



SC B4 Strategic Plan 2010 to 2020

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**Prepared by
B4 Strategic Advisory Group (AG01)**

Contributors

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CIGRE SC B4 Strategic Plan 2010 to 2020

CIGRÉ's Technical Committee has established a new Strategic Plan, which recognises the changes in the Electrical Supply Industry, and sets out updated directions for the Study Committees, which should be pursued while maintaining the following general goals:

- i) To uphold CIGRÉ's integrity, solidity and stability;
- ii) To focus on our main clients – referred to as target groups;
- iii) To recognise the key and decisive role imposed by environmental and social aspects upon the development of projects and industry trends.

The purpose of this Strategic Plan is to describe how CIGRÉ Study Committee (SC) B4, HVDC and Power Electronics plans to achieve its scope, while also meeting the mission of CIGRÉ and the strategic directives of the Technical Committee. This plan spans a 10-year time period; from 2010 to 2020. It will be re-evaluated after 5 years (2015) in order to allow for corrections and adaptations to changing trends. In addition to the strategic plan SC B4 has an Action Plan that covers a rolling three-year period of time.

The main target groups for SC B4 are the owners, operators, developers', manufacturers, consultants and regulators involved with HVDC and applications of power electric systems in high voltage ac power transmission systems and power distribution systems. The top management and executives within Non-Governmental Organizations (NGO), financial entities and the public are also recognised as being important target groups and potential users of the SC work products. The SC's environment includes low growth regions with an aging infrastructure as well as regions with high growth in their bulk power transmission systems requiring both HVDC and power electronic systems for ac transmission system applications. In some regions restructuring and reinforcement of the electric transmission systems is needed to accommodate new renewable generation sources. The market forces to which the SC is responding are as follows:

- (a) The integration of electricity markets and introduction of new market principles to the Electrical Supply Industry (ESI) causing power flows in the electric transmission systems that differs from the planning assumptions at the time the systems were designed.
- (b) High growth of the electrical systems in the developing countries requiring investments in new HVDC transmission systems for bulk power and applications of ac power electronic systems for ac network control and increased utilisation.
- (c) The aging of the electric system infra-structure in the industrialized countries requiring equipment and system life extensions and eventual decommissioning.
- (d) The global environmental concerns over the use of traditional energy resources and increasing demand for more efficient electric energy production and use of renewable energy sources and demand side management technologies.



- (e) Heightened environmental awareness and increased barriers to infrastructure projects (generation and bulk power high voltage, long distance transmission systems and interconnectors) requiring unbiased technical information about the potential environmental impact of dc and ac transmission systems.

The SC is addressing the needs of its target groups within the approved scope of the SC, which is as follows:

- i) **HVDC:** economics of HVDC, applications, planning aspects, design, performance, control, protection, control and testing of converter stations, i.e. the converting equipment itself and also the equipment associated with HVDC links.
- ii) **Power Electronic for AC systems and Power Quality Improvement:** economics, applications, planning, design, performance, control, protection, construction and testing.
- iii) **Advanced Power Electronics:** development of new converter technologies including controls, use of new semiconductor devices, applications of these technologies in HVDC, Power Electronics for AC systems and Power Quality Improvement. Power Electronics used in other fields of the ESI of interest to other Study Committees, will be covered by demand with SC B4 being the Sponsoring Committee.

The following framework describes how SC B4 intends to meet the guidelines established by the TC within its approved work scope. The work sponsored by SC B4 shall focus on the following areas:

1. HVDC systems:
 - a. Generally HVDC systems are well understood by anyone who already has these embedded in their systems, or are specialist consultants or manufacturers. Outside of this area there is a need for unbiased information about how these systems can be applied and how they will perform when one or more are embedded in an ac system as well as used as radial links between asynchronously operating ac systems. The SC will also identify the needs for various studies that should be performed at various stages of an HVDC system's lifecycle. B4 will provide such needed information. Some of the technical brochures developed by the SC may also serve as inputs to organizations that develop industry standards.
 - b. The aging of the existing HVDC systems requires study of life extension, refurbishment or upgrading of the converters, or replacement of the systems, including decommissioning and disposal of the converter stations. B4 will provide guidelines and input to standards developers in this area.
 - c. Higher voltage, high power DC links designed for operation at +/-800 kVdc poses challenges not only because of the need for information about the performance of DC insulation at these higher voltage levels, but also in their application in ac

