STRATEGIC BUSINESS PLAN (SBP)

IEC/TC OR SC:	SECRETARIAT:	DATE:
115	**China**	**2017-12**

Please ensure this form is annexed to the Report to the Standardization Management Board if it has been prepared during a meeting, or sent to the Central Office promptly after its contents have been agreed by the committee.

A. STATE TITLE AND SCOPE OF TC

Are there any new or emerging trends in technology that will impact the scope and work activities of the TC? Please describe briefly.

Do you need to update your scope to reflect new and emerging technologies? If yes, will these changes impact another TC's scope or work activities?

If yes, describe how these will impact another TC(s) and list the TC(s) it would impact

Title: High Voltage Direct Current (HVDC) Transmission for DC Voltages Above 100 kV

TC 115 was established in August 2008 to meet the requirements concerning rapidly emerging HVDC system market. HVDC transmission offers for power systems important benefits of flexibility, controllability, cost-effectiveness and environmentally-friendliness. It presents significant advantages for large-capacity power transmission over long distances as well as for the interconnection of power systems. Since the first commissioned HVDC project in 1950s, more than 100 HVDC projects have been put into service, among which over 80% were planned and built after 1980. In view of the wide use of HVDC, the improvement of the existing and creation of new standards for the HVDC transmission will be important in the areas of planning, design, construction, operation and maintenance of HVDC system as well as in the areas of design, manufacturing, and testing of the HVDC transmission equipment.

Scope of TC 115:

Standardization in the field of HVDC Transmission technology above 100 kV. The task includes HVDC system oriented standards as design aspects, technical requirements, construction and commissioning, reliability and availability, and operation and maintenance. Standards of HVDC equipment so far related to the system aspects will be prepared in close collaboration and in joint responsibility with the relevant Technical Committees and Subcommittees.

The objective of TC 115 is to establish a standard system for HVDC transmission as well as to promote new standards within TC 115's scope.

Road map on Standardization of HVDC technology

TC 115 has established an Advisory Group to prepare the road map and review the document regularly to make it suitable for the need of technology development and market. Membership consists of TC 115 officers, one representative from each P-member country and others by invitation.

B. MANAGEMENT STRUCTURE OF THE TC

Describe the management structure of the TC (use of an organizational chart is acceptable) (should be integrated by CO automatically) and, if relevant (for example an unusual structure is used), provide the rationale as to why this structure is used.

Note: Check if the information on the IEC website is complete.

When was the last time the TC reviewed its management structure? Describe any changes made. When does the TC intend to review its current management structure? In the future, will the TC change the current structure, for example due to new and emerging technologies, product withdrawal, change in regulations etc. Please describe.

Make sure the overview includes:

- any joint working groups with other committees,
- any special groups like advisory groups, editing groups, etc.

Secretariat: China

Officers:

Chair: Mr. Marcus Häusler (DE)

Secretary: Mr Jun YU (CN)

Assistant Secretary: Ms Chen GU (CN)

Technical officer: Ms Suzanne Yap Geok Sim

Advisory Group, Working Groups and Maintenance Teams:

AG 1: Road map on standardization of HVDC technology

WG 2: Reliability and availability evaluation of HVDC systems

WG 3: Electromagnetic performance of high-voltage direct current (HVDC) overhead transmission lines

WG 4: Guidelines on Asset Management for HVDC Installations

WG 5: Guideline for the System Design of HVDC Converter Station with Line-commutated Converters (LCC)

WG 6: Guidelines for operation and maintenance of line commutated converter (LCC) HVDC converter station

WG 7: DC side harmonics and filtering in HVDC transmission systems

MT 8: Design of earth electrode stations for high-voltage direct current (HVDC) links - General guidelines

WG 9: High voltage direct current (HVDC) power transmission- System requirements for DC-side equipment - Part 1: Using line-commutated converters

WG 10: Planning of HVDC systems

WG 11: Performance of voltage sourced converter based high-voltage direct current transmission – Part 1: Steady-state

