



## **Study Committee C6**

# **Distribution systems and dispersed generation**

## **Strategic plan for the period 2015-2024**

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# **1. INTRODUCTION**

## **1.1. Purpose of the SC Strategic Plan**

The purpose of the Study Committee (SC) Strategic Plan is to define the main mid to long term strategies of the Committee and provide a global framework for its activities.

The SC Strategic Plan takes into consideration the mission and objectives stated by the CIGRE Technical Committee (TC) as defined in 2002, when reorganization of CIGRE was concluded, as well as the factors which are affecting or are expected to affect its activities in the area of specific competence.

A first Strategic Plan was prepared at the time of creation of the SC, to cover the period 2002 – 2004. In keeping with established CIGRE practice, a second strategic plan covers a decade (2007 - 2016). The new strategic plan covers the period 2015-2024.

A new SC Action Plan covering a period of three years (2015 – 2018) will define a set of priority short-term actions linked with the implementation of this strategic plan.

## **1.2. Mission of the SC**

To facilitate and promote the progress of engineering and the international exchange of information and knowledge in the field of distribution systems and dispersed generation. To add value to this information and knowledge by means of synthesizing state-of-the-art practices and developing recommendations.

## **1.3. Scope of the SC**

The activities are principally concerned with the assessment of the technical impacts and requirements which a more widespread adoption of distributed/dispersed generation could impose on the structure and operation of the whole energy system.

In parallel, the Study Committee should assess the degree to which such solutions are likely to be adopted in the short, medium and long term. The practical importance and timing of the related technical impacts and requirements should also be assessed.

Rural electrification, demand side management methodologies, smart cities and application of storage are within the scope of this Study Committee.

Through its work the Study Committee strives to objectively analyse the implications of distributed/dispersed generation and to become an internationally recognised forum on this evolving subject.

The SC shall co-operate with Study Committee D1 concerning emerging technologies for dispersed generation, and also with other System Study Committees for the development of the whole energy system.

#### **1.4. SC Targets groups**

The study committee target groups are the same as described later in the membership profile and chapter 1.6. By integrating all stakeholders as members, their interests are considered best.

#### **1.5. Main goals of the SC**

The main goals of the SC in CIGRE as a pre-standardization organization are:

- Provide state-of-the-art knowledge and identify best practices in the field of Distribution Systems and Dispersed Generation
- Identify the main needs of the SC target groups and identify gaps and new fields of action to be performed
- Develop technical analysis on the impact of DG to support National Bodies in developing policies
- Integrate in the SC new members who don't have experience in the organization and activity of CIGRE, also coming from professional areas previously not considered by CIGRE (for instance, distribution utilities and companies)
- Involve people from developing countries
- Promote the name of the SC in non-traditional (for CIGRE) areas
- Establish links with other bodies active in the field of the SC, such as CIRED, EDSO, EURELECTRIC, IEA, IEC, IET, IEEE, and also other appropriate non-technical bodies.

#### **1.6. Composition of the SC**

The SC is composed of:

- The SC Chair.
- The SC Secretary.
- 24 Regular members.
- 13 Observer members.
  
- Working Groups (WG) aim to perform extensive activities on broad subjects of paramount importance for the SC. Their activity has to be completed in 3-4 years.
- Task Forces (TF) aim to perform activities on subjects of specific and present interest where results are required in due time. Their activity has to be completed in 2 years.
- Advisory Groups (AG) assist the SC Chair to perform the mission and to pursue the scopes assigned by the TC. The activity could last one or more years.

Participation to WG/TF is open. Deliverables are reports, technical brochures and summary for ELECTRA, papers for CIGRE conferences and symposia.

Participation to AG is not limited to SC members. Deliverables are terms of reference for new WG/TFs, reports dealing with the management of the SC, proposals on strategies and organisation of the SC.

### **Membership profile**

The membership profile shall reflect the stakeholder's profile to make sure that the results are relevant for the stakeholders:

- distribution system operators, mainly engineers from asset management, system planning and system operation.
- power consultants
- technology providers
- experts from countries with different levels of integrating renewables
- rural electrification experts
- information and communication technology experts
- academia on respective topics

## 2. KEY FACTORS

The Master Plan of CIGRE established in 2000 stated that CIGRE should look at the “Electrical System” as a whole, including all interconnected components whose role is the conversion of primary energy sources into electricity and the further transmission and distribution of electric energy to the end user. In particular it is noted that **Dispersed Generation** is within CIGRE’s scope. Consequently in 2002 a new SC was created on “**Distribution Systems and Dispersed Generation**”.

