



BSI Standards Publication

# **HVDC Grid Systems and connected Converter Stations — Guideline and Parameter Lists for Functional Specifications**

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Part 2: Parameter Lists

## National foreword

This Published Document is the UK implementation of CLC/TS 50654-2:2020. It supersedes PD CLC/TS 50654-2:2018, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GEL/8, Systems Aspects for Electrical Energy Supply.

A list of organizations represented on this committee can be obtained on request to its secretary.

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**HVDC Grid Systems and connected Converter Stations -  
Guideline and Parameter Lists for Functional Specifications -  
Part 2: Parameter Lists**

Réseaux CCHT et stations de conversion connectées -  
Lignes directrices et listes de paramètres pour les  
spécifications fonctionnelles - Partie 2: Listes de  
paramètres

Hochspannungsgleichstrom-Netzsysteme - Leitfaden und  
Parameter-Listen für funktionale Spezifikationen - Teil 2:  
Parameter-Listen

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**Contents**

Page

European foreword .....	6
Introduction .....	7
1 Scope .....	8
1.1 General .....	8
1.2 About the present release.....	8
2 Normative references .....	9
3 Terms, definitions and abbreviations .....	10
3.1 Terms and definitions .....	10
3.2 Abbreviations.....	12
4 Coordination of HVDC Grid System and AC Systems .....	13
4.1 General .....	13
4.2 Purpose of the HVDC Grid System and Power Network Diagram.....	13
4.3 AC/DC Power Flow Optimisation .....	13
4.4 Converter Operational Functions.....	17
4.4.1 Basic Operation Functions – Converter Normal Operation State .....	17
4.4.2 Basic Operation Functions – Converter Abnormal Operation State.....	18
4.4.3 Ancillary Services .....	21
5 HVDC Grid System Characteristics .....	25
5.1 HVDC Circuit Topologies.....	25
5.1.1 Availability and Reliability.....	25
5.1.2 Basic Characteristics and Nomenclature .....	26
5.1.3 Attributes of HVDC Grid Systems or HVDC Grid Sub-Systems.....	26
5.1.4 Attributes of a Station .....	26
5.2 Connection Modes.....	27
5.3 Grid Operating States.....	27
5.3.1 General.....	27
5.3.2 Normal State.....	27
5.3.3 Alert State.....	27
5.3.4 Emergency State .....	28
5.3.5 Blackout State .....	28
5.3.6 Restoration .....	28
5.4 DC Voltages .....	28
5.4.1 General.....	28
5.4.2 Nominal DC System Voltage .....	29
5.4.3 Steady-State DC Voltage.....	30
5.4.4 Temporary DC Voltage .....	30
5.4.5 Neutral Bus Voltages .....	31
5.5 Insulation Coordination.....	31
5.6 Short-Circuit Characteristics .....	31
5.6.1 Calculation of Short-Circuit Currents in HVDC Grid Systems.....	31

5.6.2	Short-Circuit Current Design Requirements .....	33
5.7	Steady-State Voltage and Current Distortions .....	33
5.7.1	Voltage and Current Distortion Limits.....	33
5.7.2	Frequency Dependent DC System Impedance .....	34
5.8	DC System Restoration .....	34
5.8.1	General.....	34
5.8.2	Post DC Fault Recovery .....	34
5.8.3	Restoration from Blackout.....	34
6	HVDC Grid System Control .....	35
6.1	Closed-Loop Control Functions .....	35
6.1.1	General.....	35
6.1.2	Core Control Functions .....	35
6.1.3	Coordinating Control Functions.....	35
6.2	Controller Hierarchy.....	35
6.2.1	General.....	35
6.2.2	Internal Converter Control.....	35
6.2.3	DC Node Voltage Control .....	35
6.2.4	Coordinated HVDC Grid System Control .....	35
6.2.5	AC/DC Grid Control .....	37
6.3	Propagation of Information .....	38
6.4	Open-Loop Controls .....	41
6.4.1	Coordination of Connection Modes between Stations and their PoC-DCs .....	41
6.4.2	Operating Sequences for HVDC Grid System Installations .....	41
6.4.3	Post DC Fault Recovery .....	43
7	HVDC Grid System Protection.....	43
7.1	General .....	43
7.2	DC Fault Separation .....	43
7.3	Protection System Related Installations and Equipment.....	43
7.3.1	AC/DC Converter Station.....	43
7.3.2	HVDC Grid System Topology and Equipment.....	43
7.4	HVDC Grid System Protection Zones.....	43
7.4.1	General.....	43
7.4.2	Permanent Stop P .....	45
7.4.3	Permanent Stop PQ.....	46
7.4.4	Temporary Stop P.....	46
7.4.5	Temporary Stop PQ.....	46
7.4.6	Continued Operation.....	46
7.4.7	Example of a Protection Zone Matrix .....	46
7.5	DC Protection .....	46
7.5.1	General.....	46
7.5.2	DC Converter Protections .....	47
7.5.3	HVDC Grid System Protections .....	47
7.5.4	DC Grid Protection Communication .....	47
8	AC/DC Converter Stations.....	47
8.1	Introduction .....	47