JWG 22: Atmospheric and altitude correction (managed by TC 42)

JMT 1: High voltage direct current (HVDC) substation audible noise (linked to SC 22F)

JMT 3: Maintenance of IEC 60919-1 Ed.3 Performance of high-voltage direct current (HVDC) systems with line-commutated converters - Part 1: Steady-state conditions (managed by SC 22F)

JMT 7: Revision of IEC/TS 61936-2 Power installations exceeding 1 kV a.c. and 1,5 kV d.c. - Part

2: d.c. (managed by TC 99)

AHG 5: Refurbishment/Replacement of HVDC Equipment incl. C&P

Review of Management Structure

The Management Structure was last reviewed during the plenary meeting in Frankfurt, Germany, 2017-10-16/17. It was decided to establish an ad-Hoc group on “Refurbishment/Replacement of HVDC Equipment incl. C&P”. Whether to start a new work item will be decided at the next plenary meeting based on one year work of this ad-Hoc group. It was decided to change the number and the title of WG5 to “IEC TR 63127 Guideline for the System Design of HVDC Converter Stations with Line-commutated Converters (LCC)”. It was also decided to convert the AHG4 to WG11 to start the work of Performance of voltage-sourced converter based high-voltage direct current transmission-Part1: steady state.

The Management Structure will next be reviewed during the plenary meeting in Kuala Lumpur, Malaysia.

C. BUSINESS ENVIRONMENT

Provide the rationale for the market relevance of the future standards being produced in the TC.

If readily available, provide an indication of global or regional sales of products or services related to the TC/SC work and state the source of the data.

Specify if standards will be significantly effective for assessing regulatory compliance.

HVDC power transmission technology is the most important application of power electronics in electrical transmission and distribution systems resulted from the tremendous progress in the development of power semi-conductor devices and conversion technique during the last 60 years. With great technical advantages (integration into the interconnected grids, interconnection of grids with asynchronous power systems, large capacity transmission over long distance, submarine cable power transmission etc.), HVDC transmission has been widely used in the world.

D. MARKET DEMAND

Provide a list of likely customers of the standards (suppliers, specifiers, testing bodies, regulators, installers, other TC/SC’s etc.). Do not specify company names, only categories of customers.

With the increase of voltage level and transmission distance of HVDC transmission projects, apart from domestic extensive construction, cross-border interconnection of energy export and import countries through HVDC transmission projects are emerging. Since the construction of HVDC transmission projects is capital-intensive while the number of these projects having been built is limited, and the establishment of standards with respect to the HVDC transmission technologies has to include different design, construction and operation experience, it would be difficult to set up these standards by a single country or based on one single HVDC project. The standards to be developed by TC 115 for HVDC transmission will therefore incorporate experience gained by numerous experts all around the world who have been involved in construction and operation of HVDC projects. As a result, such standards should attract wide attention and be applied by engineers participating in design, construction, operation and maintenance of HVDC transmission projects, as well as those engaged in studies for HVDC transmission technologies in different countries and areas. Besides, individual HVDC transmission equipment manufacturers will also employ relevant standards and equipment technical criteria established by TC 115 and other TCs to guide design, manufacturing, and testing of equipment.

The users of the outputs of TC115 are purchasers, suppliers, specifiers, testing bodies, and other TC/SCs.

E. TRENDS IN TECHNOLOGY AND IN THE MARKET

If any, indicate the current or expected trends in the technology or in the market covered by the products of your TC/SC.

