European Network of
Transmission System Operators
for Electricity

entsoe

NC HVDC
Evaluation of comments

30 April 2014

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1. Introduction

This document lists ENTSO-E's assessment of comments provided in the formal web-based consultation on the draft "Network Code on High Voltage Direct Current Connections and DC-connected Power Park Modules" (NC HVDC) in the period of 7 November 2013 – 7 January 2014. Rather than providing responses per individual comment received, an assessment of all input is done on a clustered basis, e.g. per topic or paragraph, in order to give a coherent view on ENTSO-E's approach towards the final NC HVDC. Minor items, such as editorials or restructuring of clauses have been assessed in the review but are mostly not mentioned in this document. The clustering of comments and summary of the initial issue is based on ENTSO-E's judgment, irrespective of the organization(s) providing the comment nor the number of times it was provided.

The Article numbering in this document refers to the Article numbering of the draft code published on 7 November 2013. Where reference is made to the final NC HVDC, in case of updated numbering, this is explicitly indicated.

In order to provide a clear oversight of comments and responses, the issues mentioned in this document may have been summarized with respect to the original comments provided. For a full overview of all comments provided in the web-based consultation, in their original formulation, please refer to consultation platform[1], or the NC HVDC web page[2].

This document is not legally binding. It only aims at clarifying the content of the final NC HVDC, based on feedback provided during the formal consultation period. This document is not supplementing the final network code, nor can it be used as a substitute for it.

2. Respondents

3.1 Detailed comments

Name	Organization
Marcelo Ferraz	Alstom Grid
Michael Wunnerlich	BDEW
Lorcan Murray	BritNed Development Limited
Gunnar Kaestle	Clausthal University of Technology
Torsten Haase	DONG Energy
Nina Scholz	E.ON AG
Thomas Wilson	ECOS
Jasmina Pierre	EdF
Guy Nicholson	Element Power
Markus Hemmer	EnBW
Niina Honkasalo	Eurelectric org
Ivan Pineda	EWEA
Suckow Jan	Forum Netztechnik/Netzbetrieb im VDE (FNN)
Ana Aguado	Friends of the Supergrid
Pedro Cendoya Alvarez	Mainstream Renewable Power
Christopher Smith	National Grid International Limited
Ian Gilbert	National Grid International Limited
NorthConnect KS	NorthConnect KS
Wojciech Kozubinski	PTPiREE

[1] https://www.entsoe.eu/consultations/
[2] https://www.entsoe.eu/major-projects/network-code-development/high-voltage-direct-current/

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Zoltan Zavody	RenewableUK
Kim Weyrich	REpower Systems SE
Julius Bosch	SBB
Gavin Greene	Scottish Power
Trevor Plummer	Seagreen Wind Energy limited
John Bech	Siemens AG
Frank Schettler	Siemens AG
Garth Graham	SSE Generation Ltd
Fabio Spinato	Statkraft AS
Kamran Sharifabadi	Statoil ASA
Franziska Huber	Swisselectric
Chuan Zhang	The Crown Estate
Istvan Erlich	University of Duisburg-Essen
Jesper Runge Kristoffersen	Vattenfall AB
Ying He	Vattenfall AB
VGB PowerTech e.V.	VGB PowerTech e.V.
Mario Genovesi	Worldenergy Sa

3.2 General cover letters

In addition to detailed and motivated suggestions for changes to the text, ENTSO-E received general cover letters in response to the NC HVDC public consultation during the period of 7 November 2013 to 7 January 2014 from the following organizations:

- EdF Group
- BDEW
- Vattenfall R&D
- EWEA
- Eurelectric / VGB Powertech
- Statkraft
- Element Power
- Iberdrola
- Renewable UK
- Seagreen

This document does not provide an explicit response to these letters as such. ENTSO-E's view is that the elements raised and suggestions provided are all addressed via other (detailed) contributions in the consultation.

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3. Assessment of consultation feedback

CHAPTER 1 - GENERAL PROVISIONS

Article 1 Subject matter

	Comment	Change	Motivation
0.0-2	Correct the table of contents	Accepted	Table updated
0.0-3	The requirements of the NC HVDC should be classified into the four different categories: mandatory / non-mandatory and exhaustive / non-exhaustive. Is this classification of the NC HVDC in line with the NC RfG?	Partially accepted	The mandatory character or exhaustiveness of a certain NC provision follows from the provision itself. Same principles are used as in NC RfG. The specific character of a requirement is clarified in the supporting documents ('NC HVDC – Requirements Outlines'). The mandatory/exhaustive nature of all NC HVDC requirements is aligned with the related requirements of the RfG unless technical specificities or system needs justify otherwise.
1.1-1	This document is too specific particularly in the area of defining the dynamic characteristics of the HVDC connection and it is not in line with the approach of the Framework Guideline to set up minimum requirements.	Rejected	To ensure system security within the interconnected transmission system and to provide an adequate security level, a common understanding of these requirements to all grid users (generation, demand, DC-connections) is essential. Since the NC covers cross border network issues, extending beyond national regulatory jurisdictions, a harmonized framework for requirements and procedures with further national specifications are therefore included in the NC HVDC. These principles follow the ACER framework guidelines on Electrical Grid Connections, and earlier NCs on grid connection.
1.1-10	Due to the poor quality of the draft version as published for consultation, a serious consultation is impossible. After completion and correction of the actual draft, a new version must be published for a second Public Consultation.	Rejected	The process for the establishment of network codes as defined by Article 6 of Regulation (EC) 714/2009 is followed. The assessment of all comments and guiding discussions in public workshops and user group meetings demonstrated that the code requirements are well understood, and resulted in clear suggestions made in the written consultation. In addition to a formal written consultation, subsequent user group meetings and bilateral discussions have given the option to all interested parties to have further iterative discussions towards finalization of the text and prior to submission to ACER.
1.1-11	The provisions of the NC HVDC must be in line with the provisions of the other Network Codes on Grid Connection (RfG and DCC), as well as with the Network Codes concerning System Operation.	Partially accepted	This point is addressed in general in the NC HVDC supporting documents, and in detail in further comment assessments.

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1.1-12	A target on grid quality for the grid operators is missed in the draft. (parameters for harmonics, symmetry of the three phases, delivery of short circuit power, etc.). Also a maximum frequency of occurrence of deviations is not properly described in any Network Code	Rejected	Such indicators are given in the scope of operational codes (see NC OS and NC LFCR), and are often complemented by national grid codes.
1.1-14	As other network users are affected by this network code as well (compare article 27), a corresponding statement [as in Whereas 3] should be included in the recital to avoid misunderstandings.	Accepted	This principle has been included in the recitals.
1.1-15	Because HVDC Systems connected to networks are also owned and operated by DSOs, the "Relevant TSO" should be replaced by: the "Relevant Network Operator".	Accepted	Revised where appropriate throughout the document. Broadly speaking specific terms and conditions for connection are defined by a. The Relevant TSO; or b. The Relevant Network Operator in coordination with the Relevant TSO; or c. The Relevant Network Operator.
1.1-16	Wind Turbine Generator technologies should be taken in to the account, since some are limited to with regards to voltage and frequency. Not just wind turbines, but all DC-connected AC components like motors, transformers and cables could be dimensioned smaller if the frequency range is kept small. Limiting frequency range to the minimum required for secure system operation and allowing the same active power reduction during low and high frequencies as in the RfG NC, is recommended.	Rejected	Technology-neutrality is a key principle for the NC HVDC, as for other connection codes (notably NC RfG in this context). Further national implementation allows covering specific technologies and specific local system conditions. See also the NC RfG – Implementation Guidelines for further information on this topic.
1.1-17	The term "HV" is not defined. Any definition in the Explanatory Note should be included in the NC itself. The use of the term "maximum output" is misleading and needs further explanation. Suggested is to use the term 'rated power'. Missing definitions in this NC among others: "Synthetic Inertia", "Embedded System", "FCR", "FRR", "Imbalance Netting Power". Where is 'Network Connection Agreements' defined? There is a general need for a consistency check of definitions used in the NC RfG, NC DCC and all other codes.		Covered in other comments (Article 2 & 3)
1.1-18	General comments that the document mostly ignores what must be provided (and when) by TSO's, or coordination between TSO's when the HVDC System Owner is a third Party. See specific examples in comments to Articles 29(2) and 30(1)(c), and also 52 to 54.		Covered in other comments.

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1.1-20	The draft HVDC NC imposes additional requirements and burdens on generators beyond those in the RfG NC. The technical conditions are easier to satisfy with VSC based converters, so may exclude the option to use a cheaper basic CSC system and reduction of overall cost of energy.		See specific comments on technology-neutrality per requirement.
1.1-21	The NC addresses the interface requirements of HVDC and HV AC system only. It does not address interface requirements on the DC side of a HVDC Converter Station. It is recommended to address the scope at a prominent place in article 1 or even modify the title of the NC accordingly. A dedicated document could be elaborated later addressing the NC of the DC side system.	Accepted	The recitals and the scope Article emphasize this point again. It is commonly agreed that this NC HVDC is a first step in a further evolving HVDC grid code with the option and expectation that DC-side requirements can be covered at a later stage when technology matures.
1.1-23	The HVDC System Owner is not necessarily the TSO. TSO-owned HVDC equipment, without Connection Agreement have to comply with all the requirements set in this Network Code. Additional requirements should be agreed by all Relevant Network Operators and Grid Users and be considered as ancillary services. DC-connected PPM are already included in NC RfG. This Code should only focus on the HVDC Connection. In case of two TSO's connected by an HVDC system, both are relevant.	Partially accepted	Connections between two TSOs and links embedded in one TSO's control area have to comply with the technical requirements of Chapter 2, 3 and 4 of this NC. It is agreed that the specific process for operational notification and compliance are only sensible when two different parties are involved in a connection of new assets. DC-connected PPMs are indeed in scope of the ENTSO-E NC RfG of July 2012. ENTSO-E suggests that these are eventually covered by the NC HVDC, allowing for synergies with HVDC System requirements.
1.1-24	It appears that the NC allows TSOs in certain Member States to act without reference to any external body, such as the NRA. It is suggested that the current TSOs decision making powers should be changed as a result of this Network Code (and the governance principles is Article 4 (3) applied).	Rejected	All the specifications made by TSOs regarding parties connected to the transmission system under the scope of the NC, including the powers to elaborate details of minimum requirements of this NC, should be in line with this Code and are in line with powers granted to NRAs and Member States as prescribed in Directive 2009/72. Article 4 is applicable in this respect.
1.1-3	Definition for 'significant grid user' should be added to Article 2 Definitions. There is no provision within this Network Code to define 'significant'. Article 72 (1) has a meaningless reference to “deemed significant in accordance with the procedure set forth in Article 60 and Article 61 – but neither of these Articles has a reference to ‘significant’. There are numerous references to ‘Significant Grid User’ in other Network Codes.	Partially Accepted	The FWGL on Electrical Grid Connections give already a general definition of the Significant Grid Users by defining them as “pre-existing grid users and new grid users which are deemed significant on the basis of their impact on the cross border system performance via influence on the control area’s security of supply, including provision of ancillary services”. The notion of significance has been removed throughout the code, rather referring to the scope of application as outlined in Article 3.
1.1-4	Further versions of future NC drafts should be given a line numbering, so reference can be made easier.	Rejected	The basic format for European legislation is followed in all NCs, which provides for numbering of articles and paragraphs.

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1.1-8	There should be no requirement on DC connected PPMs or Remote-end HVDC Converter Stations. The relevant RfG requirements should apply to the HVDC Converter Station where it connected to the TSO network.	Rejected	See specific comments on Chapter 4, but especially also the NC HVDC supporting documents which emphasize the need for a forward-looking European frame for 'offshore' integrated connections.
1.1-9	The code focusses only on the AC behaviour of the convertor in the DC - AC mode. Attention must also be paid to the effects on the AC grid in case of AC - DC mode operation. Here the requirements of the NC DCC should be applied. Because of the effects on the AC grid, the requirements of the NC DCC should be applied in case of AC-DC mode operation.	Partially accepted	The code applies regardless of the direction of the power injection. The NC text has been clarified at several instances to avoid ambiguity.
1.3-1	Suggestions for rewording of Article 1(3)	Rejected	Various comments have been received on Article 1(3). This clause is envisaged to be included across all NCs to emphasize several key principles and remove ambiguity. Eventually this clause may still evolve during comitology. All comments are well noted for future consideration.

Article 2 Definitions

	Comment	Change	Motivation
2-1	Article 2 does not make it clear that the first list superseded that of other NCs. To be revised anyway.		With all three connection codes now in an advanced and stable state, an aligned set of definitions has been prepared for the purpose of all NCs. In other words, RfG/DCC terms that are re-used in NC HVDC have been amended to be fit for purpose in this NC. As such, no terms in NC HVDC are superseding earlier NC terms anymore.
2-10	Grid User - new definition needed	Accepted	Term is introduced
2-11	Connection Point - split in Onshore Connection Point and Offshore Connection Point	Rejected	Part of the suggestion is covered by the notion of Connection Point and (the newly introduced term) Interface Point. The wording in Chapter 3 has been reviewed as to make sure that a single correct interpretation only is possible.
2-12	DC-Connected PPM - means a Power Park Module that is non-synchronously connected to one or, at the request of the DC-connected PPM Owner, more Synchronous Area(s) via HVDC System(s). Unless otherwise stated, Power Park Module referred to in this network code means a DC-connected Power Park Module;	Rejected	The notion of 'at the request of the DC-connected PPM Owner' is not relevant as such decision may follow from general long-term grid development plans. Note that the notion of various Synchronous Areas has been removed, as the key point is that the user is connected via a DC link.

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2-13	HVDC Convert Station - HVDC Converter Station means part of an HVDC System which consists of one or more HVDC Converter Units installed in a single location together with buildings, reactors, filters, reactive power devices, control, monitoring, protective, measuring and auxiliary equipment;	Accepted	Editorial, wording revised.
2-14	HVDC System - should allow for connection of more than 2 Synchronous Areas (as implied in definition of DC Connected PPM). - Should also use capitalized terms where needed - all converter stations instead of the pair of converter stations	Accepted	Wording revised
2-15	New HVDC System - update to reflect future changes of thresholds (as in RfG)	Partially accepted	NC HVDC does not use thresholds as in RfG for HVDC Systems. It does use the RfG classification for DC-connected PPMs – the term for New DC-connected PPM has been updated.
2-16	DC-Connected PPM - confusion with PPM in RfG that could be read as including an HVDC System	Partially accepted	The definition of HVDC System is considered to be clear to avoid this circular interpretation.
2-17	use Operator instead of Owner	Rejected	The legal obligation of compliance for a connection code lies with the owner. The owner may delegate tasks to another operator, but not the responsibility for compliance.
2-18	Network - split in AC Network and DC Network	Rejected	This split definition does not add value.
2-19	New HVDC System - allow for a four year period after entry into force when final contracts can be made to fall in the existing user category	Rejected	The framework guidelines allow for a three year transition phase maximum. A similar approach is taken in other connection codes.
2-2	Not clear to many readers that the terms of other NCs apply in the NC HVDC as well.	Partially accepted	This is stated in Art 2(1).
2-20	HVDC Converter Station - Is a transformer part of the station? - What if there is no building or filtering?	Partially accepted	The transformer is covered in the definition of the HVDC Converter Unit. If there is no building, than this does not mean there is no HVDC Converter Station.
2-21	HVDC System - introduce Connection Points in first sentence to make it clear that these are the boundary of the HVDC System - define or set threshold for 'high voltage' (100kV DC given as an example) - 'comprises of at least two HVDC converter stations' --> 'comprises of at least two HVDC converter stations or units' (to also include back-to-back schemes -> has only one converter station) - the use of 'multi-terminal' makes no sense	Partially accepted	Definition is revised addressing some of the suggestions. No specific threshold for HV is introduced in this NC, as the argument would still hold that all transmission connected DC links are in scope, while distribution connected links need to be assessed at national level anyway for cross-border impact.

