



The European Association of the Electricity Transmission
and Distribution Equipment and Services Industry

HYBRID AC/DC NETWORKS, OPERATIONAL CHALLENGES AND R&D&I ROADMAP
ENTSO-E WEB-CONFERENCE, 14 OCTOBER 2020

Technology Innovations for Sustainable Green Power Systems

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Europe's Grid Technology Providers

T&D EUROPE is the European association of the **electricity transmission and distribution** equipment and services industry

Our scope includes the **complete range of products and services** necessary to transport and distribute electricity in high and medium voltage

T&D Europe is working towards **future-proofing the electricity networks** in Europe by means of policy, technology and investments

The companies represented by T&D Europe account for a production worth over €25 billion, and employ over 200.000 people in Europe

National trade association members



Corporate members



Associate members



Opening notes

- T&D Europe welcomes the ENTSO-E Vision on Market Design and System Operation towards 2030.
- Transferring Europe's energy system towards a sustainable, carbon-free future requires new approaches as addressed by ENTSO-E's „True System of Systems“ concept.
- From T&D Europe perspective, the transition needs:
 - Innovative, reliable and cost efficient technologies developed by the industry in line with the market requirements
 - Attractive conditions for all players in the market to invest in new technologies
 - Effective regulatory frameworks for operating the power systems of the future as one integrated system
- As a representative of the industry, T&D Europe is already contributing to several activities supporting this transition process.

The Potential of HVDC



Technology is available today, optimized for different purposes, e.g. Cable and Overhead Line



Broad worldwide operational experience with more than 10 GW transmission capacity alone to offshore wind parks in operation or under construction



Most efficient means for energy transport over long distances and for subsea applications



“Multi-Purpose” HVDC applications serve:

- as interconnectors between different synchronous AC zones
- strengthening AC zones as embedded systems
- connecting remote generation and demand

Today's European Design Approach



HVDC today is point-to-point with the DC side being coordinated by the HVDC system vendor (with a few exceptions)



Multi-Purpose HVDC Systems will tend to be multi-terminal, developing stepwise with the perspective to add new links to the existing DC circuit

- First Multi-Terminal Projects are under execution or under development in Europe

MTDC
ready

- Some HVDC systems are already prepared to become Multi-Terminal
- With the present design approach, future system expansions will have vendor-specific requirements



A new Approach is needed



HVDC grids consist of individual stations (e.g. AC/DC converter stations, switching stations) typically provided by different vendors and connected via transmission lines



Interoperability needs to be assured based on:

- standardized functional requirements for all necessary station interfaces at the AC and DC side
- HVDC grid code for the DC circuit



System integration risks can be minimized by comprehensive testing; Testing should be Hardware-in-the-Loop until sufficient experience is available.

The development of HVDC grids is a European endeavor, which needs real industrial size projects to materialize.

Interoperability: Ability of a system to work together with other systems, now or in the future, without restrictions

system: defined by its boundaries and expected function,

in the future: multi-stage development

without restrictions: performance according to specifications,

together with other: multi-vendor design

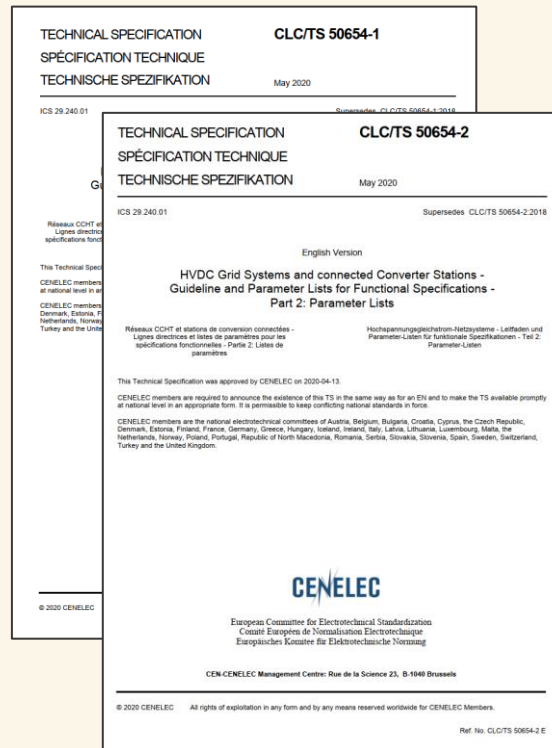
The Technical Framework is Available

CENELEC TS/50654:

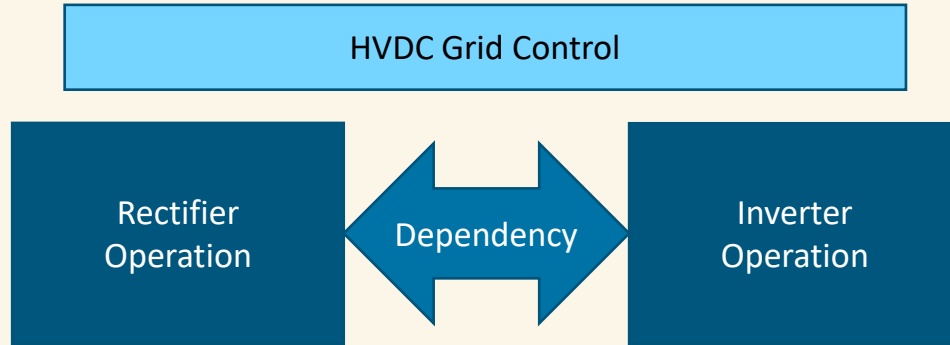
HVDC Grid Systems and connected Converter Stations -
Guideline and Parameter Lists
for Functional Specifications, May 2020

The Standard addresses all HVDC grid specific aspects:

- Coordination with the AC system(s)
- Main circuit design
- HVDC grid controls
- HVDC grid protection
- Models
- Testing



- HVDC is a power transmission system
- Active power fed to or taken from the DC circuit needs to be balanced at all times

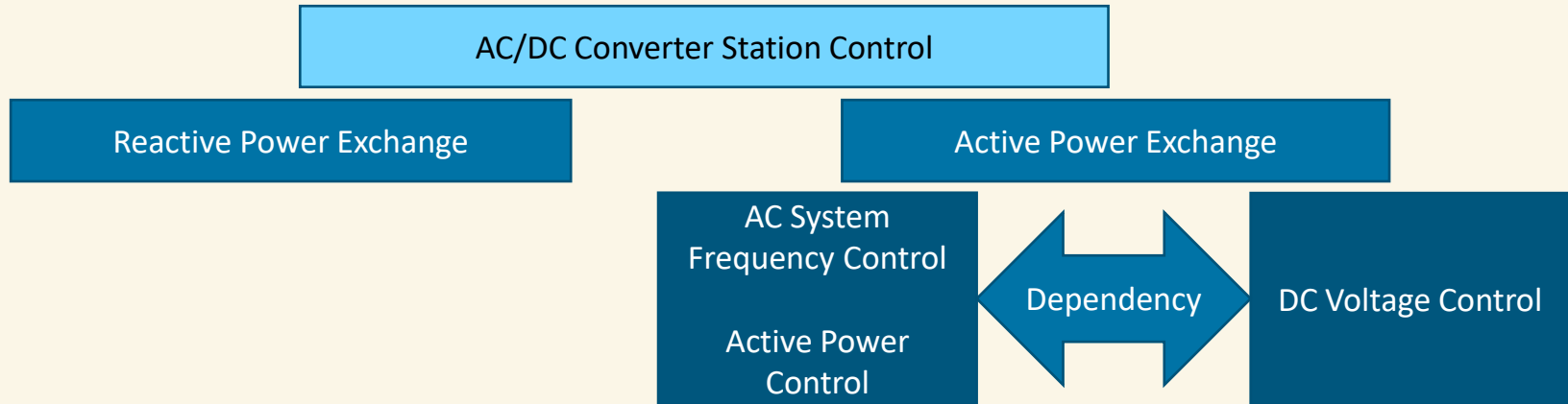


CLC/TS 50654 describes how the coordination of power flows associated with primary frequency control shall be specified

AC/DC System Integration at Station Level

HVDC allows flexible grid integration providing system ancillary services including fast frequency support, AC voltage control, System Recovery Ancillary Services (SRAS), etc.