Trends in technology

With the growth of load demand and the imbalance between energy demand and supply, power plants are needed which are far away from load centers (e.g. large hydropower and pit-mouth fossil-fired power stations), and clean and renewable distributed generation (e.g. wind power and solar power) will be introduced to a great extent. The former are characterized by large capacity and long distance and will enjoy remarkable advantages when employing HVDC transmission technology. The latter are characterized by small capacity and dispersion leading to technical and economic disadvantages when employing conventional AC technology to interconnect them to the main power system. Therefore, adopting the new type voltage sourced converters based HVDC is a reasonable alternative. Consequently, the development of HVDC transmission technology is mainly oriented to:

I. High voltage, high current and long-distance bulk power transmission. Currently, construction of HVDC transmission projects is characterized by:

- High voltage: at present ±800 kV HVDC projects have been put into operation and R&D and planning of ±1100 kV HVDC projects is in progress;
- Bulk power transmission capacity; one bipole transmission capacity of (3 – 8) GW at present and up to 12 GW in the future;
- Long transmission distance; the transmission distance has been increased to be more than 2500 km and will be potentially increased up to and even more than 3000 km.
- Construction of HVDC transmission systems in severe environmental conditions, such as building converter station and DC transmission lines at very high altitude(3000m-5300m), posing higher requirements for the HVDC transmission technology.

All these features, however, also pose new challenges for HVDC transmission technology in the following aspects:

1. Increasing manufacturing challenges. For example, the design and manufacturing of ±800 kV and above HVDC transmission equipment, e.g., converter transformer, converter transformer bushing, wall bushing, converter valve and DC yard equipments etc. are becoming more challenging.
2. More stringent requirement in respect of equipment external insulation. With increased voltage level, the equipment external insulation is a concern. The HVDC transmission has imposed more stringent requirements on insulation of the line insulators. As a result, special provisions have to be made for external insulation of switchyards in converter stations.
3. Complex basic structure of main circuit in the converter stations. Converter valves in some of the ±800 kV, ±1100kV HVDC transmission projects employ serial-connected (or parallel-connected) double 12-pulse valves, resulting in complex operating modes, higher control & protection reliability requirement as well as difficult equipment arrangement.
4. Higher requirement for environment-friendliness. The environmental concerns mainly include audible noise, radio interference and ground field strength, etc.
5. Higher electrode earth current. As an example, in case of monopole operation of HVDC transmission, the electrode current is as high as 5000 A or more, which

poses challenges to consider and mitigate the risk of adverse effects on surrounding environment.

6. High impact on power system caused by pole blocking faults, and especially in case of bipolar faults.

7. New cable technology. High power transfer capacity requirement coupled with long distance HVDC submarine cable necessitates the use of new cable technology. The long submarine cable length hinders the use of conventional oil filled cable because of the difficulty in maintaining fluid pressure and since the cable cooling requirement such as oversized pumping station would make the project unfeasible. New development in the use of DC XLPE cable and MI-PPL (Mass Impregnated Polypropylene Layer) with cable insulation material at higher operating temperature may support the way to break current limits for HVDC submarine cable.

II. The VSC-HVDC technology has been widely used in integration and transmission of wind farms, interconnection with regional power grid, power supply for megacity center and other aspects. The market demand, in turn, promotes the technology development. Consequently, the development of VSC-HVDC transmission technology is mainly oriented to: large capacity and high voltage technology, multi-terminal HVDC technologies and overhead line VSC transmission and etc..

- High voltage and bulk power transmission.
- Multi-terminal HVDC(MTDC) transmission.
- Overhead line VSC transmission.

The trend in technology development described above makes desirable that TC 115 makes recommendations to relevant IEC TCs/SCs to update the existing standards, and alternatively, to establish new standards and technical reports which are not covered by the scopes of existing TCs/SCs. To cater the emerging new situations standards in the following areas are required to be established:

- Technical report for system design of HVDC transmission projects;
- Technical reports for HVDC equipment, including converter transformers, converter valves, wall bushings, smoothing reactors, DC side switchgears and measuring equipment as well as various types of surge arrester etc.;
- HVDC transmission system commissioning guideline;
- HVDC transmission system operating and maintenance guidelines;
- Standard/guideline for insulation coordination including altitude correction for HVDC system in high altitude areas;
- Reliability & availability evaluation of HVDC systems;
- Standards/guidelines for VSC-HVDC transmission technologies.