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2-22	Remote end HVDC Converter Station - definition not clear enough	Rejected	Wording has been slightly revised.
2-24	New HVDC System - define Main Plant (does it cover also the cable contracts?)	Rejected	Consistent approach as for RfG/DCC. Note that the NRA can be involved in assessing the contract.
2-25	Existing HVDC System - add definition	Accepted	Term included
2-26	Embedded - needs to be defined	Accepted	Term included
2-27	Back-to-back - needs to be defined	Rejected	This is clarified in the definition of HVDC System.
2-29	Significance - needs to be defined	Rejected	The scope clauses are considered to be sufficiently clear and unambiguous as to applicability of code to grid users.
2-6	Connection Point - make fit for purpose in NC HVDC	Accepted	These terms are align across all NCs, and will be inserted in NC RfG.
2-30	Define what is meant by 'the consent of the HVDC System Owner shall not be unreasonably withheld'	Rejected	This is not a definition. Similar terms are existing practice without further definition in other European regulations.
2-4	Defined terms are not always consistently used with capitals.	Accepted	Text revised where needed
2-5	NC is not self-explanatory. Explanations from supporting documents should be included in the NC itself.	Rejected	The 'what' is given in the NC, the 'why' in supporting documents. The code as European regulation should only cover enforceable and clear requirements.
2-7	Relevant TSO - Relevant TSO means the TSO(s) in whose Control Area(s) the HVDC System or the DC Connected Power Park Module is or will be connected to the Network at any voltage level.	Rejected	The code uses Relevant TSO or Relevant TSO(s) where appropriate, instead of changing the definition itself.
2-8	Connection Point / Connection Agreement - clarify that requirements also cover AC side equipment.	Rejected	The definition of Connection Point considered appropriate for this.
2-9	Relevant Network Operator - use this term in NC HVDC to cover distribution connected DC links, and to use in case of DC-Connected PPMs	Accepted	Changes made throughout the text where appropriate

Article 3 Scope

Comment	Change	Motivation

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3.1-1	DSO connected links either out of scope of the code, or appropriate references included throughout the code to Relevant Network Operator	Accepted	DSO-connected links are in scope of the code if, based on long-term network development plans, a cross-border impact can be demonstrated and approved by the NRA. Specifications of requirements in the code have been reviewed with the appropriate references to Relevant Network Operator specifications (be it in some cases with involvement of the Relevant TSO still, in a similar logic as with NC RfG).
3.1-2	Missing grid quality targets	Rejected	Such indicators are given in the scope of operational codes (see NC OS and NC LFCR), and are often complemented by national grid codes.
3.1-3	Exclude railway connections from scope of the code	Accepted	In the initial wording an embedded DC-link could be understood to cover such demand. The introduced definition of Embedded HVDC System explicitly excludes connections for the purpose of a single Demand Facility.
3.1-4	delete DC-links within a control area from the scope - no cross-border impact	Rejected	All transmission-connected DC-links are considered to have a larger system impact, e.g. in case of faults. See also supporting documents.
3.1-6	define Embedded Link	Accepted	Embedded HVDC System is defined and used in the scope for clearer classification of the NC HVDC applicability
3.1-7	clarify if DC connections between grids at different frequency are in scope of the code	Accepted	This comment refers to connections with railway grids (operating at lower frequencies). These are not in scope of the code. Note that a similar argument could be made for offshore grids, where the applicability in case of other (non-50Hz) frequencies has been clarified.
3.1-8	Clarify that multi-terminal and meshed DC-grids are not in scope of the code.	Partially accepted	DC-side requirements are not in scope of the code; in other words no dedicated meshed DC-grid requirements are prescribed by the NC HVDC. Nevertheless, all AC connection point requirements would apply to all HVDC System configurations. The latter point has been clarified in the scope.
3.1-9	The code should only cover DC systems, not the DC-connected PPMs. Discrimination between generators should be avoided.	Rejected	DC-Connected PPMs are covered in this code to allow for synergies with HVDC System requirements. NC RfG requirements are taken as reference still.
3.1-10	Allow for DC-connected PPMs in an AC collection grid at other frequencies then 50Hz	Accepted	Clarified in Chapter 3
3.1-11	Clarify the PPMs connected via DC to a distribution grid	Accepted	Wording modified.
3.3-1	deleted provisions for existing demand and generation	Rejected	This requirement refers to the contribution of data/models in context of interaction studies for new DC connections. For the sake of clarity and transparency the role of existing users in this regard is given in the scope.
3.3-2	This clause should refer to existing HVDC systems as well.	Accepted	Wording modified.
3.4-1	The concept of 'significant' needs to be defined.	Partially accepted	The classification indicates which users are significant in context of this code.

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3.5-1	TSO owned links are exempted from the code.	Rejected	All transmission-connected DC links have to fulfil the technical requirements of the code. The majority of DC-links involve several TSOs, in which case also all procedures of compliance, operational notification and derogation would apply. For the small number of DC-links within a single TSO's control area, these procedures cannot be applied as there are no two parties involved, for which reason the code refers to present application of e.g. planning standards to ensure compliance with the technical requirements and their specifications.
3.6-1	The code cannot apply to all existing users, only when a CBA demonstrates this and is accepted.	Accepted	Chapter 5 on operational notification for existing users covers the full process in this regard.
3.6-2	Delete 'deemed'	Accepted	Wording modified
3.6-3	Include a threshold, e.g. 100MVA, for existing DC links that can be covered by this code.	Rejected	Since a detailed case-specific CBA is needed and will be scrutinized, there is little added value in having a specific threshold to prevent any action.
3.7-1	Suggestion to clarify the wording	Rejected	Wording is considered clear, and is in line with similar provisions in NC RfG and DCC.
3.7-2	This should be addressed to all Relevant TSO(s)	Accepted	Wording modified.
3.7-3	Clarity is needed for cases of refurbishment	Accepted	Clause on modernization is shifted to the scope article for the sake of clarity
3.8-2	Proper definition needed of Existing DC-Connected PPMs	Rejected	No clear proposal is given. The definition of New Dc-connected PPM is considered clear. Note that it is in line with similar provisions in NC RfG and DCC.

Article 4 Regulatory aspects

Generally all comments have been discussed in context of NC RfG and DCC already. We refer to the ENTSO-E arguments given in that context, to ACER's opinion on both codes, and to the ongoing work by EC in comitology for more information on this topic.

The NC HVDC wording in this article is aligned with RfG/DCC or reflects the state of ongoing work on all codes.

Article 5 Recovery of costs

Generally all comments have been discussed in context of NC RfG and DCC already. We refer to the ENTSO-E arguments given in that context, to ACER's opinion on both codes, and to the ongoing work by EC in comitology for more information on this topic.

The NC HVDC wording in this article is aligned with RfG/DCC or reflects the state of ongoing work on all codes.

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Article 6 Confidentiality obligations

Generally all comments have been discussed in context of NC RfG and DCC already. We refer to the ENTSO-E arguments given in that context, to ACER's opinion on both codes, and to the ongoing work by EC in comitology for more information on this topic.

The NC HVDC wording in this article is aligned with RfG/DCC or reflects the state of ongoing work on all codes.

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CHAPTER 2 - GENERAL REQUIREMENTS FOR HVDC CONNECTIONS

SECTION 1 REQUIREMENTS FOR ACTIVE POWER CONTROL AND FREQUENCY SUPPORT

Article 7 Frequency ranges

	Comment	Change	Motivation
7.1-1	Acceptance of reduced P-Q capability in case of frequency is inside frequency range with limited time period for operation	Accepted	Admissible power reduction can be specified.
7.1-10	possibility to use 16,7Hz	Accepted	Changes included in article 39
7.1-2	more severe requirements frequency ranges and time period for operation than in RfG	Rejected	NC HVDC ranges ensure that transmission assets are more resilient to disturbances than any grid user's equipment.
7.1-3	deletion of the second phrase of 7.1(b)	Rejected	The agreement could be blocked of by the HVDC system owner without technical or economic arguments. Fair treatment of HVDC system owner is guaranteed by article 4(3).
7.1-4	reduction of the permanent frequency ranges	Rejected	NC HVDC ranges ensure that transmission assets are more resilient to disturbances than any grid user's equipment.
7.1-5	Is the article applicable to PPM?	Rejected	No, the article is not applicable to PPM, it refers explicitly to HVDC Systems.
7.1-6	harmonisation of frequency ranges of article 7 and 39	Partially accepted	Note that onshore and offshore converter stations have the same frequency withstand capabilities. Article 39 only addresses offshore PPMs. In the improved wording, Art 7 makes it explicit that the ranges for converters need to account for relevant generation/demand specifications.
7.1-7	The phrasing 'connected to the Network' is ambiguous in case of a HVDC System connecting two Networks	Rejected	All converters have to comply with this requirement at any connection point.
7.1-8	definition of "HVDC connection owner"	Accepted	Wording modified
7.1-9	possibility to reduce the requirements for frequency ranges on a national basis	Rejected	This can be covered by a motivated derogation request.

Article 8 Rate-of-change-of-Frequency withstand capability

	Comment	Change	Motivation
8.0-1	clarification of the "rolling measurement"	Accepted	Wording modified
8.0-2	Alignment with RfG. Merchant links are discriminated against generators.	Rejected	Merchant links follow the same requirement as all other HVDC Systems, ensuring non-discriminatory treatment. Without prejudice to the eventual setting for generator ROCOF setting, the NC HVDC requirement is expected to ensure that the network is more resilient to disturbances than generators.
8.0-3	Method how to measure frequency. First order filter should be used rather than a moving average.	Rejected	The rolling measurement method is clarified, and is based on detailed studies from various TSOs on this topic already.
8.0-4	Align ROCOF capability for HVDC links with NC RfG and DC-connected PPMs	Rejected	This capability ensures that transmission assets are more resilient to disturbances than any grid user's equipment.

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8.0-5	ROCOF requirement is misunderstandable	Accepted	Wording modified
8.0-6	Remove the whole article.	Rejected	No motivation given for the proposal.

Article 9 Active power controllability; control range and ramping rate

	Comment	Change	Motivation
9.1-10	The definition of the procedure of article 1.a.iii and pre-defined regulation sequences of article 9.1(b) to be subject of article 4(3)	Rejected	These procedure and pre-defined regulation sequences are operational issues which have to be agreed between the relevant TSO(s) and the HVDC system owner but do not need the approval of NRA. Note also that the NC HVDC in itself does not request the specification of these sequences but refers to it.
9.1-11	Clarify the definition of triggering signal	Accepted	Wording modified from "triggering signal" to "triggering signal sent by the Relevant TSO(s)"
9.1-12	Clarify definition of article 9.1(b)	Accepted	change "In case of Disturbance in one" to "In case of Disturbance in one or more"
9.1-13	Clarify the meaning of the 10ms in article 7.1(b)	Accepted	Wording clarified that it refers to the initial delay.
9.1-14	Test description is not consistent with the requirement.	Accepted	Compliance Test updated (Article 67.7)
9.1-15	Editorial changes in article 9.1c)	Accepted	Wording modified
9.1-16	Consistency of ramping rates in article 9 and 11	Partially accepted	Included clarification in article 9.2
9.1-17	Fast active power reversal needs to be coordinated between all relevant TSO(s)	Partially accepted	Operational agreement has to be concluded between the relevant TSO(s), but it is not within the scope of a connection code. Coordination on all connection capabilities is required as per Article 4(6)
9.1-18	Existing HVDC Systems should only be required to provide FCR and FRR when the technology is installed.	Rejected	NC HVDC applies to new users, not by default to existing links.
9.1-19	HVDC System cannot provide FCR, FRR and RR services, only exchange it.	Accepted	Wording modified referring to exchange and sharing of services.
9.1-2	Fast power reversal: Not possible for LCC technology and some type of cables due to dielectric stress if not designed for this purpose. The 2 second threshold has to be justified as beneficial.	Rejected	The capability is non-mandatory.
9.1-3	no definition for FCR and FRR	Rejected	Defined in NC LFC&R
9.1-4	What is meant by minimum power resolution?	Accepted	Wording modified
9.1-5	Existing LCC type links cannot meet these requirements and should be exempted.	Rejected	See Article 3(6) for the specific (exceptional) conditions under which an existing link would have to be compliant with the NC technical requirements.

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9.1-6	Power reversal makes no sense for DC-connected PPMs.	Rejected	Power reversal is sometimes needed even for the connection of DC-connected PPMs. In any case the requirement is non-mandatory, and to be specified respecting the provisions of article 4(3).
9.1-7	Change maximum output and use maximum capacity	Accepted	Wording modified to Maximum HVDC Active Power Transmission Capacity ' (also indicated in Figure 1) throughout the document.
9.1-8	Remove whole Article 9, and ensure that frequency control is covered in Article 14	Rejected	Article 9 does not only apply to frequency control but also to load flow management
9.1-9	Different minimum active power transmission capability for each direction.	Accepted	Wording modified as to allow for different values in each direction.
9.2-1	Capability of adjusting the ramping rate after instruction is limited by inherent technical constraints.	Partially accepted	Wording modified
9.2-2	Instructions for setting ramping rate can only be done at the time of design.	Rejected	The Relevant TSO shall have the right to modify the ramping rate during operation, but within the technical capability of the HVDC system.
9.3-2	Definition of FSM, LFSM-O, LFSM-U and Frequency Control needed	Rejected	These terms are defined in NC RfG and apply also in NC HVDC.