8.2	AC/DC Converter Station Types .....	47
8.3	Overall Requirements .....	47
8.3.1	Robustness of AC/DC Converter Stations .....	47
8.3.2	Availability and Reliability .....	47
8.3.3	Active Power Reversal .....	48
8.4	Main Circuit Design .....	48
8.4.1	General Characteristics .....	48
8.4.2	DC Side .....	49
8.4.3	AC Side .....	54
8.5	Controls .....	54
8.5.1	General .....	54
8.5.2	Automated vs. Manual Operation .....	54
8.5.3	Control Modes & Support of Coordination .....	55
8.5.4	Limitation Strategies .....	56
8.5.5	Operating Sequences for AC/DC Converter Station .....	56
8.5.6	Dynamic Behaviour .....	56
8.6	Protection .....	57
8.6.1	General .....	57
8.6.2	Configuration Requirements .....	57
8.6.3	Function Requirements .....	57
8.6.4	DC Grid Interface .....	57
8.6.5	Fault Separation Strategy for Faults inside the AC/DC Converter Station .....	57
8.6.6	Coordination of the DC Protection with the HVDC Grid System .....	57
8.6.7	Example for Coordination of the DC Protection with the HVDC Grid System .....	57
9	HVDC Grid System Installations .....	57
9.1	General .....	57
9.2	DC Switching Station .....	58
9.2.1	Overall Requirements .....	58
9.2.2	Main Circuit Design .....	58
9.2.3	Controls .....	64
9.2.4	Protection .....	68
10	Models and Validation .....	69
10.1	Introduction .....	69
10.2	HVDC Grid System Studies .....	69
10.2.1	Type of Studies .....	69
10.2.2	Tools and Methods .....	69
10.3	Model General Specifications .....	69
10.3.1	Model Capability .....	69
10.3.2	Model Format and Data Type .....	69
10.3.3	Model Aggregation .....	69
10.4	Model Specific Recommendations .....	70
10.4.1	Load Flow Models .....	70
10.4.2	Short-Circuit Models .....	71
10.4.3	Protection System Models .....	71
10.4.4	Insulation Coordination Related Models .....	71

10.4.5	Electromechanical Transient Models .....	71
10.4.6	Electromagnetic Transient Models .....	72
10.4.7	Power Quality Models .....	78
10.5	Model Validation .....	78
10.6	Compliance Simulation .....	79
10.7	Outputs/Results .....	79
10.7.1	Model Data .....	79
10.7.2	Model Documentation .....	79
10.7.3	Model Example .....	79
10.7.4	Model Compliance Documentation .....	80
10.7.5	Model Validation Documentation – Model Final Version .....	80
10.7.6	Model Guarantee .....	80
11	HVDC Grid System Integration Tests .....	80
11.1	Off-Site Testing of the HVDC Control and Protection System .....	80
11.2	Dynamic Performance Study/Tests (DPS) Performed with Offline Models .....	80
11.2.1	DPS Simulations in a Multi-Vendor Environment .....	80
11.2.2	DPS Simulations Scenarios .....	80
11.3	Factory Tests .....	81
11.3.1	General .....	81
11.3.2	Factory Test Scenarios .....	81
11.3.3	Factory Tests when Existing System C&P Replicas are Available .....	81
11.3.4	Factory Tests when Existing System C&P Replicas are not Available .....	81
11.4	On Site Testing .....	82
	Bibliography .....	83

## **European foreword**

This document (CLC/TS 50654-2:2020) has been prepared by CLC/TC8X “*System aspects of electrical energy supply*”.

