Network Code on HVDC connections

Completing a coherent set of connection rules

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The 9th NC on electricity

**Connection Codes**

**NC RfG**
- From smallest generation
- To largest plants

**DCC**
- Industrial demand
- T/D interface
- Demand Side Response

**NC HVDC**
- HVDC connections
- Offshore wind

**Operational Codes**

**Market Codes**
Why does the European power system need a NC HVDC?

- HVDC technology has a large potential, and is increasingly used in Europe’s grid planning.
- An *integrated system vision* is crucial at European level.
- Application is based often on national best practices. Also standards are still under development.
- A NC HVDC gives a clear framework for future *project specifications* and *technical standards*.
- A level playing field is needed for all generation (including offshore wind), for all DC links (including 3rd parties), regardless of ownership.
- The NC HVDC *completes* the trio of connection codes.
Almost two years of European code development

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I. Initial Scope
II. Call for Stakeholder Input
III. Drafting NC HVDC
IV. Consultation on draft code
V. Finalizing NC HVDC

- Call for HVDC User Group
- Preliminary Scope & Call for Stakeholder Input
- Draft NC HVDC
- ENTSO-E publication
- Public workshop
- User Group

ENTSO-E publication
Public workshop
User Group

NC HVDC submitted to ACER

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All pushing for continuing improvements of the code

Written consultation on preliminary scope and key questions (15 responses)

Written consultation on draft code (33 organizations / 2500 comments)

European & national associations

Consumers

DC link owners & operators

Wind sector

Project developers & consultancy

Manufacturers

NC HVDC User Group (> 20 organizations / 5 meetings)

Survey to HVDC equipment manufacturers (confidential)
**NC HVDC Scope**

- **DC-connected PPMs (mainly offshore wind)**
- **HVDC Systems connecting Synchronous Areas or Control Areas**
- **Embedded HVDC Systems**
- **DC links connecting PPMs**

- **Focus on new connections**

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NC HVDC in light of ACER’s framework guidelines

**HVDC general requirements**
- covers all relevant technical provisions mentioned in the framework guidelines.
- complements other NCs, notably NC RfG and DCC, in requirements and procedures

**Criteria for significant user**
- clarity on system needs by capturing all transmission-connected links
- ensuring coherency of national practices, e.g. planning standards, for embedded links
- pragmatic approach for distribution-connected links and PPMs

**Relationship with present practices**
- described in supporting documents, and often discussed with other industry actors
- feedback pursued in Call for Stakeholder Input - supported by manufacturer/TSO survey
- NC HVDC is broadly in line with existing practices where applicable, and in itself does not create a significant cost increase for new projects.
Often discussed topics

- **Clarity** of a network code: aligned definitions and clear interpretation

- **Equitable and proportional** treatment of all network operators and grid users across the three connection codes

- **Avoid barriers** for future offshore developments: clear need for requirements offshore, but allowing pragmatic and efficient solutions (e.g. non-50 Hz systems, reactive power compensation, etc.)

- **Rights and obligations** of HVDC owners, network operators and other grid users (Power quality and mitigated interaction of controllers)

- **Costs and benefits** of NC HVDC: Survey to manufacturers and options in the code to relax requirements

- **Technology neutrality**: requirements compatible with both LCC and VSC

- **Applicability at the AC connection point**: Present code does not look at meshed DC grids or additional DC-side capabilities
Summary and next steps

- NC HVDC provides the instruments for network operators to cope with future challenges of RES integration onshore/offshore and to maintain security of supply in converter dominated power systems with large transit flows.

- Extensive stakeholder feedback throughout the entire NC development process, significantly improved the code and a common understanding of its rationale and benefits.

- ACERs current task to assess that the Network Code complies with the principles and objectives of the framework guidelines, is key for the successful further implementation of the code.