Article 10 Synthetic inertia

	Comment	Change	Motivation
10.1-1	Replace "synthetic inertia" by "secondary frequency response" or "fast frequency response"	Rejected	Terminology consistent with NC RfG is used.
10.1-10	Cancel article 10.1c)	Accepted	The clause has been removed as not to limit possible implementations of synthetic inertia.
10.1-11	Change "where a need is demonstrated" to "after having demonstrated the need"		Clause deleted
10.1-2	include "of the present network code"	Rejected	This goes without saying. The present nature of the text does not need to be emphasized each time.
10.1-3	Question of costs of additional losses caused by synthetic inertia and interaction between frequency control and synthetic inertia	Partially accepted	Impact of possible additional losses caused by synthetic inertia are to be addressed when requesting and further specifying this capability. Synthetic inertia will only be activated in case of low and/or high frequency regimes, meaning in case that FSM or LFSM is expected not to able to stabilise the frequency.
10.1-4	Add the need for CBA.	Rejected	The implementation process as referred to in Article 4(3) needs to be followed. The exact process is not specified in this NC but follows from the objectives of Directive 2009/72. It is expected that in many Member States this national process will require a CBA justification.
10.1-5	No need for synthetic inertia by a DC link embedded in the system	Rejected	Requirement is non-mandatory and will be required where a need is demonstrated, and when the HVDC control means of delivery is justified to be realistic/feasible.

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10.1-6	This requirement should only apply to new HVDC Systems without discrimination in a Synchronous Area.	Partially accepted	In case of synthetic inertia, the system needs even within a synchronous area can be locally different. The NC focuses on new connections; retrofit of existing connections needs to be in line with the process of Article 61 (consultation, CBA and NRA approval).
10.1-7	Need for further definition or description of synthetic inertia	Rejected	As it is an emerging technology the intention of the code is to describe the systems needs and to keep flexibility in for the implementation specifications. Note that the requirement is non-mandatory but covered in connections codes for generation, demand and HVDC Systems.
10.1-8	What is NC OS?		NC OS refers to the Network Code on Operational Security
10.1-9	Use of LFSM-O instead of synthetic inertia	Rejected	Synthetic inertia is only required during a very short period of time as opposed to LFSM which is activated as long as there is a frequency deviation.

Article 11 Frequency Sensitive Mode (FSM)

	Comment	Change	Motivation
11.1-1	Clarify 'Figure 1', interactions with articles 12 and 13 (threshold to be defined)		See supporting documents and NC RfG concepts.
11.1-10	Use the term "rated power" instead of "maximum active power transmission capability"	Rejected	In this NC the term Maximum HVDC Active Power Transmission Capacity is used, which refers to connection agreement specifications. This can be different than the rated power.
11.1-11	Rename FSM to Secondary Frequency Response	Rejected	Terminology consistent with NC RfG is used.
11.1-12	Small droops / large gains lead to instability. This setting should not be allowed although it's technically feasible. Set a larger value for minimum droop.	Partially accepted	The eventual specification by the Relevant TSO(s) will indeed need to be based on appropriate system studies, taking into account stability issues.
11.1-13	Restrict droop to 0.1 - 12% to avoid discrimination with generation.	Rejected	As the TSO can request low Active Power range available for FSM, a high value of droop (in %) has to be possible. In comparison to generation (NC RfG) there is no lower limit for the active power range of an HVDC System.
11.1-14	Insensitivity must be limited. Define Delta f/fn and Delta P/Pmax values in the NC.	Rejected	Limits for Delta f/fn and Delta P/Pmax values will depend on the Active Power range available for FSM and the Droop requested by the relevant TSO according to article 11.1(d). They will change according to operation conditions and it is not possible to specify value in the code.
11.1-15	definition of Droop s	Accepted	The definition of Droop is modified (in context of NC RfG), to ensure unambiguous interpretation.

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11.1-16	For HVDC Systems connecting PPM, change max. active power to max. available power	Rejected	Capabilities of HVDC systems connecting PPM have to be prepared for further network developments. Actual FSM operation takes into account operational constraints.
11.1-17	Clarification needed: curtailment of the PPM in order to comply with FSM.	Rejected	Curtailment to allow for active power headroom is an operational issue and is therefore out of the scope of a connection code.
11.1-18	Article 11.1.(e) is unclear	Accepted	Wording modified
11.1-19	Change terminology of initial delay and full activation time	Rejected	Terminology is considered clear and is consistent with NC RfG
11.1-2	Add a reference to provisions of article 4(3) - There needs to be an NRA approval on the parameters specified by the TSO	Rejected	The specification is an operational one for which a formal approval is not appropriate. NRA involvement is ensured by means of notification as prescribed in national agreements, code or law. The requirement is consistent with that for generators in NC RfG.
11.1-20	0.5s initial delay is not consistent to the 2s in RfG	Rejected	The 2s reference was justified in context of NC RfG because of constraints in certain generation technologies and their primary drivers, e.g. thermal plants. For HVDC converter units, as with PPMs, a faster reaction is inherently possible. Longer reaction times could still be allowed, but need to be justified.
11.1-21	add "at a HVDC Station" in the code	Rejected	Confusing : response to FSM has to be provided by the whole HVDC system and not only by a converter station
11.1-22	Articles 9 and 11 appear to be partly contradicting	Rejected	FSM and fast active power reversal are two different control modes. Each one has a specific response time.
11.1-24	Requirements in Table 2 and 3 are too specific. Functional requirements are recommended.	Rejected	The requirements are considered to be functional specifications to support the system, and giving a clear frame for all users within the European power system. Note that the requirement is aligned with similar rules for generators (NC RfG).
11.1-3	change "Frequency Response Deadband 0-500mHz" to "Frequency Response Deadband +/- 250mHz"	Partially accepted	Wording is clarified. "Frequency Response Deadband 0- 500mHz" is replaced to "Frequency Response Deadband 0 - +/- 500mHz"
11.1-4	Remove article 11, this should be covered by article 14 (Frequency Control) with further details to be specified nationally.	Rejected	FSM capabilities are key requirements where a common European frame would be of benefit. The requirement on Frequency Control allows indeed in addition for more specific capabilities. The requirements are aligned with those for generators (NC RfG).
11.1-5	sentence missing	Accepted	Wording modified.
11.1-6	If the HVDC system is connecting different countries, which parameters are to be complied with?	Partially accepted	Each HVDC Converter Station has to comply with the parameters specified at its Connection Point (in the relevant Member State, by the Relevant TSO, respecting Article 4(3)). Coordination where needed should be ensured (Article 4(6))

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11.1-7	The top part of the image in Figure should be mirrored (for reverse power direction)	Partially accepted	The Figure 1 gives an example with a positive Active Power setpoint. This has been specified more clearly in the text of article 11. The same requirement indeed applies in the other power direction.
11.1-8	The symbol for the droop shall be a small 's'.	Accepted	S changed to s throughout the code.
11.1-9	FSM makes only sense if the HVDC system connects two different synchronous areas	Rejected	FSM is also beneficial HVDC Systems within a Synchronous Area, e.g. in case of system split. See supporting documents for more info (Requirement Outlines).

Article 12 Limited Frequency Sensitive Mode Overfrequency (LFSM-O)

	Comment	Change	Motivation
12.1-1	Change frequency threshold from 50.2 to 50.4 Hz.	Rejected	Argumentation not clear. The requirement allows for a consistent frame as with generators (NC RfG)
12.1-10	Frequency threshold and droop setting need to follow Article 4(3) provisions and be published on TSO website.	Rejected	The specification is an operational one for which a formal approval is not appropriate. NRA involvement is ensured by means of notification as prescribed in national agreements, code or law. The requirement is consistent with that for generators in NC RfG.
12.1-11	Article 12(a) Requirements too specific. Functional requirements are recommended.	Rejected	The requirements are considered to be functional specifications to support the system. Note that the requirement is aligned with similar rules for generators (NC RfG).
12.1-12	The capabilities of an HVDC System to fulfil the requirements of articles 12 and 13 depend on the possibilities to balance power with the connected AC systems.	Rejected	An operational agreement will be needed to address power transfer; this is out of the scope of a connection code.
12.1-13	Change "to the AC Network(s)" to " to a connected AC Network"	Rejected	LFSM-O mode shall be available at each AC Network to which the HVDC system is connected.
12.1-2	Change shaving to setting	Partially accepted	Wording modified.
12.1-3	Redraw figure 3 to cover also export scenarios	Partially accepted	Wording clarified.
12.1-5	Reword Article 14 to cover all frequency control	Rejected	Wording is consistent with that of NC RfG.
12.1-6	Pref' is better called 'Pmax' as Pmax	Accepted	In figure 3 'Pref' has been changed to 'Pmax'
12.1-7	How do the different Frequency Sensitive Modes shall behave for an HVDC system in an embedded system?	Partially accepted	LFSM-O is also beneficial HVDC Systems within a Synchronous Area, e.g. in case of system split. See supporting documents for more info (Requirement Outlines).

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12.1-8	Justification of requiring a very low Droop	Rejected	HVDC technology is considered to have more inherent capability. No specific cost information has been provided to date to argue against the 0.1% proposal.
12.1-9	An additional line for ZERO power should be included for reference. It is not clear, why there is plus and minus sign for deltaf/fN, but only plus sign of deltaP/Pmax and Pref. The definition of plus and minus sign should be clearly stated.	Partially accepted	Figure has been updated for clarity.

Article 13 Limited Frequency Sensitive Mode Underfrequency (LFSM-U)

	Comment	Change	Motivation
13.1-1	Article 12(a) Requirements too specific. Functional requirements are recommended.	Rejected	The requirements are considered to be functional specifications to support the system. Note that the requirement is aligned with similar rules for generators (NC RfG).
13.1-10	Frequency threshold and droop setting need to follow Article 4(3) provisions and be published on TSO website.	Rejected	The specification is an operational one for which a formal approval is not appropriate. NRA involvement is ensured by means of notification as prescribed in national agreements, code or law. The requirement is consistent with that for generators in NC RfG.
13.1-11	Clarification needed: curtailment of the PPM in order to comply with LFSM-U.	Rejected	Curtailment to allow for active power headroom is an operational issue and is therefore out of the scope of a connection code.
13.1-2	Delete "In the LFSM-U mode the HVDC System shall be capable of adjusting a power increase up to its Maximum Transmission Capacity." (HVDC assets not treated in an identical way to AC infrastructure).	Rejected	This capability has to be implemented on the HVDC system control. To be operated, an operational agreement will be needed to precise how the power is generated at the other side of the HVDC system. Note that this operational arrangement is out of the scope of a connection code.
13.1-3	Redraw figure 4 to cover also export scenarios	Partially accepted	Figure not updated, but wording in the text is clarified that LFSM-U applies in both import and export situations.
13.1-4	Reword Article 14 to cover all frequency control	Rejected	Consistent with NC RfG
13.1-5	How do the different Frequency Sensitive Modes work for an HVDC system in an embedded system?	Rejected	LFSM-U is needed also for embedded HVDC systems, in case of a possible system split. See also supporting documents.
13.1-6	Justification of requiring a very low Droop	Rejected	HVDC equipment has inherently faster response than generation (rotating mass and primary drivers). No clear arguments have been received that indicate unreasonable cost impact for a 0.1% droop.

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13.1-7	Change Droop to a minimum value between 0.1 % and 12 %.	Rejected	In contrast to RfG, there is no need for an upper limit value for the droop. Only the lowest value of droop (fast reaction) is more demanding for an HVDC system.
13.1-8	The capabilities of an HVDC System to fulfil the requirements of articles 13 depend on the possibilities of the generators to balance power in the connected AC system.	Accepted	An operational agreement will be needed to precise how the power is generated, but this is out of the scope of a connection code.
13.1-9	In Figure 4, s not defined. In Figure 3 & 4, the axis deltaP/Pref and deltaP/Pmax should consider plus and minus signs. An additional line for ZERO power should be included for reference. It is not clear, why there is plus and minus sign for deltaf/fN, but only plus sign of deltaP/Pmax and Pref. The definition of plus and minus sign should be clearly stated.	Accepted	Figure has been updated for clarity.

Article 14 Frequency control

	Comment	Change	Motivation
14.1-1	The requirement is not clear. No technical and financial benefits are demonstrated. This should be offered as ancillary service.	Rejected	Various needs for frequency control exist, e.g. to provide synthetic frequency in a passive islanded network with few or no synchronous generators (see supporting documents). It is not self-evident whether FSM and LFSM are enough to cover such situations. This requirement allows for other alternative frequency control modes when justified (on a non-mandatory basis). Flexibility is given at this stage for defining performance parameters and activation criteria.
14.1-2	Add "(c) the frequency control requirement shall be agreed, in a TSO/TSO agreement, between the two relevant TSO's and HVDC system owner."	Partially accepted	An operational agreement will indeed be needed to precise how the power is transferred, but this is out of the scope of a connection code.
14.1-3	Add "(d) The relevant TSO's, subject to 14(c), shall have a proven cost benefit analysis"	Partially accepted	This may be covered in the national implementation process as referred to by Article 4(3)
14.1-4	Operating principles are in the responsibility of the HVDC System Owner and should therefore be defined in agreement with him.	Rejected	Definition of principles and performances of such a capability is a TSO responsibility. Provisions of Article 4(3) ensure that a due consultation of all concerned parties will be performed.
14.1-5	Reword Article 14 to cover also FSM and LFSM in a general manner.	Rejected	FSM, LFSM and Frequency Control requirements are consistent with NC RfG, and provide additional clarity on functional capabilities for frequency stability to be covered by all DC systems in Europe.

Article 15 Maximum loss of active power

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	Comment	Change	Motivation
15.1-1	The Relevant TSO cannot define the maximum size of a converter station. Delete Article.	Rejected	The intention of the requirement is not to constrain the total transmission capability of an HVDC System project, but rather to ensure that an internal fault does not result in a trip of the entire HVDC System (modular scheme or appropriate redundancy).
15.1-2	The definition of LFC Blocks is missing	Rejected	Definition is given in NC LFC&R, and applies in this NC as well.
15.1-3	Removal of the reference to LFC Block.	Rejected	Reference to LFC Block is important as the maximum loss of active power can result from a problem of dimensioning the FRR and not only the FCR (i.e. case of continental Europe).
15.1-4	Addition of "the Relevant TSO should be informed as to the nature of the remote HVDC end, as this will affect the loss of active power during a fault. "	Partially accepted	Article 4(6) prescribes the coordination between all Relevant TSO(s). A second clause has been added to emphasize the need of coordination in this specific case.
15.1-5	Also in the event of loss of both links in the case of a PPM you do not require set information on the PPM.	Not understood	

SECTION 2 REQUIREMENTS FOR REACTIVE POWER CONTROL AND VOLTAGE SUPPORT

Article 16 Voltage ranges

	Comment	Change	Motivation
16.1-1	Voltage ranges (overvoltage) should be aligned with NC RfG and IEC testing procedures.	Rejected	Text is in line with NC RfG ranges and time duration. See supporting docs for further explanation. Note that in context of NC RfG preparations for comitology the wording may be adapted to accommodate exceptional situations.
16.1-10	Clarity on maximum output across the entire set of voltage ranges	Accepted	Notion of “HVDC System Maximum Current” introduced, which links the requirement to reactive power capability specifications and specific ratings as specified in the Connection Agreement.
16.1-2	Clause that allows for wider voltage ranges should be removed.	Rejected	Wider ranges can only be required under agreement of HVDC Owner and Relevant TSO. Note also that the code focuses on new connections. (Similar approach as in NC RfG)
16.1-3	Voltage withstand capability should not go beyond that in NC RfG and needs to be in line with international standards.	Rejected	This requirement ensures that the transmission assets are the ones that can withstand more extreme conditions and that in emergency operation cases, generators and loads disconnect first. See supporting docs for further explanation.
16.1-4	The reference to 'maximum output' should be changed to 'rated power;	Partially accepted	Rated power is not a perfectly clear term. New definition added in the code for HVDC System Maximum Current.
16.1-5	Change nominal value by nominal system value	Accepted	Wording modified.