Trends in the Market

In recent years, the amount of power transmission using HVDC technology has been significantly increased in both two major fields of their application: long-distance power transmission and interconnection of power systems.

HVDC can transmit more power per mono-polar over-head transmission line compared with HVAC single circuit. As economic and environmental aspects become more and more important, this boosts the HVDC applications. New dimensions of power transmission capabilities are reached

with the development of HVDC technology at 800 kV and above as of 6-inch thyristors increasing the dc current capability above 5 kA.

The HVDC voltage range provides also a means for extra long-distance transmission schemes above 3000 km. Due to reduced losses, projects under consideration since several years such as feeding solar energy from Sahara desert to Europe are becoming more attractive economically.

Furthermore, DC technical advantages improve the extension of the existing ac power systems. A number of interconnections from mainland to islands and long undersea applications have been realized.

The development of voltage sourced converters (VSC) for HVDC applications provides technical features allowing connecting to weak AC system or to support the emerging of start-up system using the black-start capability. Presently, a number of voltage sourced converters based HVDC transmission projects are under construction and planned in Europe, North America, South America and East Asia. Connections of small electrical networks to the main grid become feasible.

Furthermore, detailed investigations have started evaluating benefits of connecting several DC links together forming multi-terminal DC grids.

F. SYSTEM APPROACH ASPECTS (REFERENCE - AC/33/2013)

Does your TC/SC have a need for a systems approach?

If so:

- Will the Systems work be in a single TC or in multiple TCs?
- Will a Systems Evaluation Group (SEG), Systems Committee (SyC), or Systems Resource Group be required?
- Is your TC/SC work of relevance to ISO?
- Is or are there fora or consortia working in parallel to IEC? Is there a chance to integrate this work in your TC/SC?

This should not only be restricted to the customer/supplier relationships with other TC/SCs indicating types of co-operation (e.g. liaisons, joint working groups) but be of a more generic nature.

If there is no need for a systems approach as outlined in AC/33/2013, is it intended a TC would not be requested to report on general systems approach considerations such as customer/supplier relationships, liaisons, joint WGs, etc. as referenced in the system approach matrix illustrated in slide 14 of the presentation attached to AC/37/2006?

TC 115 will actively work side by side with the relevant IEC technical committees and sub-committees. This is crucial to perfect the system structure of TC 115 and ensure smooth progress of TC 115 activities. The following principles will be followed in the cooperation between TC 115 and other TC/SCs:

II. TC 115 will submit its findings on relevant technologies, information as well as standards to other TC/SCs;

III. TC 115 will accept all valuable information, standards as well as working experiences from other TC/SCs actively;

IV. TC 115 will cooperate with other TCs/SCs to establish HVDC related standards through:

- Sharing of information;
- Assignment of experts to participate in the meetings convened by the related committees and inviting the experts and management personnel from such committees to participate in the meetings convened by TC 115;
- Establishment of joint working groups.

TC 115 has already established liaison with SC 22F, TC28，TC 36, TC 38, TC 42, TC 99, TC 8,

SC 8A, CIGRE SC B4, ISO/TC251，and will establish liaison with TC 11, TC 14, TC 33, TC 37, TC 95. Additionally, TC 115 will cooperate with ISO, IEEE and CIGRE working groups.

G. Conformity Assessment

With reference to clause 6.7 of Part 2 of the ISO/IEC directives, are all you publications in line with the requirements related to conformity assessment aspects?

Will the TC/SC publications be used for IEC Conformity Assessment Systems (IECEE, IECEx, IECQ, IECRE)?

Will any of your standards include test specifications, reproducible test requirements, and test methods?

Are there likely to be special conformity assessment requirements generated by any standards projects? If yes, list which projects.

All publications of TC 115 are in line with the requirements related to conformity assessment aspects.

TC 115 publications are not used for IEC Conformity Assessment Systems (IECEE, IECEx, IECQ, IECRE) until now.