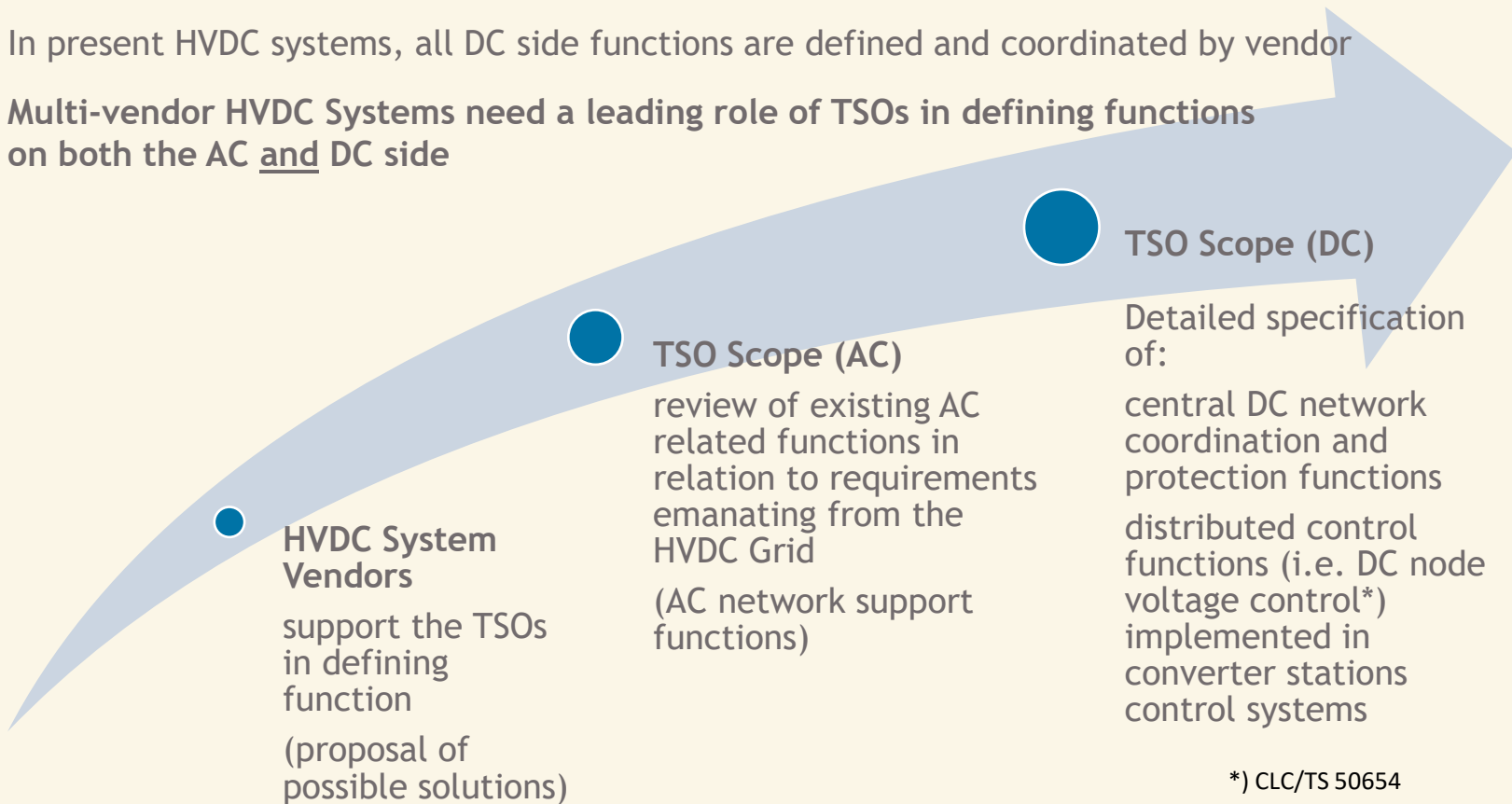
CLC/TS 50654 defines “basic operation functions” which need to be parameterized to achieve proper coordination between the AC and DC side



Changing Responsibilities for TSOs and Vendors

In present HVDC systems, all DC side functions are defined and coordinated by vendor

Multi-vendor HVDC Systems need a leading role of TSOs in defining functions on both the AC and DC side



*) CLC/TS 50654



There is a high potential for climate-neutrality by shifting sectors traditionally relying on fossil fuels (transport, buildings, industry, etc.) to electricity.



Requirements are needed, defining what functions are essential for an efficient grid enabling a climate neutral future.



Distribution networks will have to become an integral part of AC and DC system operation, calling for a TSO-DSO cooperation.



Distribution grids need to provide the required level of observability and controllability to manage the increased volatility of the system, characterized by e.g. intermittency of renewable generation or decreasing inherent inertia.



Variable generation from solar and wind power requires flexible services for balancing supply and demand. Such services should be much stronger incentivized.

Summary

- HVDC and particularly HVDC grids in coordination with AC transmission and distribution grids will play a key role in reaching the European Green Deal targets.
- Being integral part of an automated overall grid control, HVDC grids can become the backbone of Europe's power system interconnecting different synchronous zones, strengthening existing AC grids, connecting large scale renewables and remote loads.
- HVDC grids will change the roles of TSOs and vendors with respect to DC side requirements.
- Commonly agreed functional requirements will allow the industry to develop compatible solutions while keeping the freedom for technological developments.
- An appropriate regulatory framework should stimulate investments into new technologies and support attractive business models.
- Paperwork is not enough, industrial scale pilot projects are needed as a necessary step in ensuring scalable HVDC grids.

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