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16.1-6	Specify that this requirement applies at the connection point, not the internal collector grid of a wind farm.	Accepted	Requirement refers already explicitly to the Connection Point.
16.1-7	Coordination among TSOs: There needs to be a dispute resolution procedure to deal with disagreements otherwise the process can be blocked.	Rejected	Dispute resolutions and impact of non-compliance are not settled in this NC itself. See FAQ document on dispute resolutions for further info.
16.1-8	The application of wider voltage ranges should require a proper justification of benefits for the whole system.	Partially accepted	No changes in the wording. The text refers to technical and economic benefits, and an agreement to be settled under Article 4(3).
16.1-9	Remove paragraph c) on automatic disconnection settings.	Rejected	List (a) establishes voltage ranges that the HVDC system should be capable of withstand, however automatic disconnection settings should be within the ranges defined in (a).

Article 17 Short circuit contribution during faults requirements

	Comment	Change	Motivation
17	- Article 17 is not mandatory. - Appliance of Art17 only in onshore HVDC side - Involvement of the NRA in definition of Short circuit contribution - wording change required that goes against RfG alignment - Inconsistency between FRT Article and short circuit contribution - coordination among TSOs - relevant TSO to publish requirements instead of "shall have the right"	Partially accepted	Following review of the NC RfG, the specifications for short circuit contributions for PPMs have been clarified in collaboration with the impacted industry. The NC HVDC has been aligned with these principles, which provide flexibility for technical solutions but still emphasize the need for a fast current component. The requirement is still non-mandatory, also for HVDC Systems, which avoids technology discrimination. Specifications are considered to be coordinated with those for FRT.

Article 18 Reactive power capability

	Comment	Change	Motivation
18.1-1	The shape of the fixed outer envelope should be more realistic.	Rejected	The fixed outer envelope does not represent a default reactive power capability requested from HVDC Converter Stations. See also the supporting documents of NC HVDC and NC RfG for further info.
18.1-10	Reactive power and steady state voltage ranges are unreasonably high for an offshore collector grid, with cable network and no consumption.	Rejected	This comment refers to DC-connected PPMs and associated HVDC Converter Stations. See review of Chapter 3 comments.
18.1-11	Refer to Relevant Network Operator instead of Relevant TSO.	Accepted	Wording modified.
18.1-12	lead/lag and consumption/production clarification needed in Figure 5	Rejected	Wording is considered clear. Requirement frame is in line with the reactive power requirement in NC RfG.
18.1-13	Wording not clear.	Accepted	The sentence "at minimum or maximum voltage point the reactive range is zero" is deleted.

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18.1-14	Reactive power capability should only serve system preservation to set target voltages, but should not be a barrier for a reactive power market	Rejected	The NC HVDC does not prescribe market-based services, nor when reactive power should be delivered.
18.1-15	The reactive power capability is excessive and technology discriminating (LCC), especially the corners of the diagram.	Rejected	The fixed outer envelope does not represent a default reactive power capability requested from HVDC Converter Stations. See also the supporting documents of NC HVDC and NC RfG for further info. The requirement allows the Relevant TSO to require a 0 range (e.g. a stepwise curve), which would be aligned with LCC capabilities. As indicated also for generators in the NC RfG Implementation Guidelines, the cost impact of capabilities in the lower-left and upper-right corner should be taken into account when specifications are made.
18.1-2	Make clear that the requirement applies in both AC-DC and DC-AC mode.	Rejected	Wording is considered clear that the capability applies for both active power directions.
18.1-5	wording: maximum active power capacity vs maximum capacity; minimum active power capacity vs minimum active power transmission capability	Partially accepted	terminology modified
18.1-7	Remove table 6. LCC is not able to deliver freely adjustable reactive power to the grid to the stepwise switching of capacitor banks and filters.	Rejected	The inner envelope defined in Table 6 and Figure 5 are the maximum ranges that could be required. Nevertheless, the requirement allows the TSO to require a 0 range, which would be in line with LCC capabilities.
18.1-9	use of comma, as defined in technical standards	Rejected	Convention of European legislation is followed.

Article 19 Reactive power exchanged with the Network

	Comment	Change	Motivation
19.0-1	Inconsistency between reactive power exchange and capability Articles	Rejected	Both articles have a different objective. The aim of Article 19 is to limit the net steady state reactive power consumption or production. This is mainly relevant for LCC technology, so aiming at the design of filters, reactors and condensers. Article 18 prescribes the reactive power capability for delivery along the voltage range and for the whole range of operation of active power. Art 18 can be seen as equivalent to the generator capability in RfG, while Art 19 covers the equivalent for passive demand/distribution in DCC.

Article 20 Reactive power control mode

	Comment	Change	Motivation

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20.0-1	The priority in respect to P/Q control for extended voltage variation should be mutually agreed.	Not understood	If the comment refers to P/Q capabilities for extended voltage range, it is defined according Article 18. If it refers to priority of P and Q contribution, then it will be done as specified in Article 21. If it refers to the priority of the reactive power control modes and the change among them in operation, the issue is out of the scope of the NC HVDC, which only defines capabilities.
20.1-1	LCC not compliant with three control modes	Partially accepted	LCC is compliant with the voltage control mode and power factor control mode as in 3 and 5 it is stated "… utilizing its capabilities, while respecting the provisions of Article 18 and 19...". These same words are added to the Reactive Power control Mode stated in Article 20.4
20.1-2	Make clear if just one or all three modes are mandatory.	Partially accepted	Initial wording asked for all three modes to be possible. In the updated draft (based on other suggestions made) at least two out of the three modes are required.
20.2-1	Request for other control modes can only be based on commercial offers.	Rejected	As with all non-mandatory requirements, the Relevant TSO should justify the reason why another control mode is required, and final approval is fitted in the process of Article 4(3).
20.3-10	There is no interval between the maximal admissible t1 and the minimum admissible t2 values. To make this requirement feasible there should be some time between t1 and t2 otherwise there will be no slope. Coherency between ranges of t1 and t2, increase of t2 from "10" to 60 sec.	Rejected	The specification of t1 and t2 should indeed not conflict, but that does not justify a shift in the ranges themselves.
20.3-12	NRA involvement and Relevant Network Operator	Accepted	wording modified
20.3-2	Requirement is too specific in points c) and d)	Rejected	The requirement is aligned with RfG wording, including the technical capabilities typical of the HVDC systems (lower time responses).
20.3-3	Requirement should apply only at the onshore connection point.	Rejected	The TSO will require the parameters of the voltage control mode according to the specific conditions of the AC island side of the HVDC link. Voltage control mode may be required for the AC island stability.
20.3-4	Is set point voltage always the rated voltage? Delimitate voltage control range according to unlimited operational range as stated in Article 16.	Partially accepted	Voltage set point is independent for each Connection Point and therefore for each Relevant TSO (so, the plural has been deleted in NC HVDC and "at the connection point" has been included). Setpoint voltage shall be defined within a range defined by the Relevant TSO and related to the voltage base of the HVDC system. Setpoint voltage is the target voltage value that the action of the control will try to achieve when the Voltage Control Mode is in Operation. Grid quality targets are not specified in this NC HVDC, but these targets will of course drive the set point.
20.3-5	NRA involvement should be ensured	Accepted	Several references to Article 4(3) included where appropriate.

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20.3-6	Refer to Relevant Network Operator	Accepted	"Relevant Network Operator" has been included
20.3-7	To avoid unnecessary changes and fast changes in voltage there has to be a minimum dead band.	Rejected	The approach is consistent with that for generators in NC RfG. The slope ensures stable smooth operation even with no dead band.
20.3-8	5% is too small for a deadband	Rejected	Too wide deadband values lead to inaccurate voltage control, which goes against system security and reduces system controllability. The 5% value is also in line with NC RfG.
20.3-9	Add a figure to specify t1 and t2 response shape. Note that these terms are also used in other articles.	Rejected	The text is considered to be clear, with little added value for a figure. There is no relation between t1 and t2 in Figure 2 in Article 13, and t1 and t2 in Article 20 d).

Article 21 Priority to active or reactive power contribution

	Comment	Change	Motivation
21.0-1	Remove requirement from the code and implement nationally as national standard.	Rejected	Comment not fully understood. The specification via Article 4(3) allows for a national reference standard.
21.0-2	P and Q priority needs to be within HVDC capability	Accepted	wording modified

Article 22 Power quality

	Comment	Change	Motivation
22.0-1	Article should apply for all HVDC links, without exemption for TSO assets.	Accepted	See comments on Article 3: the requirement applies to all (transmission connected) HVDC links, irrespective of ownership.
22.0-10	Quality requirements for HVDC Systems (e.g. maximal admissible THD, etc.) should be defined. The relevant Grid Users should provide the Network Operator with the necessary information and data to conduct studies.	Partially accepted	Power quality standards definition is not within the scope of the NC HVDC. Note also that a regulation cannot refer to a standard which would make it legally binding. Data provision is covered by Article 30 and 22.
22.0-11	Relevant Network Operator	Accepted	Relevant Network Operator included
22.0-12	Term 'contribution' to be changed to 'data'	Accepted	wording modified
22.0-2	It is understood that this means that every parameter defined in the document refers to performance and not to rating	Rejected	Comment is not fully clear. Requirements refer to system needs and performance, which impacts the design and rating of the equipment.
22.0-3	Network information from the Relevant TSO is needed	Accepted	This information exchange is covered in Article 30 and by the general rights and responsibilities of all parties regarding compliance.
22.0-4	The TSO shall provide the power quality data to the HVDC connectee. In order to do so the TSO shall be entitled to require the needed data from all affected and connected grid users at the common grid connection point.	Partially (accepted)	Similar process as for control interaction and SSTI studies is applicable.

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22.0-5	Additional thought needs to be given to standardize the approach along with the other questions that are raised such as who funds the studies, treatment of exiting generation projects and HVDC links.	Partially accepted	Not really a suggestion for change. Cost allocation for the studies is not covered in this connection code. An explicit approach towards existing users is described in the code.
22.0-7	Negative impact of HVDC on Grid Users needs to be addressed.	Accepted	Mitigation of negative impact that the HVDC may have on other Grid Users is addressed by the level of distortion or fluctuation allowed. The objective of the requirement is to minimize negative impact.
22.0-8	What is the timeframe to provide data to Grid Users? At present relevant data is only being provided after contracts have been let. As a result the HVDC system owner is exposed to additional costs for change to filters.	Partially accepted	This is covered in the articles on operational notification and compliance.

SECTION 3 REQUIREMENTS FOR FAULT RIDE THROUGH

Article 23 Fault ride through capability

	Comment	Change	Motivation
23.1-1	Figure 6 and LCC capability: Article deemed not to be technology-neutral.	Rejected	Figure 6 is applicable to LCC and VSC. Note that blocking of LCC is allowed, therefore the requirement is non-discriminatory. Paragraph (a) and (b) are merged.
23.1-10	Protection should not be limited to electrical faults.	Accepted	Wording modified
23.1-11	Suggested to add a dispute resolution.	Rejected	Dispute resolutions are not covered in these connection codes. See FAQ document on this topic.
23.1-12	Not clear what is defined by 'less wide settings'. These changes have to be justified.	Accepted	Reference to Article 4(3) is added.
23.1-2	Remove Table 7, values to be decided on national level. Adjust the definition of Tblc. Give justification for 10 sec value. Table 7 is not in line with RfG. Adjust range Trec to 0-180 s	Rejected	Table 7 gives a range of figures for the specific parameters, therefore it is left to national standards to define the exact values. The justification for Trec = 10 sec is given in document Requirement outlines. Where applicable, Table 7 is in line with RfG, but this table reflects the systems needs where HVDC dominates the system behaviour. Tblc is explained in the text. Table 7 does not give a value for recovery time from 0.85 to 1.0 pu.
23.1-4	To prevent discrimination, TSO should publish voltage-against-time-profile and fault conditions	Rejected	Non-discriminatory treatment is covered in implementation process of Article 4(3), and may be addressed in general NC implementation monitoring procedures.

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23.1-5	Articles 17 and 23 appears to be contradictory for LCC (no reactive power can be injected when blocking valves)	Partially accepted	Article 17 is non-mandatory, Article 23 is mandatory.
23.1-6	Suggested to add definition of when the fault begins and ends	Rejected	Figure 6 gives fault definition times. T_{REC}, defines the duration of the fault. Hence, the fault lasts while the system voltage is below U_{REC}, which is defined as 85%.
23.1-7	A contradiction in paragraph (d)?	Not understood	Comment not understood. FRT requirement intends to cope with transmission network faults. Protection schemes for internal faults serve a different purpose, but should not be designed as to jeopardize the FRT capability (e.g. by focusing only on voltage measurement). Note also that a similar provision applies to generator FRT in NC RfG.
23.1-8	Reference to article 34 should be 33	Accepted	wording modified
23.1-9	Paragraph (g) should be reviewed, is it mandatory or not?	Accepted	The second part of the paragraph is taken out of the NC, and added to the justification document.

Article 24 Post fault active power recovery

No comments received on this article.

