Group (SAG) and Working Groups (WGs) (see tables 1 and 2 in Appendix).

For the period 2014-2018, SC C1's focus will fall into five main themes overseen by the permanent Strategy Advisory Group: The topics are: System Planning; Business Management; Asset Management; Interconnections – Horizontal, Vertical; and Tutorials. With the exception of the latter, each is structured in terms of new WGs by ad-hoc AGs which meet as part of the SC C1 meeting every two years in Paris. When they define new WGs, each ad-hoc AG identifies the

corresponding target groups and the main WG topic based on the. emerging issues within the industry and recommends WG activities to examine these issues.

The Strategy Advisory Group consists of the C1 members who have especially strong expertise and shown leadership in each of the five topics. It discusses and evolves the overall strategy of the SC, monitors the progress of all WGs and prepares the annual SC meetings. To accomplish these tasks, it holds phone conferences every two to three months.

One aspiration for new WGs is where possible to encourage the target group to become engaged in the work through its CIGRE member. In this way the WG reports would have increased value and relevance within the industry. This would also encourage presenting the WG results at non-CIGRE events which would have the benefit of raising the profile of CIGRE and demonstrate its collective technical capabiloities. The target groups could also involve other SCs as well as other parts of the industry. Many of the issues of interest within the industry will span more than one SC. This will require SCs to work in partnership to a scope of work and a timetable agreed with specific external target groups.

Furthermore, the governance of WGs will be made more robust, through:

- improving transparency and planning of the number, the start date, end date and the topics of new WGs;
- tighter monitoring of work progress, e.g. through even more regular contacts between members of the Strategy AG and the WG convenors, and through the regular Strategy AG discussions;
- better utilization of resources by coordinating members' preferences and WGs' needs.

8. Composition of SC and WGs

The focus for C1 is to consider the electric power system as a whole. Its members, both at SC and AG/WGs level, must therefore have a good knowledge about the whole power sector including: generation, transmission, distribution, regulation and market issues. Members and WG contributors should therefore represent, in a comprehensive and balanced manner, the various business areas and entities involved in various functions of the whole system: Utilities, power companies, TSO/DSOs, market operators, as well as manufacturers, universities and consultancies; the central role of grid operators - and of their associations - in the development of the global system, which is clearly being emphasized by the paradigm shift, should also be properly represented.

Moreover, in order to achieve world class research and output, the composition of SC C1, over the long-term, should be designed to balance both a professional and geographical mix, there are also efforts to ensure a suitable mix according to membership status and terms of office. Details of members' composition are given in the Appendix.

9. Communication and external coverage

In order to increase the value of CIGRE's work, and keep it in line with industry evolving needs, SC C1 will make use of both traditional and innovative routes:

1. Paris bi-annual sessions, panel sessions and exhibition;
2. Yearly Regional meetings, Colloquia, Workshops and Symposia;

3. Tutorials;
4. *ELECTRA* and other CIGRE publications;
5. The C1 website and e-Cigré;
6. Liaison and cooperation with other SCs;
7. Non-CIGRE conferences/symposia, in particular cooperation with CIRED;
8. Leveraging members in National Committees.

While it is important that C1 expands its communication to a broader audience, it is necessary to ensure that appropriate communication protocols are established and understood. Contact with the target groups is guided by the following points:

- Internal: (for example, other SCs), through the SC Chairman
- External: companies, research centers, universities, National Committees, through the SC members.

With the restructuring that has taken place in the industry over recent years, the areas of interest and relevance to target groups have widened well beyond the mere technical topics. In a pervasive industry such as electricity, the WG activities should incorporate the wider business environment involving political and social aspects of the topics being considered. To successfully achieve this broader view may require expanding links with other organisations to share their views and knowledge and in this way leverage the value of WG activities to the broader target groups. This will also help avoid duplicating any work already done elsewhere and efficient sharing of scarce resources.

Appendices

Table 1: List of Strategy Advisory Group Topics

Ref.	Title	Convenor/ Lead
C1. SAG	**Strategy** Discuss, propose and fine-tune SC strategy. Coordinate all WGs for the C1 strategic goals.	Konstantin Staschus (Belgium)
	• **System Planning** Propose new power system development WG activities.	David Alvira (Spain)
	• **Asset Management** Propose new asset management WG activities.	Yury Tsimberg (Canada)
	• **Business Management** Propose new WG activities on the business environ-ment + its impact on investment in the power system.	Alan Croes (Netherlands)
	• **Interconnections – Horizontal, Vertical** Propose new WG and other activities on the inter-connectivity between large regions and with distribution, due to UHV and smart grids.	Yugal Sehgal (India) & Antonio Iliceto (Italy)
	• **Education Tutorials** Organisation of tutorials as required.	Keith Bell (UK)

Table 2: List of Current Working Groups

WG No.	WG Name	WG Convenor	WG Status	Strategic AG Topic	Original Dates	Current Target End Date
C1.15	Review the drivers for transmission investment decisions and the role of technical planning criteria in transmission investment	Adele Sleator	**Live**	Economics	2009 - 2011	March 2016
C1.20	Accommodating high load growth and urban development in future plans	Kevin Leask	**Live**	Planning	2009 - 2011	November 2015
C1.22	New investment decision processes required to deal with changing economic drivers	Olivier Herz	**Live**	Economics	2009 - 2011	June 2016
C1.23	Transmission investment decision points and trees	Ronald Marais	**Live**	Economics	2009 - 2011	March 2016
C1.27	The future of reliability	Jeff Palermo	**Live**	Planning	2011 - 2013	February 2016
C1.29	Planning criteria for Future Transmission Networks in the presence of a greater variability of power exchange with distribution systems	John Wilson	**Live**	Planning	2013 - 2015	November 2015
C1.30	Technical risks and solutions from periodic, large surpluses or deficits of available renewable generation in a particular area	Christian Schorn	**Live**	Planning	2015 - 2016	March 2016
C1/C3.31	Including stakeholders in the investment planning process	Alan Croes	Approved, starting up	Economics	2015 - 2016	December 2016
C1.32	Establishing best practice approaches for developing credible electricity demand and energy forecasts for network planning	Grame Ancell	**Live**	Economics	2014 - 2016	September 2016
C1.33	Interface and allocation issues in multi-party and/or cross-jurisdiction power infrastructures projects	Antonio Iliceto	**Live**	Interconnectors	2015 - 2017	November 2017
C1.34	ISO Series 55000 Standards: General Process Assessment Steps and Information Requirements for Utilities	Boudewijn Neijens	Approved, starting up	Asset Management	2015 - 2017	May 2017
C1.35	Global energy network feasibility study	Jun Yu	Under development	Interconnectors	2015-2017	(TBC)
C1.36	Review of the Metropolitan area power system development trends taking into account new generation, grid and information technologies	Stanislav Utts	Dependent on C1.20	Planning	-	-
B4/C1.65	Recommended voltages for HVDC grids	Alexandre Parisot	**Live**	-	2013 - 2015	March 2016