### Market environment

#### Transition of Energy Systems

There is a variety of factors driving the energy transition world-wide. Regions face different challenges, both technically speaking and from a market perspective.

- International or national policies that encourage lower carbon generation, i.e. use of renewable energy sources and more efficient energy use
- Integrating a high number of individual distributed generators and renewables into the existing electricity system
- Increased customer participation
- Progress in technologies, such as Information and communication technology (ICT)
- Ageing assets and need to manage reinvestments efficiently
- Evolution of market design
- Sustainability.

It is likely that the future energy system will integrate two major developments: an increasing importance of large networks for bulk transmission to connect centralized renewable generation with load regions. And a cluster of small, largely self-contained distribution networks with a number of new stakeholders who own distributed generation, energy storage and loads that can participate in demand side management. [Electricity 2014] elaborates the top ten technical issues that are relevant for transition of the energy system. They will be described in the context of technical directions for the study committee.

In the meantime, dispersed and volatile generation in distribution systems has already reached unprecedented levels in European countries such as Denmark, Germany, Spain and Italy. Outside Europe, renewables are scaling up. Pilot projects are ongoing for improving reliability and self-sufficiency. In many countries, the development is still at an early stage, and distribution system operators want to prepare for a similar development in their countries.

## **2.1. Key factors affecting the operational activities of the SC and its working bodies**

The mandate the SC received was to work on subjects new for CIGRE, but already dealt with by other organizations.

The SC operation has therefore to take into account factors such as:

- Regarding distribution system operators, CIGRE is not known to management and thus recruiting of experts and study committee members needs better communication of benefits. (Industrial)
- Many members of SC are without experience of CIGRE rules and practices, they don't have mentors in their affiliations but need training within CIGRE.
- Limited availability of electric companies to provide financial support for experts to travel and to work in CIGRE.
- Language barriers

## **2.2. Key factors affecting the choices and priorities of the SC**

Distribution system operators now face challenges that previously only transmission system operators had to handle. The benefit of CIGRE can be that in the working groups, experts from TSOs work together with experts from DSOs and can help to build up relevant knowledge on lower voltage levels and higher number of elements in the system.

Another benefit is to learn from best practices in other countries. Experience with the implementation and management of DG is quite different in different countries across the world. The task of SC C6 is to share the existing knowledge and to work out recommendations for new guidelines supporting the further enhancement of the technologies and their penetration into the power systems. The discussion during the 2014 Study Committee meeting in general decided to continue with the previous directions and added new topics to the agenda.

The aim continues to identify and share the “*best practices*”:

- Exchange of information on practical implementations and policies
- Disseminate results of research projects,
- Support the development of internationally accepted rules and standards,
- Support the development of internationally accepted models and benchmarks,
- Identify the requirements for DG component manufacturers and provide recommendations for the technical content of Distribution Codes and Grid Access Rules.

### **3. STRATEGIC DIRECTIONS**

#### **3.1. Administrative directions and communication**

Administration should allow for elaboration of unbiased information and for efficient management. Study committee C6 contributes to the strategic direction identified by the Technical Committee in 2010 [CIGRE 2010] regarding interactive communication with the public and with political decision makers. The SC elaborates technical brochures, tutorials, publications, presentations. It further strengthens cooperation with other organizations, i.e. EDSO, CIRED.

The present structure and organization, the set-up and operation of the working bodies are respecting the guidelines prepared by the Central Office [CIGRE 2009]. The efforts of the SC should be focused on the specific issues that follow.

- To develop and maintain a high level technical role of the SC on the subject of DG that is of high interest for other international organizations. To develop and exploit synergies, while respecting rules and recommendation stated by TC
- To increase the flexibility and develop speed of reaction of the SC just to catch in due time new issues of interest of the SC Target Groups
- To promote and facilitate the active participation of all the SC Members. In order to involve more distribution system operators in CIGRE working groups and flow of information, the national organizations of SC C6 may play a stronger role. They can involve experts from local DSOs in mirror working groups and consolidate input to the international level.
- To maintain a significant number of working bodies realistically tailored with the disposition of electric power industry to support expert participation
- For SC C6, as mentioned above, it is key to success to attract distribution system operators, technology providers, power consultants and academia to work in working groups and task forces. In order to communicate to them, CIGRE should agree on max. 10 strong messages on the electricity system, identify the target groups (Grid operators, industry, academia) and then elaborate the marketing material in a way that the messages are visible on the internet and available for all CIGRE members to present them in a professional way to the target groups (i.e. with well-designed overview slides in a common CIGRE look&feel)
- Improve flow of information between working groups and study committee members.