Article 25 Autoreclosure

	Comment	Change	Motivation
25.0-1	Article 25 is not necessary if HVDC system fulfils all requirements with respect to FRT	Rejected	Article 25 (1st paragraph) covers a more specific functional capability. Note that it has been shifted to the general requirement on System Robustness.
25.1-1	Change content of article in more functional description	Not understood	
25.1-2	Add text 'unless the converter station is in the process of clearing the fault' at end of clause 1.	Not understood	Comment is not understood, the requirement does not focus on internal faults.
25.2-1	Clause 2 is not clear about autoreclosure on AC or DC side in case of a fault in the HVDC system	Accepted	Wording modified ('DC overhead lines')

SECTION 4 REQUIREMENTS FOR CONTROL

Article 26 Converter energisation and synchronisation

	Comment	Change	Motivation
26.0-1	Contradiction between article 26 and 41?	Accepted	We assume this refers to the explicit limit for transients caused by connection of converter stations and PPMs. The requirements have been aligned

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26.0-2	Please make clear what is the difference between a and b	Accepted	The clause refers now explicitly to a system with more than 2 converter stations.
26.0-3	3% is too low or should be left to national TSO	Partially accepted	The 3% limit is currently industrial practice. The code is updated to allow for national specification up to a 5% level.
26.0-4	Article not in line with Black Start article.	Rejected	This article starts with "unless following an instruction …". This article is applicable for normal network conditions (Normal State). Black start is not a normal network condition.
26.0-5	3% should be 3.00 %	Rejected	Not exceeding 3% means up to and including 3.00%. Any voltage transient above 3.00% is not compliant with the code. (Note that the requirement is updated referring to a 5% level)

Article 27 Interaction between HVDC System(s) and other Grid Users

	Comment	Change	Motivation
27.1-1	When should the study be performed? Suggested to extend the description with other DC and/or AC assets.	Accepted	Article title changed to Interaction between HVDC System(s) and/or other plant(s) and equipment.
27.1-2	It should be an obligation for the TSO that studies are performed instead of that the TSO shall have the right to require study.	Rejected	The TSO has an obligation to ensure system integrity covered in general operational measures and short/long term studies. Performing such study necessitates detailed knowledge of the HVDC converter topology and control which is why the responsibility for the study is assigned to the HVDC System Owner. The TSO has an obligation to provide relevant network data in context of other requirements already.
27.1-3	Article 4(3) to be added to 27.1	Accepted	Wording modified
27.1-4	Add 'onshore' in text	Rejected	Not clear why this should be restricted to onshore. No arguments given.
27.2-1	The process should be open for all parties, relevance not be decided by the TSO	Rejected	TSO is responsible for the system integrity. It is in the interest of the TSO to make sure that all relevant and affected parties are identified and informed.
27.3-1	Remove paragraph because TSO should be in charge of the study	Rejected	HVDC system owner is responsible for performing the study. For this reason paragraph 3 is needed.
27.3-2	NRA should review/assess the performed studies.	Rejected	TSO is responsible for system integrity and security. This is without prejudice to the role of the NRA in the national legal framework. Note that regulatory oversight as with other requirements is ensured.
27.4-1	The mitigating actions identified by the studies shall not only be reviewed by the Relevant TSO(s), but also by the affected grid users. Concern that the mitigating actions to be undertaken by the HVDC system owner are not the most economic solutions.	Rejected	TSO is responsible for the system integrity. It is in the interest of the TSO to make sure that all relevant and affected parties are identified and informed. Mitigating actions are set in accordance with the process as referred to in Art 4(3)
27.5-1	Add reference to article 4(3)	Accepted	Wording modified

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27.5-2	Is article 27.5 necessary? Proposal to remove this paragraph.	Rejected	This clause clarifies the intent of the (complex) studies as referred to in the other clauses of Art 27.

Article 28 Power oscillation damping capability

	Comment	Change	Motivation
28.1-1	NRA involvement requested. POD should only be applicable for reactive power. More details are needed (e.g. damping level).	Partially accepted	Only functionality is required. The implementation is an operational aspect. Preference is given to not restrict POD schemes here by referring only to reactive power. Reference to Article 4(3) is added, referring to national processes to cover further details.
28.1-3	Network changes after commissioning (FON) should not be the de facto responsibility of an existing HVDC system.	Rejected	Only functionality is required, not a specific implementation. The requirement requires the TSO to specify a range of network conditions, aiming to cope with future system changes.

Article 29 Sub-synchronous torsional interaction damping capability

	Comment	Change	Motivation
29.1-1	Once implemented then the HVDC system owner shall not be required to change his SSTI control if new generators enter onto the system.	Rejected	Only functionality is required. The implementation is an operational aspect and depending on local system needs which might change in time.
29.2-1	Data might not be available	Partially accepted	Article 4(3) addresses the extent of the study as specified by the TSO. Existing grid users may indeed not have all relevant data; note that the requirement states that such info shall not be unreasonably withheld, in other words grid users are requested to provide input to the extent possible.
29.2-2	Studies should be performed by the TSO	Rejected	As a baseline, the new connecting party having all info on the new project has the obligation to perform this study. See similar comments on Article 27.
29.2-3	Add reference to article 4(3)	Accepted	Wording modified.
29.2-4	Add existing HVDC to Article 3(3)	Accepted	Wording in Article 3(3) modified so that it refers to all existing grid users.
29.2-5	If the topology and/or generators change during operation the HVDC System Owner will cooperate in changing the SSTI damping criteria, given new studies undertaken by the requested party.	Rejected	Only functionality is required. The implementation is an operational aspect and depending on local system needs which might change in time.

Article 30 Network characteristics

	Comment	Change	Motivation
30.1.4	This data shall be provided to the HVDC system owner prior in a timely manner for the HVDC system owner to place main contracts.	Partially accepted	Reference to article 4(3) is also inserted in (c).

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30.1.5	Normal and disturbed conditions are not defined. NC Operational Security uses Normal, Alert and Emergency State.	Accepted	The reference to normal/disturbed conditions has been deleted as it does not add much value.
30.1-1	More explicit reference to the connection point is requested.	Accepted	TSO is replaced by Relevant Network Operator.
30.1-2	Add reference to Article 4(3) in clause (b)	Partially accepted	The specification refers to paragraph (a) where reference to Article 4(3) is already made.
30.1-3	Article should be more precise. Furthermore grid quality target parameters should be defined.	Partially accepted	Wording modified. Requirement on power quality impact is covered in Article 22. Note that this connection code itself does not set grid quality targets.

Article 31 HVDC System robustness

	Comment	Change	Motivation
31.0-1	Delete article (repetition of already mentioned functionalities.)	Rejected	Considered that these are not fully covered by other requirements and to add further detail on system needs. Also, no conflict is seen with other requirements. Hence, the preferred approach is to maintain this requirement.
31.1-1	Remove (d) changes in DC Voltages	Accepted	Wording modified
31.1-2	Remove (h) extreme low short circuit power at the connection points	Accepted	Wording modified
31.1-3	Include reference to Article 4(3) in (1)	Accepted	Wording modified
31.2-1	Article unclear. What is the requirement? Is a limit to the installed capacity required here?	Accepted	Paragraph deals with multi terminal and/or embedded HVDC Systems. Text changed.
31.2-2	Add the word onshore before Connection Point(s)	Partially accepted	TSO is replaced by Relevant Network Operator
31.3-1	Please delete or explain clearly what should be achieved. Very vague provision.	Partially accepted	Last part of the article 31.3 removed. Reference made to AC system disturbances.

SECTION 5 REQUIREMENTS FOR PROTECTION DEVICES AND SETTINGS

Article 32 Reconnection

	Comment	Change	Motivation
32.0-1	Suggest to add third paragraph, to insure NRA involvement		Article deleted
32.1-1	Delete paragraph, requirement not clear	Accepted	Article deleted

Article 33 Electrical protection schemes and settings

	Comment	Change	Motivation
33.0.1	Add new paragraph to cover for NRA involvement	Rejected	Not fully understood, reference is already made to Article 4(3)

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33.1-1	Extent wording regarding internal faults (converter and cable)	Rejected	Internal faults are all faults between Connection Points. Wording considered clear.
33.3-1	Requested to introduce a dispute resolution in this article.	Rejected	Dispute resolutions are not part of a NC (see also argumentation on other connection codes).

Article 34 Priority ranking of protection and control

	Comment	Change	Motivation
34.1-1	This whole article would be better discussed within a Guidance Note as the information detailed within is not appropriate for European Law. The Article also lacks the necessary references to agreements between Parties.	Partially accepted	Further specifications will indeed be needed, based on the basic principles in this requirement. No motivated argument is seen to change the requirement.
34.1-2	Requested to introduce a dispute resolution in this article.	Rejected	Dispute resolutions are not part of this NC. Where needed reference is already made to Article 4(3).

Article 35 Changes to protection and control schemes and settings

	Comment	Change	Motivation
35.0-1	Check for redundancies within Art 35 (and 34) as well as Chapter 4 Information Exchange.	Rejected	No confusing overlap or conflicts identified.
35.1-1	Remove reference to paragraph 3	Rejected	Not motivated or understood why.
35.1-2	Only parameters relevant to the AC grid should able to be changed	Rejected	Every change of the HVDC system control mode parameters will affect the AC system.
35.2-1	Requested to add a dispute resolution	Rejected	Dispute resolution is not part of this connection code. Reference is already made to Article 4(3).
35.3-1	Paragraph 3 not necessary, because todays standard is remote operation	Partially accepted	Agree that this is common practice. If modern equipment allows it, this does not necessarily mean that it is implemented.
35.3-2	Changes should not be done by the TSO	Rejected	Article only requires the functionality. It is not required in the text and not the intention that the TSO should do the changes directly.

SECTION 6 REQUIREMENTS FOR POWER SYSTEM RESTORATION

Article 36 Black start

	Comment	Change	Motivation
36.1-1	Considering current different capabilities of different available technologies (VCS, LCC), 'Sub-synchronous torsional interaction damping capability' requirement would have an important impact for HVDC systems operators	Not understood	Article is about Black Start not SSTI. Not clear what the proposal or question is, even in context of black start provisions.

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36.1-2	Discrimination of technologies.	Rejected	TSO has only the right to request a quote. No functionality is specified. Black Start is not mandatory (Note that this is made explicit in the text now). The NC requirement in itself cannot oblige an HVDC System Owner to choose for a specific technology.
36.1-3	Change wording 'obtain' into 'request'	Rejected	Wording is consistent with that of NC RfG.
36.1-4	It has to be clear that the HVDC System cannot generator power, only transport it. Paragraph should mention that the quote is based on financial and technical benefits.	Partially accepted	It is well understood that only the transmission capability could be provided by the HVDC system. A quote is inherently based on financial and technical benefits.
36.1-5	Right to obtain quote not applicable for existing unit	Partially accepted	NC HVDC focuses on new connections. Application to existing HVDC systems (in exceptional cases) needs to be in compliance with Article 3(6).
36.2-1	How should a HVDC System start without external energy supply?	Partially accepted	Only the energisation of the busbar of the AC substation is required. The emergency diesel engines are considered part of the internal HVDC converter station. Wording is modified.
36.2-2	A further procedure clarification for is necessary	Not understood	No proposal was suggested.
36.2-4	Article 26 is meaningless under black start conditions.	Rejected	Comment is correct, but Article 26 starts with sentence 'Unless following an instruction …'. Therefore it is covered.
36.2-5	The term 'external energy supply' is not clear and should be defined.	Accepted	Text is changed; the notion of external energy supply is removed.
36.2-6	Replace 'remote AC-substation' with 'AC-grid and substation(s) if installed)'	Rejected	Text is changed, only the remote AC busbar has to be energised.
36.2-7	Add NRA approval to paragraph	Rejected	The Article only describes a contractual agreement between parties to deliver transmission capacity.
36.3-1	Agreement with all relevant TSO(s)	Accepted	Wording modified
36.3-2	Add a dispute resolution	Rejected	The Article only describes a contractual agreement between parties to deliver transmission capacity. In general, dispute resolutions are not covered in this connection code.

Article 37 Isolated network operation

	Comment	Change	Motivation
37	Various requests for clarification	Partially accepted	The article is deleted.

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CHAPTER 3 - REQUIREMENTS FOR DC-CONNECTED POWER PARK MODULES AND ASSOCIATED HVDC CONVERTER STATIONS

Article 38 Scope

	Comment	Change	Motivation
38.1-1	No applicability of chapter 3 in case of a single owner of entire DC connected PPM and HVDC connection. Only the onshore connection point needs to have connection requirements	Rejected	To ensure non-discrimination, chapter 3 has to apply to all types of owners. Perceived long term development shows consistent need to reuse assets into a network to connect further generation, and which drives the need for consistent requirements at all offshore interface points.
38.1-2	Article 38 is discriminatory to DC connected PPMs compared to AC connected PPMs	Rejected	The requirements are based on the needs of the DC connected AC collection grid for PPMs and factors in the future expansion potential. Consequently requirements will differ from AC connections to a much larger synchronous system. Note that various requirements in this chapter have been updated which may address the expressed concern.
38.1-3	Requirements should account for the long term development of AC collected DC systems	Accepted	It is considered that the revised HVDC code factors this in. The development of AC collected DC systems and associated DC networks may result in a change in future of the connection point and the requirements which are normally specified at the connection point are flexible for this.
38.1-4	Connection Point for DC connected PPMs is not defined	Accepted	Definition of connection point in Art. 2 reworded and new term of Interface Point defined in case no connection agreement exists between DC link owner and PPM owner (the same owner).
38.1-5	Discrimination between various PPM technologies	Rejected	The requirements in this network code are functional in nature and are therefore restricted to what is required in order to operate the system and consequently technology neutral. No clear example provided of discrimination.
38.1-6	Requirements should be based on the whole system rather than individual circuits or components	Rejected	The connection point is the main point of specification for the whole system and therefore specifying here is actually specifying the whole system.
38.1-7	Art. 41 to Art.45 shall not apply to the remote end HVDC converter	Partially accepted	Only article 41 and 44 apply to remote end converter stations and are necessary. Control and synchronism and power quality of an AC collected network to avoid safety and security and supply issues. For the sake of clarity the Chapter has been split clearly in HVDC converter and PPM requirements.
38.2-1	Requirements in RfG apply to DC connected PPMS	Partially accepted	NC RfG is the reference point for DC-connected PPMs with a limited set of modifications as expressed in the NC HVDC.
38.2-2	Remove DC connected PPM requirements into its own network code	Rejected	The interaction and synergy between the HVDC inverter requirements and the DC connected PPM means that the NC HVDC is a natural fit for DC connected PPMs. No clear benefit is seen for placing DC-connected PPMs in a separate code.

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38.2-3	Ensure consistency of NC HVDC with comitology changes in RfG	Accepted	It is acknowledged that further specifications in the adoption phase of the NC RfG necessitate a review of the NC HVDC text to ensure a coherent set of connection codes. Since no stable draft is available at the time of finalization of the NC HVDC, the code stills refer to the March 2013 version of NC RfG as published by ENTSO-E and recommended to the EC by ACER.