This document supersedes CLC/TS 50654-2:2018.

CLC/TS 50654-2:2020 includes the following significant technical changes with respect to CLC/TS 50654-2:2018:

- new content concerning AC/DC converter stations;
- new content concerning HVDC Grid System installations, including DC switching stations;
- new content concerning HVDC Grid System integration tests.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

## **Introduction**

HVDC Grid Systems are a new field of technology. There are very few systems with a small number of converter stations in operation; some more are in execution or in detailed planning.

The Guidelines and Parameter Lists to Functional Specifications are presented featuring planning, specification and execution of multi-vendor HVDC Grid Systems in Europe. Being elaborated by a team of experts from leading manufacturers of HVDC technology, Transmission System Operators (TSO's), Academia and Institutions in Europe, the present document provides a commonly agreed basis for an open market of compatible equipment and solutions for HVDC Grid Systems. Executing such systems and gaining operational experience is seen an important prerequisite for developing corresponding technical standards in the future.

By elaborating this document, special care has been taken to as far as possible describe the requirements in a technologically independent way. In order to achieve that, a function of interest is described by a comprehensive set of parameters. The parameters are selected based on a systematic analysis of physical phenomena relevant to achieve the requested functionality. The physical phenomena are categorized in order to show the mutual dependence of the individual parameters and ensure completeness of the physical aspects to be considered. Based on a clearly defined common language describing the functionalities requested, existing technologies can be applied, or new dedicated technical solutions can be developed.

Reflecting the early stage of technology, these Guidelines and Parameter Lists to Functional Specifications need comprehensive explanations and background information for the technical parameters. This dual character of the content will be represented by two corresponding parts:

- Part I “Guidelines” containing the explanations and the background information in context with the Parameter Lists.
- Part II “Parameter Lists” containing the essential lists of parameters and values describing properties of the AC respectively DC system (operating conditions) and parameters describing the performance of the newly installed component (performance requirements).

## **1 Scope**

### **1.1 General**

These Guidelines and Parameter Lists to Functional Specifications describe specific functional requirements for HVDC Grid Systems. The terminology “HVDC Grid Systems” is used here describing HVDC systems for power transmission having more than two converter stations connected to a common DC circuit.

While this document focuses on requirements, that are specific for HVDC Grid Systems, some requirements are considered applicable to all HVDC systems in general, i.e. including point-to-point HVDC systems. Existing IEC, Cigré or other documents relevant have been used for reference as far as possible.

Corresponding to electric power transmission applications, this document is applicable to high voltage systems, i.e. only nominal DC voltages equal or higher than 50 kV with respect to earth are considered in this document.

**NOTE** While the physical principles of DC networks are basically voltage independent, the technical options for designing equipment get much wider with lower DC voltage levels, e.g. in case of converters or switchgear.

Both parts have the same outline and headlines to aid the reader.

### **1.2 About the present release**

The present release of the Guidelines and Parameter Lists for Functional Specifications describes technical guidelines and specifications for HVDC Grid Systems which are characterized by having exactly one single connection between two converter stations, often referred to as radial systems. When developing the requirements for radial systems, care is taken not to build up potential showstoppers for meshed systems. Meshed HVDC Grid Systems can be included into this specification at a later point in time.

The Guidelines and Parameter List to the Functional Specification of HVDC Grid Systems cover technical aspects of:

- coordination of HVDC grid and AC systems
- HVDC Grid System characteristics
- HVDC Grid System control
- HVDC Grid System protection
- AC/DC converter stations
- HVDC Grid System installations, including DC switching stations
- models and validation
- HVDC Grid System integration tests

Beyond the present scope, the following content is proposed for future work:

- transmission lines and transition stations
- DC/DC converter stations
- DC line power flow controllers