- networks since the loss of a single pole or line operating at 3,000 to 5,000 MW can lead to severe disturbances in the ac systems. Furthermore, different configurations of these new high voltage HVDC scheme are emerging with potentially different performance attributes, which also have to be understood and communicated to the technical communities. The design and reliability of control systems for very high power converter systems must also be given serious attention since a failure to design the control systems properly can lead to severe system wide outages when a large block of power is lost. B4 will collect experience from early operation of new systems and will provide technical guidance and input to standards developers for this area.
- d. The development of larger, high efficiency Voltage Sourced Converter HVDC (VSC HVDC) systems is ongoing and will continue for many years. Standardisation is required in a number of areas, and B4, because of its significant experience base, is qualified to develop the needed information for such standards. SC B4 is prepared to provide the technical leadership to support this emerging use of power electronic technology.
 - e. The use of HVDC connections for intermittent generation, such as wind and marine generation, offers advantageous control capabilities, particularly if they are combined with energy absorption facilities to enable ride through during faults in the rectifier ac network. More information about these capabilities and input to standards will be provided by B4.
 - f. VSC HVDC technologies have opened up the possibilities to develop HVDC grids. Such grids may be needed for collecting power from for example, numerous wind generators in large, dispersed off-shore wind farms but could also be used for power sharing over large geographic and possibly intercontinental areas. An HVDC grid could possibly also be used for city infeed without increasing the short circuit capacity of the system. Many technical challenges need to be met before such systems can be realised successfully, and standardisation will be required in a number of areas to enable converter stations from different manufacturers to connect to a dc grid and to be controlled as part of the grid. B4 will provide the unbiased and technical guidelines to facilitate these developments.
 - g. The utilization of the DC low voltage distribution might open new possibilities for network development, especially in rural areas. By using DC the current carrying capability of low voltage cables could be fully utilized. The use of DC could also facilitate connecting small scale distributed generation to the distribution network
2. AC Power Electronic Applications (Flexible AC Transmission Systems commonly referred to as FACTS systems):
 - a. Static-Var controllers have been widely applied primarily for reactive power compensation in ac power systems but also to achieve stable operation of the ac systems under contingency conditions during which the ac system otherwise

- would become unstable. New reactive power controlled systems such as the Static Compensator or STATCOM have emerged. The industry needs unbiased technical information about the different systems available for voltage support so that the technical and economic tradeoffs between the alternatives are understood by the user community. B4 will provide up to date application guidelines for these systems.
- b. Power electronic systems such as the Thyristor Controlled Series Compensator (TCSC) and the Unified Power Flow Controller (UPFC) have been developed primarily for better control of the power flows through ac lines. These systems are also used to achieve stable operation of the ac transmission systems under contingency conditions but they also provide voltage support and reactive power compensation as do all series compensation systems. Thus, these systems can be used to increase the power flow over existing ac lines thereby potentially reducing the capital expenditures required to accommodate new generating plants being connected to the ac grid. B4 will provide unbiased and relevant application guidelines for these systems.
 - c. SC B4 will assist the ESI by developing information to help the industry understand the trade-offs between the different power electronic technologies available for ac system transmission and distribution system applications. The emergence of distributed generation technologies such as solar power systems installed at or close to the end users' facilities can also be expected to increase the demand for energy storage systems. Larger storage systems could even be utilised for power system frequency control. The power electronics expertise available within the SC will be utilized to develop information needed by the industry for all ac applications.
3. Environmental aspects of HVDC and AC power electronic applications.
 - a. B4 will support other SCs with technical information needed for development of appropriate environmental guidelines relating to the overall implementation of HVDC Systems and FACTS, including associated overhead lines and cables.
 - b. B4 will develop environmental guidelines relating to the development, implementation, operation and decommissioning of HVDC converter stations, earth or sea electrodes and FACTS equipment.

B4 will continue to provide unbiased information through the publication of Session Papers, Technical Brochures, and by organizing Technical Symposia and Colloquia, workshops and tutorials as required and appropriate. The development of the B4 website is also an essential tool for disseminating information. To ensure that published information is truly unbiased and factual B4 will strengthen its internal review process..

In the past the information provided by SC B4 has been aimed mainly at engineers or researchers who are working in the fields of HVDC and FACTS. Whilst this target group will continue to be important due to the ongoing changes in the HVDC and FACTS



technology, the top management and executives within NGOs, system operators, regulators, financial entities and the public are recognised as being important target groups for the SC work products, and increased efforts will be made to satisfy the needs of these groups. The primary but indirect delivery channel for these groups will be through engineers and consultants operating within these areas. The channels used for delivery of the SC's work products are as follows:

- Publications of technology and application updates through CIGRE
- Guidelines for planning, specification, engineering, commissioning, operation and maintenance in the form of technical brochures and articles published in CIGRE publications.
- Performance monitoring of HVDC and Power Electronic Systems with regular publication of the collected information
- Tutorials and seminars
- Conferences and colloquia to provide a forum for dissemination of technical information and for discussions on related technology matters.

The B4 Action Plan will be developed upon approval of the Strategic Plan. It will take into account the TC Strategic Plan and initiatives, such as the Network of the Future, efficiency of the electric transmission and distribution systems, as well as meeting the needs of SC B4's target groups. B4 recognises that different regions have different economic and social-economic needs, and B4 will endeavour to support all areas as appropriate.

Bjarne Andersen – Chairman of SC B4
30th November 2009