### 3.2. Technical directions

Since its creation the SC studied, through the activities of WGs and TFs, the several aspects of integrating dispersed generation into the power system. The study committee C6 contributes to the strategic directions identified by the Technical Committee in 2010 [CIGRE 2010] and to the ten technical issues defined in the study “Electricity supply systems of the future” [Electricity 2014].

In discussion with the members of study committee C6, the following topics were identified as our specific strategic technical directions [C6 2014].

The study committee C6 topics are listed below the related TC directions and 10 technical issues. The numbering does not express any priority.

#### **TC Direction 1: The electrical power system of the future**

*“Technical Issue 1: Active distribution networks resulting in bidirectional power and data flows within distribution levels and to the higher voltage networks”*

- Massive penetration of distributed energy resources (DER), including small size generators, intelligent loads, storage and relevant power electronic devices.
- Novel methods for integrating planning and operation including asset management, control and protection
- Deal with future uncertainties
- Enabling technologies for increasing penetration of renewables, including energy storage and demand side integration.
- Medium-long term evolution (including road map) of distribution systems supporting management of transmission and distribution grids (Microgrids and Active Distribution Networks)

*“Technical Issue 2: The application of advanced metering and resulting massive need for exchange of information”*

- Smart communication for active distributions networks including data analytics using HMI data
- How to use big data

*“Technical Issue 3: The growth in the application of direct current (DC) and power electronics (PE), system control, and system security and standardization.”*

- Impact of large penetration of power electronic devices on distribution grid operation and planning
- DC distribution networks
- Use of DC at end-use premises (in home and commercial buildings etc.)

*“Technical Issue 4: The need for the development and massive installation of energy storage systems, and the impact this can have on the power system development and operation”*

- Operation and network issues: The impact of energy storage systems on distribution networks

*“Technical Issue 5: New concepts for system operation and control and market / regulatory design to take account of active customer interactions and different generation types”*

- Distribution systems perspective in interaction with TSO, aggregators, further market participants, contribution of DER to system stability
- Interconnection requirements and communication requirements.
- Impact of flexibilities on congestions in the distribution grid
- Demand side integration

*“Technical Issue 6: New concepts for protection to respond to the developing grid and different characteristics of generation”*

- Protection issues related to microgrids and intentional islanding
- New protection and automation functions for distribution networks using powerful communication networks

*“Technical Issue 7: New concepts in planning to take into account increasing environmental constraints and new technology solutions for active and reactive power flow control”*

- Integrated planning and operation for upgrading distribution networks
- Uncertainties in distribution planning

*“Technical Issue 8: New tools for system technical performance assessment, because of new customer, generator and network characteristics”*

- System development to accommodate load growth / patterns, load changes, energy efficiency and their impact on generation, understand customer behaviour
- Further developing tools for planning and operation

Further to these technical issues, the study committee has identified the following strategic directions for distribution systems:

- Energy infrastructure for urban networks, i.e. Smart Cities, Multi-energy systems (Electricity, heat, cooling, gas, water, transport, IT)
- Microgrids
- Rural electrification and remote area power supply, offgrid hybrid systems

*“Technical Issue 10: An increasing need for keeping stakeholders aware of the technical and commercial consequences and keeping them engaged during the development of the network of the future”*

- Visualization in 3D for awareness, training, designing, safety issues

### **TC Direction 2: Making the best use of the existing system**

- Transfer successful experiences to other network structures
- Improving reliability (self-healing, islanding, fault ride through ...)
- Asset life cycle issues

### **Conclusion**

The updated strategy fits to the ongoing discussions on the need to cover the whole energy system in CIGRE. It focusses on the distribution system aspects.

### **References**

- [CIGRE 2009] CIGRE Official Document: Rules for Study Committees, JK/COR(03/04/2009)
- [Electricity 2014] CIGRE Technical Committee: Electricity Supply System of the Future, 2014
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- [CIGRE 2010] Klaus Fröhlich: CIGRE Technical Activities: Strategic directions 2010 – 2020, published in ELECTRA N° 249, April 2010