Article 39 Frequency stability requirements

	Comment	Change	Motivation
39.0-1	Requirements for Remote-end Converters should be identical to other converters unless the DC Connected PPM HVDC system is radial	Partially accepted	No new frequency withstand capabilities are imposed on Remote-end HVDC Converter Stations compared to other converter stations. In case of an initial radial connection then the principle is still maintained of ensuring the converters (as part of the network) are more resilient to frequency changes. As such the converters should have a margin above that of the PPMs, and not be identical to the PPMs requirements.
39.0-2	Do not reference NC RfG in NC HVDC but rather replicate requirements directly into NC HVDC	Rejected	To strengthen the baseline of NC RfG requirements for DC-connected PPMs, referencing is preferred over copying. Legislative practice is not to replicate entire requirements in multiple documents.
39.10-1	No need or possible need for Frequency Sensitive Mode monitoring capability in DC Connected PPMs	Rejected	Since frequency response capability is requested from PPMs, monitoring is necessary as well.
39.1-1	AC collected network (offshore) frequency different to 50Hz shall be included	Accepted	Wording is modified as to not block such developments.
39.1-10	Fast signal response should be required non-mandatory	Rejected	Fast signal response can be easily provided with limited cost. No factual information to the contrary has been identified.
39.11-1	Requirement for synthetic Inertia capability is unclear and also can be expensive due to offshore conditions	Rejected	Synthetic Inertia requirement is technology-neutral and non-mandatory, subject to regulatory oversight under 4(3), and subject to need and feasibility analysis if required by the Relevant TSO. The technical specification is intentionally not restrictive in a given direction.
39.1-11	Fast signal provision only if required by the remote end HVDC converter	Rejected	The Relevant TSO requires frequency response, not the remote end HVDC converter
39.1-12	Reconsider the expression "driving frequency"	Accepted	Article 39 reworded
39.1-13	Frequency Response should only be provided where it's paid for as an ancillary service	Partially accepted	The expectation is indeed that the delivery of such service fits within market-based schemes. However a distinction is made between the technical capability and procurement of the service. This NC requirement only ensures that the capability is provided.
39.1-2	Requirements for DC connected PPMs shall not change in case of a parallel AC connection	Partially accepted	Article 39 partly reworded. Note that when a DC-connected PPM is later on connected to the main system via an AC link, it falls under the category of an existing user. This strengthens the argument to align NC HVDC and NC RfG requirements to allow for stronger integration of networks as envisaged in several long-term development plans.
39.1-3	Frequency withstand capability for DC connected PPMs discriminatory, requesting longer times than RfG	Partially accepted	The requirement is reformulated to cover all RfG ranges without looking for additional margin. In practice this results in the DC-connected PPM requirement aligning with the RfG GB ranges.
39.1-4	Review of activation of response	Accepted	Paragraph partly reworded
39.1-5	LCC cannot drive network frequency offshore	Partially accepted	With additional equipment the LCC HVDC system could be able to influence network frequency offshore. In any case, based on other proposals and review of the overall requirement, the frequency support requirement for remote-end HVDC Converter Stations has been reformulated, without this specific

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			capability.
39.1-6	Remote end converter requirements should be the same for PPM for a single wind farm connection	Partially accepted	Frequency and voltage range are similar and surely related. An overarching principle is still that converters have to remain connected at least as long as what is required from PPMs.
39.1-7	Need for frequency response unclear	Partially accepted	Frequency response is required for the onshore system. Overall requirement is reworded.
39.1-8	With less than 0.1 s or within 0.1s	Accepted	Wording modified
39.1-9	Remove 39.1 a)	Rejected	No justification given for removal.
39.2-1	Feasibility on Synthetic Inertia for DC connected PPMs	Rejected	Synthetic Inertia is a non-mandatory requirement. Clear justification, national decisions and further technical details are a prerequisite for implementation.
39.2-10	Remove Article 39.2b	Rejected	No justification given for removal
39.2-11	Include HVDC System Owner in agreement with PPM owner on increasing PPM frequency ranges or durations	Rejected	See views on similar requirement for HVDC Systems (Art 7). Increased ranges are subject to Art 4(3) procedure. The requirement still explicitly states that consent cannot be unreasonably withheld, to explicitly prevent that this can be blocked because of a missing agreement.
39.2-12	Replace 'shall not' with 'may not', for not unreasonably withholding technical capabilities	Rejected	If it is not unreasonable to provide technical capabilities then they shall be provided. Wording is considered appropriate.
39.2-13	Remove Article 39.2c	Rejected	No justification given for removal
39.2-14	Remove the requirement of the PPM to be fitted with automated disconnection at specified frequencies by the Relevant TSO	Rejected	Automated disconnection where fitted is required to stabilise the frequency of the Remote-end HVDC Convertor Network which the PPM is directly connected to. E.g. in reducing the frequency following the loss of a HVDC system which was exporting power from the Remote-end HVDC Convertor Network.
39.2-3	Frequency requirement for DC connected PPMs is too stringent for an isolated single PPM	Partially accepted	The time duration for the low frequency range is revised and consistent with NC RfG and existing standards. Long-term developments of such new synchronous AC collection systems require for a common frequency withstand capability of all connections.
39.2-5	Frequency deviations at on the PPM would not affect the quality of electrical energy delivered onshore	Not understood	Proposed revised text is a duplicate of the existing text. Offshore frequency quality must be ensured with prescribed common withstand capabilities to ensure adequate security of supply to the onshore system
39.2-7	Frequency range application in Table 8 is unclear and too specific	Partially accepted	Reworded to clarify application. The level of specifications is necessary to ensure adequate withstand capability and hence frequency stability
39.2-8	Why not use Table 1 to replace Table 8?	Rejected	Table 1 is for converter, Table 8 is for PPMs. Frequency ranges in Table 1 are of longer duration to ensure HVDC System which is part of the network is the last to disconnect
39.3-1	Make Article 8 and Article 39 ROCOF Hz/s value the same	Rejected	The value of the ROCOF is intentionally different so that the HVDC System as part of the network is at least as resilient to disturbances and disconnects later than the PPM.
39.3-2	2 Hz/s value for ROCOF is higher than RfG and/or than common practice	Rejected	The value of the ROCOF is not specified in the RfG and could in principle be consistent or even higher than the HVDC requirements. Note that NC RfG also deals with synchronous machines. ROCOF settings are dependent on the total inertia of the network and hence will vary accordingly. Larger synchronous systems typically have lower Hz/s settings. The relative size of DC-connected PPM's AC collection networks is smaller than any synchronous system, with ROCOF settings at the higher end of the spectrum as a result.
39.3-3	Remove Article 39.3	Rejected	No justification given for removal
39.3-4	Replace shall not with may not (or delete requirement), for the requirement of the PPM to have a ROCOF withstand capability	Rejected	A ROCOF withstand capability is required to ensure that the PPM will be able to withstand frequency changes arising from normal operational contingencies, so that planning and operation of the

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			network can be effectively performed.
39.3-5	Add in direction of ROCOF	Accepted	Wording modified
39.3-6	Replace 'point of connection' with 'Connection Point'	Partially accepted	Wording clarified throughout the code with clearer reference to the Connection Point or Interface Point.
39.3-7	Clarification needed for which of the Networks at each end of the HVDC system for DC connected PPMs, that ROCOF requirements apply to	Accepted	Clarified and reworded
39.4-1	Remove Article 39.4	Rejected	No justification given for removal
39.4-2	No need or possible need for FSM/LFSM-O/LFSM-U capability to be installed in PPMs	Rejected	The Frequency response capability of DC-connected PPMs is essential to ensure they respond and provide their equitable share of the reduction or increase in power to respond to frequency deviations on the Synchronous Area which they are connected to. This is consistent with the principles and requirements of the NC RfG
39.5-1	No need or possible need for constant power to be retained due to varying frequency in Remote-end HVDC convertor network	Rejected	If constant power was not maintained during fluctuations of the frequency of the Remote-end HVDC Converter Station Network, the corresponding power transferred by the HVDC system would also fluctuate introducing oscillations and possible instability in the Synchronous Area.
39.5-2	Remove Article 39.5	Rejected	No justification given for removal
39.6-1	Remove Article 39.6	Rejected	No justification given for removal
39.6-2	No need or possible need for active power controllability in DC Connected PPMs	Rejected	Without being able to provide a set point for active power control, effective management of balancing cannot be ensured. Requirements are consistent with the NC RfG for other generation.
39.7-1	Remove Article 39.7	Rejected	No justification given for removal
39.7-2	Include Article 4(3) in requirement	Rejected	Requirement refers to LFSM-U requirement in NC RfG, including the prescribed regulatory involvement.
39.7-3	Insert 'fast signal response' into text to be consistent with Article 39.8	Accepted	Wording modified
39.8-1	Remove Article 39.8	Rejected	No justification given for removal
39.8-2	'Fast Signal Response' is not included in defined terms	Rejected	The fast signal response is specified in the same article in 39.1 within 0.1 of a second. A specific definition does not add value.
39.9-1	Remove Article 39.9	Rejected	No justification given for removal
39.9-2	No need or possible need for Frequency Restoration the DC Connected PPMs	Rejected	Without frequency restoration control, effective frequency regulation cannot be ensured or optimised. The requirement is consistent with the NC RfG for other generation.

Article 40 Reactive Power and Voltage requirements

	Comment	Change	Motivation
40.1-1	Remove requirement as discriminatory to DC Connected PPMs compared to AC Connected	Partially accepted	Adjustments to requirement have been made and AC and DC requirements are now or already were broadly equivalent. As the Remote-end HVDC Converter Networks are likely to be smaller than Synchronous Area Networks they will show more volatile behaviour and require a wider voltage range as a functional requirement.
40.1-10	Remove 40.1d	Rejected	No justification given
40.1-2	Remove requirement as DC Connected PPMs compared to AC Connected only influence Remote-end HVDC Converter Network	Rejected	Notwithstanding that the Connection Point can be at Remote-end HVDC converter Network and would therefore directly have an influence, the need for disconnection of PPMs due to for example high voltage maybe essential in voltage management in the Synchronous Area Network.

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40.1-3	Merge tables 9 and 10 as parameters are similar	Rejected	The issues with high voltage withstand capability for the 300kV to 400kV range means that merging of the tables would not be possible without either reducing the range of the sub 300kV equipment and hence resilience or increasing the risk of plant failure by raising the voltage of the 300kV to 400kV range beyond normal equipment limit practices.
40.1-4	Reduce the voltage ranges for efficiency and cost effectiveness	Rejected	Remote-end HVDC Converter Networks are likely to be smaller than Synchronous Area Networks they will be more volatile and require a wider voltage range as a functional requirement. Therefore, reducing to a normal operating range does not provide any margin to account for periods of disturbed operating conditions in the Network
40.1-6	Voltage deviations at on the PPM would not affect the quality of electrical energy delivered onshore	Partially accepted	Reworded to clarify Connection Point. The loss of generation at the Synchronous Area end of the DC Connected PPMs due to voltage collapse at the Remote-end HVDC Collector Network would be similar to the loss of an AC connected wind farm for the same contingency.
40.1-7	TSO shall have the right to specify ranges for nominal voltage which are not Article 40.	Accepted	Additional provision inserted to cope with other (higher) voltages.
40.1-8	Specify if voltage ranges are at connection point only	Accepted	Reworded
40.1-9	Include HVDC System as well as DC connected PPMs, and ensure that HVDC systems for DC Connected PPMS are designed for these voltage ranges	Accepted	Wording modified. The requirement is now given in the PPM and in the HVDC converter sections of Chapter 3.
40.2-1	Reactive Power requirements for DC connected PPMs is too stringent and more than RfG	Rejected	Reactive Power requirements are consistent with NC RfG and existing standards. Depending on ranges eventually selected by the network operator, the reactive power requirements for DC-connected PPMs may be even less than the AC Connected PPMs.
40.2-10	Article 40.2ai include '...Relevant TSO, WHILE RESPECTING THE PROVISIONS OF ARTICLE 4(3), already installed as part...'	Partially accepted	Reference in Article 40.2ai to the Relevant TSO specified Reactive Power capabilities is to be in line with 40.2b which does require provisions of Article 4(3) to be respected already.
40.2-11	Article 40.2aiI include '...Relevant TSO, WHILE RESPECTING THE PROVISIONS OF ARTICLE 4(3), must...'	Accepted	Wording modified
40.2-12	Change range of Reactive Power to 0-0.95Q/Pmax	Accepted	Wording modified
40.2-13	Clarification required on which DC Connected PPMs Article 40.2b applies to	Accepted	Wording modified

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40.2-14	Additional supplemental reactive power will not ever be required for PPMs which do not have a Connection Point at the HV terminals of the step up transformer	Rejected	Where connections are not at the HV terminals of the step up transformer they require additional reactive compensation to compensate for the needs of the connecting circuit, particularly for cables from the connection point to the transformer terminals. As the majority of DC-connected PPMs will be offshore and thus connected via cable networks with significant dimensions, reactive compensation becomes more essential. Wording and principles are consistent with NC RfG.
40.2-15	Reword so that reactive power range in table 11 is for the whole capacity range	Partially accepted	Requirements for below maximum capacity where specified is given elsewhere in this code for HVDC converters and in NC RfG for PPMs.
40.2-16	Add in a Figure similar to Article 15 Figure 5	Accepted	Figure introduced
40.2-17	Make the requirement in Article 40.2bii for DC connected PPMs to be demonstrate and install Reactive Power capabilities consistent with AC Connection in NC RfG only apply when the PPMs are being replaced.	Rejected	Meeting the requirements of existing and expected future running arrangements following planned development is typical for any user connecting to the Transmission system, and ensures non-discrimination towards all users. A request for derogation can always be made in exceptional circumstances.
40.2-2	AC connections will not occur in parallel with DC connections	Rejected	Numerous offshore grid development studies including those presented at NC HVDC public workshop on 4th Dec 2013 show a high proportion of AC and DC circuits in parallel. See also NC HVDC supporting documents for further information.
40.2-3	Reactive Power requirements shall only be specified at Connection Point to Synchronous Area	Rejected	Due to the potential for DC Connected PPM Networks to be further developed into more expansive and integrated Networks, reactive power requirements in the Remote-end HVDC Converter Network will emerge. Ensuring the capabilities in the most cost effective manner is essential for timely and over all minimal investment. This is evidenced in many studies included those presented in the NC HVDC public workshop 4th Dec 2013.
40.2-4	Replace 'boundaries' with 'envelope' in Article 40.2	Accepted	Wording modified
40.2-5	No need for PPM reactive power delivery - HVDC System reactive support ranges will always be more than PPMs as the faster and more stable	Rejected	The need to provide reactive power to support a Network should be equitable and proportionate to the size of the User. Also due to maintenance and other activities reactive power provision should be shared to ensure adequate reactive power provision during these periods.
40.2-6	Clarify agreement between HVDC System Owner and DC Connected PPMs is a bilateral decision in Article 40.2a	Accepted	Wording modified

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40.2-7	Clarify that requirements to meet Article 40.2b, in Article 40.2a, are for the ability to have the Reactive Power capability (i.e. PPMs could operate to provide this range) as confusing	Accepted	Wording modified
40.2-8	The agreement in Article 40.2a should not only refer to PPM owners but also the Remote-end HVDC converter Station Owner, and to the equipment at either side of the HVDC System.	Rejected	To clarify the requirement: The converter in the HVDC system connected to the Synchronous Area Network like any other converter (or Grid User) connected to the Synchronous Area should contribute to voltage stability with reactive power provision. As an agreement between the Remote-end HVDC Converter owner and the PPM owner is required, the HVDC System Owner will have accepted the terms of the agreement to provide reactive power sufficient to meet the reliability needs of Remote-end HVDC Converter Network. The Remote-end HVDC Converter has not only inherent capabilities, but is also an integral part of the network. Given future development potential of both networks and generation, the HVDC systems, the life expectancy and role of an individual HVDC system will exceed that of an individual PPM
40.2-9	Article 40.2a Replace 'time' with 'time schedule'	Accepted	Wording modified.
40.3-1	Text describes a shape that is changing continuously - Please rewrite	Accepted	Wording modified.
40.4-1	There shall not be any voltage/reactive requirements for PPM as no AC network is going to materialise in the lifetime of the PPM; the stability of the offshore PPM cannot be "transferred" to the onshore AC network, thus there is no benefit to the onshore system.	Rejected	The voltage stability requirements of the PPM is to ensure it continues supporting the AC Network during fault conditions; a resilient AC Network means PPMs can continue to generate power to support the Transmission System
40.4-2	Voltage stability requirements should also be specified for the remote-end converter station as well as for PPM	Accepted	Voltage stability for remote-end converter station is already specified under Article 17, as short circuit reactive current contribution.