The following TC 115 publications include test specifications, reproducible test requirements, and test methods:-

IEC TS 61973: High voltage direct current (HVDC) substation audible noise

IEC TS 62344: Design of earth electrode stations for high-voltage direct current (HVDC) links - General guidelines

H. 3-5 Year Projected Strategic Objectives, Actions, Target Dates

Strategic Objectives 3-5 years	Actions to support the strategic objectives	Target Date(s) to complete the actions
1. Establish cooperative relationship with the relevant TC/SCs of IEC. Subsequently, TC 115 will take initiatives in cooperating with TC 8, TC 14, SC 22F and TC 42 etc. and CIGRE etc.	Establish liaisons with following TCs and SCs: TC 11 and TC 14 in due time.	In due time
2. Based on evolution of the HVDC transmission technologies, to establish new standards that can reflect the state-of-the-art technical trends so as to satisfy the requirements in respect of planning, design, construction, operation and maintenance of HVDC transmission projects and other demands of users. During establishment of new	a) Publication of WG 4 for TR on guidelines on asset management for HVDC installations.	done
	b) Cooperate with TC 42 to accelerate the work of JWG 22 to develop the new work item proposal concerning external insulation correction for HVDC transmission system in high altitude area	2018

standards and based on the actual situations of HVDC transmission technologies, relevant working groups will be set up on an as needed basis, and improve popularity of TC 115	c) Complete the DTR of WG 5 for TR on Guideline for the System Design of HVDC Converter Station with Line-commutated Converters (LCC)	2018
	d) Publication of WG 6 for TR on guidelines for the operation and maintenance of HVDC converter station	done
	e) Continue the work of WG10 to develop a TR on Planning of HVDC systems	2018
	f) Continue the work of JMT3 with SC22F on maintenance work of IEC 60919-1.	2020
	g) Continue the work of WG 9 to develop a TS on System requirements for testing DC side equipment	TS is expected to be published by 2018.
	h) Establish a JWG with SC 22F after the completion of CIGRE WG B4.63's work on VSC-HVDC Installation – System Tests	after the completion of CIGRE WG B4.63's work on VSC-HVDC Installation- System Tests
	i) Establish WG11 on Performance of voltage sourced converter based high-voltage direct current transmission – Part 1: Steady-state	2020
	j) Develop a new work item proposal according to the HVDC roadmap developed by TC 115 AG 1 on Guideline for the system design of VSC-HVDC	2019
	k) Establish a JWG with SC 22F according to the HVDC roadmap on technical report for Valve Cooling System Adopted in	2018

	HVDC Converter Station	
	l) Establish an ad-Hoc group on “Refurbishment/Replacement of HVDC Equipment incl. C&P”	2018
3. Gain an insight into the current situation of technical publication adopted in the existing standards and work out the modified scheme based on the actual conditions of the projects as well as technical development status and actively cooperate with the relevant TC/SCs to complete revision of the existing standards and technical report	a) Finish the review and maintenance of IEC/TS 61973 High voltage direct current (HVDC) substation audible noise	2018
	b) Finish the review and maintenance of IEC/TS 62344 Design of earth electrode stations for high-voltage direct current (HVDC) links - General guidelines	2019
	c) Finish the review and maintenance of IEC/TS 62672-1 Reliability and availability evaluation of HVDC systems - Part 1: HVDC systems with line commutated converters	2018
	d) Finish the review and maintenance of IEC/TR 62681 Electromagnetic environment criterion for high voltage direct current (HVDC) overhead transmission lines	2018
	e) Establish a JMT with TC99 on maintenance of IEC/TS 61936-2, Power installations exceeding 1 kV a.c. and 1,5 kV d.c. - Part 2: d.c.	done
4. Thorough and extensive investigation and research on the existing technical status of HVDC transmission projects and the requirements in respect of standards and technical specification imposed by the relevant projects at	Update the Road Map on Standardization of HVDC Technology	annually

stages of planning, design, construction, operation and maintenance, the standards system in the HVDC power transmission will be established or refined		
Note: The progress on the actions should be reported in the RSMB.		