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40.5-1	There shall not be any reactive power control modes requirements for PPM as no AC network is going to materialise in the lifetime of the PPM; the stability of the offshore PPM cannot be "transferred" to the onshore AC network, thus there is no benefit to the onshore system	Rejected	The reactive power control modes are necessary for the optimal control of the AC network; this helps to maintain the AC Network security which will have a knock -on positive effect on the Transmission System
40.5-2	Reactive power control modes for remote-end converter station and PPM shall be in accordance with Article 16(3)(d) of RfG.	Partially accepted	The control modes of the remote-end converter station are specified under Article 20, and are not necessarily exactly the same as for PPM
40.6-1	The priority to Active/Reactive power contribution is unnecessary as no AC network is going to materialise in the lifetime of the PPM; the PPM's contribution cannot be "transferred" to the onshore AC network and thus is of no benefit to the onshore system.	Rejected	The option to prioritise can help the AC Network to recover following a fault, and therefore contributes to maintaining the integrity of the Transmission System
40.6-2	Priority of Active Power or Reactive Power contribution for DC-Connected Power Park Modules and remote end HVDC Converter Stations shall be determined in accordance with Article 16(3)e) of the [NC RfG].	Accepted	For the HVDC Converter Station, the priority is specified in Article 21
40.6-3	Priority of Active Power or Reactive Power contribution for DC-Connected Power Park Modules should be specified, not referred to RfG. This paragraph is related to FRT, not to reactive power control modes	Rejected	If requirements are exactly the same, there is no point in specifying separately. This Article is about prioritisation of active or reactive power contribution, not actually about the FRT requirements.
40.7-1	The Fault Ride Through capability is unnecessary as no AC network is going to materialise in the lifetime of the PPM; the PPM's FRT capability cannot be "transferred" to the onshore AC network and thus is of no benefit to the onshore system.	Rejected	This capability is crucial for the maintaining stable PPM generation under fault conditions, therefore supporting both the AC network and the onshore Transmission System
40.7-2	Fault Ride Through shall be the same for both the DC-Connected Power Park Modules and remote end HVDC Converter Stations; they shall be determined in accordance with Article 11(3) of the [NC RfG].	Partially accepted	Requirements for FRT for the remote-end converter station are specified in Article 23; they are not exactly the same as for PPM as the converter specifications are intended to make it more resilient and thus not trip before the PPM

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40.7-3	FRT requirements unclear, should specify them directly , not referred to RfG, and should state that it is only at the connection point	Partially accepted	The FRT requirements are referred to Article 11(3) of NC RfG where it is implied to be at the connection point. The scope of DC-connected PPM requirements indicates that all NC RfG requirements apply unless modified in the NC HVDC.

Article 41 Control Requirements

	Comment	Change	Motivation
41.1	The synchronisation voltage signal should be made available by the TSO if necessary.	Rejected	No synchronising signal required as the system frequency voltage can be taken from the network at the point of connection of either the PPM or converter
41.2-1	Voltage transients shall not exceed 2% of the pre-synchronisation AC Voltage	Partially accepted	Revised as to be specified by the network operator, with 5% a maximum, and aligned process with that of HVDC Converter Stations.
41.2-2	New requirements shall be added when there is evidence about the interaction and about the need to deal with it.	Partially accepted	The requirements are based on the needs of the DC connected AC collection grid for PPMs and factors in the future expansion potential. Consequently requirements will differ from AC connections to a much larger synchronous system. Due to low available short circuit power special attention has to be given to energising or synchronising in such AC collection grids. Note that such requirement is already needed for connections which are in operation e.g. in the German offshore installations.
41.2-3	Two decimal places are proposed to avoid confusion as to whether 2.99 or 2.00 is acceptable	Rejected	Note that the requirement now refers to 5% max. Interpretation is still that this refers to 5.00%, not 5.99% nor 5.49%
41.2-4	Explanation of 'Synchronisation of an remote HVDC converter'	Accepted	Reworded to clarify that it refers to synchronisation to an already energised remote end AC collection network, in the case of more than one Remote-end HVDC converter.
41.3-1	Removal of requirement on Active Power controllability and active power setpoint adjustment	Rejected	This functionality is relevant for the reliable operation of the European transmission system. The DC-connected PPM needs to have the same capability to take part in FSM operation as onshore connected PPMs. The Remote-end HVDC Converter Station has the capability to manage the power exchange with the synchronous area to which the response is being provided.
41.3-2	Automatic remote control equipment should not be duplicated	Accepted	Wording modified.
41.3-3	NRA approval requested	Rejected	This article is subject to notification to the National Regulatory Authority, in line with modalities specified at national level.
41.4-1	Keep control for remote end HVDC converter and DC connected PPM separated	Partially accepted	Requirements are split.
41.4-2	DC connected PPM should not be manipulated for the benefit of the HVDC link or vice-versa	Rejected	Output signals are necessary for the purpose that the HVDC systems and the DC-connected PPMs are able to follow the request for system response from the synchronous area(s).
41.4-3	Output signals should not be specified by the Relevant TSO but agreed with the HVDC system owner.	Rejected	The output signals to be specified are relevant for the purpose of system security on the main onshore system. Therefore specification by the Relevant TSO is necessary.

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41.5-1	The requirement for coordinated control should not only apply to HVDC and PPM but also between several PPMs and HVDC Systems connected to the same AC system	Partially accepted	The coordinated control shall apply for DC-connected PPMs and the HVDC systems they are connected to, in order to provide response to the synchronous area. Onshore PPMs are able to measure network frequency directly and can provide the response without coordination with HVDC converters.
41.5-1	Remove power oscillations damping because harmonics cannot travel through the DC connection	Rejected	HVDC systems to remote end AC collections systems shall have the capability for power oscillation damping. When activating this functionality Active Power deviations can be transmitted to the remote end system. For this purpose DC connected PPMs and remote end converters shall be able to support power oscillation damping as well on the remote end side.
41.6-1	Remove sub-synchronous torsional interaction damping capability	Accepted	Requirement is removed. This is not required for AC connected PPMs either. The HVDC Converter Stations are already required to provide this capability which is sufficient.
41.7-1	Replace power reduction with active power reduction		Article 41.7 deleted
41.7-2	Remove paragraph because this is limited to the wind resources	Rejected	Article 41.7 deleted, but covered via reference to NC RfG for type C generation.
41.7-4	Voltage and frequency at connection point		Article 41.7 deleted
41.8-1	Remove reconnection capability of PPMs	Rejected	The conditions for reconnection after an incidental disconnection due to a Network disturbance need to be defined for system security reasons. The clause is deleted, but the requirement applies via reference to NC RfG.

Article 42 Network characteristics

	Comment	Change	Motivation
42.1-1	Include HVDC System as well as DC-connected PPMs, and ensure that HVDC systems for DC-connected PPMs are designed for these network characteristics, short circuit power and power quality.	Accepted	Remote-end HVDC Converter Stations are covered via reference to general Chapter 2 requirements for HVDC Systems. This will also ensure that the HVDC systems should be designed to meet the same range of network characteristics and hence be adequate.
42.1-10	Replace 'shall' with 'may' in Article 42.1b	Rejected	The capability of a PPM to be able to operate for the full range of steady state operating conditions of the Network to which it is connected is required to ensure that planning and operation of the network can be effectively performed and that the PPMs will provide a reliable contribution to the network.
42.1-11	Ensure that HVDC Owner and PPM have to design their equipment to equivalent network characteristics, short circuit power and power quality	Accepted	The existing wording of both the HVDC system and PPMs is subject to regulatory oversight and therefore equitable treatment of either HVDC system or PPM will be independently considered
42.1-12	Change wording to ensure non-nominal frequency characteristics and different contingencies are provide for Power Quality design to PPMs	Partially Accepted	The existing wording requires the Relevant TSO to provide necessary information and covers non-nominal frequency information. The requirement is updated as to ensure the HVDC System Owner will also provide necessary information.
42.1-2	Remove Article 41.1b	Rejected	The range of short circuit and network characteristics provided by the Relevant TSO will represent the existing and future network parameters that the entire DC Connected PPM (PPMs and Converters) will be connected to and therefore must be used in the design of the DC Connected PPMs and HVDC system
42.1-3	Replace 'the' system with 'their' in Article 42.1c	Accepted	Wording modified
42.1-4	Add in that the HVDC System Owner must provide their characteristics in Article 42.1c	Accepted	Wording modified

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42.1-5	Replace 'Connection Point' with 'offshore Connection Point'	Rejected	The connection point does not have to be offshore and also DC-connected PPMs do not have to be sited offshore either. The criterion is being DC-connected.
42.1-6	Remove Article 41.1c	Rejected	The method of calculation for short circuit contribution at the Connection Point regardless of where this may be and who performs the calculation (PPMs Owner or HVDC System Owner) must be provided to receive the calculated contribution for planning and operation of the Network
42.1-7	A well-defined and correct method on how to calculate the min and max short circuit current for HVDC is needed.	Accepted	The NC HVDC already states that a method is to be provided by Relevant TSO
42.1-8	Include that a minimum short circuit power will be provided in 42.1a	Accepted	Reworded for clarity as the range of short circuit power provided by the Relevant TSO is intended to be the maximum to minimum short circuit power that could be expected
42.1-9	Ensure regulatory oversight by including 'while respecting of Article 4(3)' in Article 42.1b	Partially accepted	Article 42.1a specifies the method and conditions for calculating short circuit power and characteristics which is subject to Article 4(3).

Article 43 Protection requirements

	Comment	Change	Motivation
43.1-1	Article 43 Protection and Control requirements should be removed as Remote-end HVDC Convertor Network is independent	Partially Accepted	The protection requirements are restricted to protection requirements for only PPMs necessary to protect the Synchronous Area Network. Therefore requirements are restricted to this purpose and independent protection shall not be specified by Relevant TSO. Wording modified to clarify this.
43.1-2	Include protection and control requirements for the HVDC System as well as DC connected PPMs in Article 43	Partially Accepted	Article 38.1 ensures that Article 33 to 35 applies to Remote-end Convertors and HVDC systems for DC connected PPMs. This will also ensure that the HVDC systems should have the same responsibilities and is therefore non-discriminatory with DC Connected PPMs. Article 43 only applies to PPMs.

Article 44 Power Quality

	Comment	Change	Motivation
44.1-1	The Relevant TSO should provide other users information	Partially Accepted	The process for data contribution, also from existing users, has been updated in line with studies prescribed in Art 27/29.
44.1-2	Article 44 Power Quality should be removed as Remote-end HVDC Convertor Network is independent	Partially Accepted	The Power Quality requirements are to the Connection Point therefore restricted to requirements relevant to the Synchronous Area Network.
44.1-3	Power Quality data should be provided by owners or the Grid Users.	Accepted	Reworded
44.1-4	Include general planning levels for Power Quality in the NC HVDC	Rejected	Existing standards (IEC 61000-3-6, G5/4, etc.) are established and in use. Inclusion of planning levels in NC HVDC is not necessary as standards are acceptable. Inclusion of detailed specifications in the NC goes beyond the scope of a connection code. Also explicit reference to external standards cannot be provided for in an EU law.

Article 45 General System Management Requirements applicable to DC connected PPMs

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	Comment	Change	Motivation
45-1	Remove Article because services that could be provided by the PPM cannot be transferred across an HVDC link to the onshore connection point	Rejected	Article 45 deals with general system management requirements strongly needed for DC connected PPMs due to security reasons such as control schemes and settings, protections schemes and settings, information exchange, etc.
45-2	System management requirements shall apply for both DC connected PPM and HVDC converter	Partially accepted	For the Remote-end HVDC Converter Station and the HVDC system itself the system management requirements already apply with reference to chapter 2.

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CHAPTER 4 - INFORMATION EXCHANGE AND COORDINATION

SECTION 1 MONITORING

Article 46 Operation

	Comment	Change	Motivation
46.1-1	"per each converter unit" clarification	Partially accepted	HVDC Converter Unit has been defined in Article 2. Editorial corrected
46.1-10	"auxiliary services" needs to be defined.		Preferred option is to delete it.
46.1-11	NRA involvement needs to be ensured	Accepted	Wording modified
46.1-2	Delete DC side signals	Rejected	DC side signals are relevant to prevent consequences on the AC side due to contingencies or abnormal operation of the DC side.
46.1-3	Signals should be exchanged based on a contractual agreement	Partially accepted	The signals types established in the NC are the minimum required to ensure system security. Additional ones can be agreed specifically between the HVDC owner and the Relevant TSO.
46.1-4	Relevant Network Operator instead of Relevant TSO	Accepted	Wording changed
46.1-6	subpara a)-c) should become para 2, 3, 4.	Rejected	The signal types are referred to the automatic controller defined in 1, so it should be a subparagraph of it.
46.1-7	It is not clear what the difference between severe and urgent signals is.	Accepted	Both categories are combined.
46.1-8	Format	Accepted	Section 1 header is deleted.
46.1-9	Remove paragraph: For a merchant link the relevant TSO should only have control of emergency functions. Changes to active and reactive setpoints have a direct commercial impact.	Rejected	This section is only referred to information exchange. The HVDC System has to have the capability to exchange these values. This clause does not as such give the right to change setpoints.

Article 47 Parameter setting

	Comment	Change	Motivation
47.1-1	Modification of parameters should be with NRA involvement.	Rejected	Article 47 states the need that the HVDC system has the capability of modifying the settings and parameters of the control functions. The procedure how to modify them is out of the scope of the NC HVDC.
47.1-2	Discrimination among TSO owned and non-TSO owned HVDC Systems	Accepted	Chapter 4 will apply also to TSO owned assets embedded within a Control Area. Reference in Article 3 is updated.

Article 48 Fault recording and Monitoring

	Comment	Change	Motivation
48.1-1	delete Article and add that the TSO can install its own monitoring and recording system at the connection point	Rejected	Fault monitoring and recording systems are essential to analyse any incident that may happen in the network with cross-border impact.
48.1-2	NRA oversight in clause c)	Accepted	Wording modified

Article 49 Simulation models

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	Comment	Change	Motivation
49.1-1	A simulation model needs to be defined as it is, by standard definitions, a simplification of the truth and, therefore, never a true representation of all behaviour. Asking for too much could create issues with Intellectual Property Rights	Partially accepted	A simulation model has to represent the behaviour of the HVDC system so as to analyse the interactions with the network, according to the scope of the model and the study. The requirement does not ask for an exact control system replica. To deal with intellectual property rights issues, the normally reduced model required could be dealt with under a Non-Disclosure Agreement.
49.1-2	Explicitly mentioning 50 Hertz does not allow for e.g. 16.7 Hz	Accepted	"50 Hz" replaced by "fundamental frequency component"
49.1-3	More details needed on timing for simulation models exchange procedures and data exchange.	Rejected	This is partly covered in the operational notification procedure, and needs to be complemented in national provisions. It is not realistic to set exact procedures in this NC covering connection requirements.
49.1-4	Models for electromagnetic transient simulations cannot be provided without encryption of the control concepts to protect intellectual property.	Accepted	This is covered in Article 30.
49.2-1	SSTR definition missing	Accepted	Editorial corrected (SSTI)
49.5-1	- Why would a replica be needed, and who bears the costs? - This should make clear that this is a right to purchase a replica, not the right to demand a replica at no cost	Rejected	As the requirement indicates, there may be a need for the exact replica when control interactions with severe adverse impact are possible. This will need to be justified by the TSO in line with the Article 4(3) process, also covering the scope and definition of the replica. Cost arrangements are not in scope of this code.
49.5-2	A replica is not needed, better joint studies can be sufficient.	Partially accepted	The initial study with a good model is essential, as stated in Article 28 and Article 49. Depending on the particular conditions, a replica of the control may be also needed.

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CHAPTER 5 - OPERATIONAL NOTIFICATION PROCEDURE FOR CONNECTION

	Comment	Change	Motivation
50.1-1	Clarify that only section 1 applies to New HVDC Systems	Accepted	Wording modified
50.1-2	Clarify in text that this section applies to New HVDC systems, except those not yet connected to the network	Rejected	In Article 2 there is already a definition for New HVDC System that already excludes the case of HVDC not yet connected as defined in Article 3.7(a).
50.1-3	Discrimination between TSO owned and non-TSO owned HVDC systems	Rejected	Articles 50 to 59 are related to Operational Notification for connection. There is little benefit from such procedure in case a single TSO owns the link, embedded in its own network, although the TSO may have some internal process to achieve a similar outcome.
50.2-1	More than one Relevant Network Operator could be involved.	Accepted	Wording modified
50.2-2	Compliance with the whole Network Code	Rejected	This section applies only to HVDC Systems, and is referred to compliance. Only compliance with Chapter 2 and 4 needs to be demonstrated as Chapter 3 is referred to DC connected PPMs, not to HVDC systems.
50.3-4	Request for add Article 27 and 28 from RfG	Partially accepted	Principle of RfG Article 28 included in the text
50.3-5	The investment into a merchant HVDC link is subject to exemption from third party access for a certain period of time, in order to recover investment costs. Furthermore, investment feasibility strongly depends on good performance during the first few years of operations. It should be addressed if: A) the exemption period includes the Interim Operational Notification period or excludes it: and B) how efficient commercial operations can be warranted, while the HVDC link can be required to perform, at least in principle, a number of tests, as described in Section 6 of the NC.	Partially Accepted	Further details on the ON process will be given in line with national decision (Art 4(3)). Normal operation can generally only start when a FON has been obtained, i.e. when full compliance with the code has been demonstrated; there is no argument seen as to why a warranty should be given to a merchant line owner during an ION.
51.1-1	Relevant Operators(s)	Accepted	Wording modified
51.2-1	NRA involvement	Accepted	Wording modified, Article 4(3) reference included.
51.2-2	Dispute resolution	Rejected	Dispute resolutions are not in the scope of connection codes.
52..3-2	"interim" State of Compliance?	Accepted	Editorial: "itemized" included
52.0-1	ON independently to both TSOs or coordination between TSOs?	Accepted	Both TSO(s) should coordinate, as specified in Article 4(6)
52.1-1	Relevant Operators(s)	Accepted	Wording modified
52.1-2	Request for adding 57.2 from NC RfG (addressing emerging technologies) for non-discrimination	Rejected	Not understood how this provision relates to emerging technologies (in RfG: small-scale, limited penetration, just entered the market).
52.2-1	change "on" instead of "subject to", there is no delay then.	Accepted	Wording modified
52.2-2	NRA involvement	Accepted	Reference to Article 4(3) included
52.3-1	Equipment Certificate definition is required for NC HVDC.	Accepted	Definition aligned across all NCs.
52.3-3	NRA approval	Accepted	Reference to Article 4(3) included
52.4-1	request to change the Article as RfG 30.4	Accepted	Wording modified
52.4-2	Proposal to delete "24 month" period by	Rejected	It is possible to extend the 24 month period

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	"defined by the TSO", as it may take more than 2 years.		upon request for Derogation made to the Relevant Network Operator. This formulation is in line with RfG/DCC
53.1-1	Connection point by Connection Agreement	Accepted	Words deleted
53.1-2	FON independently to both TSOs or coordination between TSOs?	Accepted	Both TSO(s) should coordinate, as specified in Article 4(6)
53.1-3	Relevant Operators(s)	Accepted	Wording modified
53.2-1	Unreasonable delays must be avoided.	Partially accepted	Unreasonable delay could be interpreted as not complying with the code. Nationally more detailed connection procedures could still give timing constraints.
53.3-1	"interim" should be "itemized"	Accepted	Editorial: Wording modified
54.1-1	ION independently to both TSOs or coordination between TSOs?	Accepted	Both TSO(s) should coordinate, as specified in Article 4(6)
54.1-2	Relevant TSO(s)	Accepted	Included
54.5-1	Reference missing	Accepted	Reference has been included
54.6-1	delete Owner	Accepted	Wording modified
55.1-1	only section 2 applies	Accepted	Wording modified
55.1-2	Include Art27 and Art28 from RfG	Partially Accepted	Principle of RfG Article 28 included in the text, as DC-Connected PPM is generally expected to fall in the type D category
55.2-1	HVDC System correction to DC-connected PPM	Accepted	Wording modified
56.2-1	request to change the Article as RfG 51,2	Rejected	There is not Article 51.2 in RfG. The comment was probably refers to Article 29 of RfG, but has the same principles.
56.2-2	Dispute resolution should be covered in the code.	Rejected	Dispute resolutions are not in the scope of connection codes.
57.3-1	Similar to Art 52.3. Itemized	Accepted	Wording modified
57.3-2	Similar to Art 52.3. Detailed technical data…	Accepted	Words included in Art 57.3
57.3-3	NRA involvement	Accepted	Wording modified
57.4-1	Reference to 4(3) or 4(2)	Accepted	Reference is to 4(2). It has been corrected
57.4-2	Differences between Articles 57 and 52	Accepted	Article has been modified according to Art 52
58.3.2	itemized	Accepted	Wording modified
58.3-1	Adding "owner"	Accepted	Wording modified
58.3-3	proposed wording	Accepted	Wording modified
60.1-1	CBA by the TSO to request changes to existing plants - proposal to set further limits on when this can be pursued.	Partially accepted	Agree that the (exceptional) case of retrospective application needs to be well argued and needs to be scrutinized. NC HVDC wording is in line with NC RfG and DCC.
60.2-1	adding "existing"	Accepted	Wording modified
60.3-1	Relevant data may have more delay than 3 months. They propose "available"	Rejected	Only data is required within these 3 months, not modifications. There is possibility to ask for more time if justified, as the wording "unless otherwise agreed" set at the end of the paragraph.
60.3-2	DSOs and TSOs also to provide data	Accepted	Wording modified to cover distribution connected users
60.4-1	CBA made by an independent body	Rejected	Once the CBA analysis has been made, there is a public consultation and a NRA approval foreseen, ensuring transparent and non-discriminatory treatment. NC HVDC wording is in line with NC RfG and DCC.
60.4-2	If socio-economic benefits are considered then the cost benefit analysis will always be favourable to the relevant TSO. As a merchant link has no mechanisms to	Partially accepted	Not understood what a favourable CBA for a TSO means. Costs incurred by regulated network operators need to be approved by NRAs. A non-regulated actor by its very nature

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	recover these costs.		has other means to recover costs. In addition, national processes could deal more specifically with cost allocations, e.g. for retrospective applications. The CBA established, consulted, and - if valid – approved, is set from societal viewpoint. By virtue of the CBA methodology not being concerned with who the cost is incurred by and who has the benefit it avoids the concerns of bias raised in this comment.
60.7-1	objection process	Rejected	Objections can be given with appropriate arguments during public consultation. Dispute resolutions are out of scope of this connection code.
61.2-1	Adding "existing"	Accepted	Wording modified
61.3-1	DSOs and TSOs to provide data	Accepted	Wording modified
62.1-1	Why existing only for HVDC systems?	Accepted	Wording modified
62.1-2	Correct numbering	Accepted	This Article is moved for proper understanding.
62.1-2	Notification to the TSO is always needed. New equipment does not necessarily need to comply with the NC.	Rejected	The TSO shall be notified only if the change is relevant and significant enough. Regarding the fulfilment of the new equipment with the NC, regulatory oversight is prescribed.
62.1-3	remove the reference to spare components	Rejected	Spare components that do not comply with the NC should be notified to the TSO and its use should be agreed between both parties. A default rejection or acceptance of use of spare parts cannot be motivated; this deserves case-specific considerations. The text is in line with NC RfG.

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CHAPTER 6 - COMPLIANCE

Apart from explicit comments given on Chapter 6 requirements, the section has been updated where relevant to reflect the general requirements of Chapter 2, 3 and 4.

	Comment	Change	Motivation
63.0-1	Responsibility of the PPM Owner is mentioned in the article but not included in the title	Accepted	Wording modified
63.1-1	Existing systems should be exempt from compliance testing	Partially accepted	Existing users are required to comply with compliance provisions in case this has been approved by the NRA, following detailed CBA and consultation. An explicit exemption as such for new users is not needed.
63.1-2	Structure the compliance tests in such a way so that they can be easily integrated in standards on HVDC systems	Partially Accepted	The importance and benefit of standards in compliance testing is acknowledged. In the comment no clear recommendation is given as to how to restructure the compliance testing provisions in a better manned. Please note, often a standard applies to individual items of plant and equipment, whereas NC HVDC applies to overall required performance of a facility connected to the system.
63.1-3	or' means that only one of them has to be compliant	Accepted	Wording modified
63.1-4	New Chapter starts with Section 1. please be consequent	Accepted	Wording modified
63.1-5	In order to avoid discrimination of treatment, compliance obligations should also place on Relevant TSOs.	Partially Accepted	The article already applies to all HVDC System Owners, including links between two TSOs. Exceptional situations of embedded links in the area of a single TSO are covered by Article 3.5
63.5-1	If the TSO wants to record the performance, he is free to do this with his own equipment. The HVDC System Owner will only record the behaviour at the Connection Point.	Partially Accepted	That is the correct interpretation of the initial article.
64.1-1	This will cause major costs for the HVDC System Owner. If the TSO wishes to assess the compliance he shall bear all the costs for it.	Rejected	This principle of regular compliance testing is in line with the framework guidelines for grid connections, and the related provisions in NC RfG. This NC does not address how costs for one party can be allocated to other actors.
64.1-2	The term 'regularly' should be defined (yearly, every 2 years,)	Rejected	As the facilities to assess will be quite different in terms of age, size, technology, project, local system conditions etc., more detail on the time span is considered not reasonable and may end up becoming wasteful
64.2-1	This is too open-ended. It should be removed. If the Relevant TSO wants to ask for compliance testing, proper procedures with checks and balances need to be in place. HVDC System Owners need to know whether such compliance testing would be needed and when.	Rejected	The demand for a plan and the reference to Article 4(3) provide assurances.
64.2-2	Remove 'of the' or add further intended words?	Accepted	Wording modified
64.3-1	PGF Owner is not defined in this code.	Accepted	PGF owner is defined in NC RfG, and is still applicable in NC HVDC
64.6-1	This shall also be valid if the tests cannot be performed due to for example environmental circumstances.	Rejected	Force majeure is an overarching principle, but is not explicitly defined in a network code.
65.11-1	There must be NRA approval of all items to	Partially accepted	The time specification refers to the general

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	be defined after this Network Code is approved.		requirement in Chapter 2, which is already referring to Article 4(3)
65.2-1	Discrimination. Article is incomplete. Copy from article 66.2.b	Accepted	Missing clause introduced ("The test shall be carried out…")
65.2-2	Agreed is also decided.	Accepted	Revised as 'applicable'
66.2-1	Maximum Capacity not defined	Accepted	New terms introduced
66.3-1	As this is part of article 66, which applies for DC-connected PPMs, what to state here regarding HVDC Converter Units?	Accepted	Wording modified
66.7-1	What means may? Is it 'shall' or 'is free to'? Selecting of one of the three control options depends on TSO could lead to discrimination	Accepted	Wording modified
67.11-2	This requirement has been given in Article 67(4).	Accepted	Article 67.11 deleted.
67.2-1	A component shall demonstrate its capability to simulate something. So simulation facilities must be inside the component?	Accepted	Wording will be changed
68.2-1	Discrimination. Article is incomplete. Copy article 67.3 from RfG.		Not understood

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CHAPTER 7 - DEROGATIONS

	Comment	Change	Motivation
69.3-1	The code does not contain any provisions on Network Operators applying for Derogations	Rejected	This clause allows the TSO to initiate a derogation process for a specific technology/manufacturer
69.4-1	Cross reference to article 50 is incorrect	Accepted	Wording modified
70.0-1	The wording in Art 70 (1) and (2) which applies to HVDC Systems is different to that applicable, in Art 70 (3) to PPMs. Both should be the same to avoid discriminatory treatment.	Accepted	Wording modified
70.2-1	The option for a pan European derogation should be added.	Rejected	The code (as RfG and DCC) allows for manufacturer-derogations by means of having the TSO file the application. A derogation is by its very nature a national decision, which makes a default European approach not possible. That said, NC implementation monitoring has as an objective to identify and address possible discrepancies.
70.2-2	Application should be to NRA.	Rejected	The derogation procedure is designed so that all relevant parties contribute before decision by NRA. This is to have an effective procedure facilitating a complete basis for the decision.
71.3-1	The process should cover also the role of DSO in case of distribution-connected users	Accepted	Wording modified
71.7-1	Who is the Agency • ? Definition missing	Rejected	Definition was initially given in NC RfG, and is still applicable in NC HVDC
72.2-1	Given that Article 64 relates to 'Tasks of the relevant TSO' it is not clear how it can be used by a PPM for the purposes that appears to be suggested in this Article 72 (1).	Accepted	Wording modified
73.1-1	Instead of maintaining a database in each Member State, a single pan-European register should be introduced where each NRA has write access.	Partially accepted	The article does not prevent the introduction of such a register. Still it is expected that national registries will have to be maintained.
73.1-2	Register should only be for new systems.	Rejected	The need for transparency on derogations is not less for existing systems than for new.
73.1-3	ENTSO-E should not be granted a privileged position of receiving information that is of importance to all stakeholders. This information should be placed on the NRA website.	Rejected	The article provides for publication both by NRAs as well as by ACER.

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CHAPTER 8 - FINAL PROVISIONS

	Comment	Change	Motivation
74.0-1	Generally define in Article 2 what is a new facility, instead of introducing each equipment item with a 'New' token.	Accepted	Terms restricted and defined
74.0-2	Power Park Module System is not defined.	Accepted	Wording modified
75.0-1	Add sentence on procedures how to amend the NC code, or introduce an article on maintenance of the code.	Rejected	This is prescribed in Regulation (EC) 714/2009.

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