

STN P	Sieťové systémy na prenos energie jednosmerným prúdom vysokého napätia (HVDC) a pripojené meničové stanice Návod a zoznam parametrov na funkčné špecifikácie Časť 2: Zoznam parametrov	STN P CLC/TS 50654-2 33 0130
------------------	---	--

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

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 08/18

Obsahuje: CLC/TS 50654-2:2018

127176

TECHNICAL SPECIFICATION
SPÉCIFICATION TECHNIQUE
TECHNISCHE SPEZIFIKATION

CLC/TS 50654-2

March 2018

ICS 29.240.01

English Version

**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

This Technical Specification was approved by CENELEC on 2018-01-22.

CENELEC members are required to announce the existence of this TS in the same way as for an EN and to make the TS available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Contents

Page

European foreword	5
Introduction	6
1 Scope	7
1.1 General.....	7
1.2 About the present release	7
2 Normative references	7
3 Terms, definitions and abbreviations	8
3.1 Terms and definitions	8
3.2 Abbreviations.....	10
4 Coordination of HVDC Grid System and AC Systems.....	11
4.1 Purpose of the HVDC Grid System and Power Network Diagram	11
4.2 Hybrid AC/DC Power Flow Optimization.....	12
4.3 Basic Operation Functions – Converter Normal Operation State	14
4.3.1 General.....	14
4.3.2 AC System Frequency by a Frequency / Power Droop	15
4.3.3 DC Voltage / DC Power Droop	15
4.4 Basic Operation Functions – Converter Abnormal Operation State	15
4.4.1 General.....	15
4.4.2 Network Conditions and Power Flow Requirements	16
4.4.3 Abnormal AC Voltage Conditions	16
4.5 Ancillary Services.....	18
4.5.1 General.....	18
4.5.2 Frequency Control Related Services	18
4.5.3 AC Voltage Control Related Services	20
4.5.4 Power Oscillation Damping Services	20
4.5.5 System Restoration Services.....	20
5 HVDC Grid System Characteristics	21
5.1 HVDC Circuit Topologies	21
5.1.1 Basic Characteristics and Nomenclature.....	21
5.1.2 Attributes of HVDC Grid Systems or HVDC Grid Sub-Systems	21
5.1.3 Attributes of a Converter Station.....	21
5.2 Grid Operating States	22
5.2.1 Normal State	22
5.2.2 Alert State	22
5.2.3 Emergency State.....	22
5.2.4 Blackout State	23
5.2.5 Restoration.....	23
5.3 DC Voltages	23
5.3.1 General.....	23
5.3.2 Nominal DC System Voltage	24
5.3.3 Steady-State DC Voltage.....	24
5.3.4 Temporary DC Voltage	24
5.4 Insulation Coordination	25

5.5	Short-Circuit Characteristics	25
5.5.1	General Remarks	25
5.5.2	Calculation of Short-Circuit Currents in HVDC Grid Systems.....	25
5.5.3	Short Circuit Current Design Requirements.....	27
5.6	Steady-State Voltage and Current Distortions	27
6	HVDC Grid System Control.....	27
6.1	Closed-Loop Control Functions.....	27
6.1.1	General.....	27
6.1.2	Core Control Functions	27
6.1.3	Coordinating Control Functions	28
6.2	Controller Hierarchy	28
6.2.1	General.....	28
6.2.2	Internal Converter Control.....	28
6.2.3	DC Node Voltage Control.....	28
6.2.4	Coordinated System Control	28
6.2.5	AC/DC Grid Control.....	30
6.3	Propagation of Information	31
6.4	Open-Loop Controls	34
6.4.1	Operating Sequences for Grid Installations	34
6.4.2	Operating Sequences for the Return Path.....	35
6.4.3	Recovery	35
7	HVDC Grid System Protection	36
7.1	General.....	36
7.2	DC Fault Separation.....	36
7.3	Protection System Related Installations and Equipment	36
7.3.1	AC/DC Converter Station.....	36
7.3.2	HVDC Grid System Topology and Equipment.....	36
7.4	HVDC Grid System Protection Zones	36
7.4.1	General.....	36
7.4.2	Permanent Stop P	38
7.4.3	Permanent Stop PQ	38
7.4.4	Temporary Stop P	39
7.4.5	Temporary Stop PQ	39
7.4.6	Continued Operation	39
7.4.7	Example of a Protection Zone Matrix.....	39
7.5	DC Protection	39
7.5.1	General.....	39
7.5.2	DC Converter Protections	40
7.5.3	HVDC Grid System Protections	40
7.5.4	HVDC Hub Respective HVDC Node Protections	40
7.5.5	DC Grid Protection Communication	40
8	AC/DC Converter Stations	40
8.1	General.....	40
8.2	AC/DC Converter Station Types	40
9	HVDC Grid System Installations	40
10	Models and Validation	40
10.1	Introduction.....	40
10.2	HVDC Grid System Studies	40
10.2.1	Type of Studies	40

10.2.2	Tools and Methods.....	41
10.3	Model General Specifications	41
10.3.1	Model Capability.....	41
10.3.2	Model Format and Data Type	41
10.3.3	Model Aggregation	41
10.4	Model Specific Recommendations.....	42
10.4.1	Load Flow Models	42
10.4.2	Short-Circuit Models.....	42
10.4.3	Protection System Models	42
10.4.4	Insulation Coordination Related Models	42
10.4.5	Electromechanical Transient Models	43
10.4.6	Electromagnetic Transient Models.....	44
10.4.7	Power Quality Models	49
10.5	Model Validation.....	50
10.6	Compliance Simulation	51
10.7	Outputs/Results.....	51
10.7.1	Model Data	51
10.7.2	Model Documentation	51
10.7.3	Model Example	51
10.7.4	Model Compliance Documentation	51
10.7.5	Model Validation Documentation – Model Final Version	51
10.7.6	Model Guarantee	51
11	HVDC Grid System Integration Tests	51
	Bibliography.....	52

European foreword

This document (CLC/TS 50654-2:2018) has been prepared by CLC/TC8X/WG 06 “System Aspects of HVDC Grid”.

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 a.c. respectively d.c. 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 d.c. 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 d.c. voltages equal or higher than 50 kV with respect to earth are considered in this document.

NOTE While the physical principles of d.c. networks are basically voltage independent, the technical options for designing equipment get much wider with lower d.c. 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 show-stoppers 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 a.c. Systems
- HVDC Grid System Characteristics
- HVDC Grid System Control
- HVDC Grid System Protection
- Models and Validation
- Beyond the present scope, the following aspects are proposed for future work:
- AC/DC converter stations
- HVDC Grid System Equipment
- HVDC Grid System Integration Tests

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 62747:2014, *Terminology for voltage-sourced converters (VSC) for high-voltage direct current (HVDC) systems (IEC 62747:2014)*

EN 61660-1:1997, *Short-circuit currents in d.c. auxiliary installations in power plants and substations — Part 1: Calculation of short-circuit currents (IEC 61660-1:1997)*

koniec náhľadu – text ďalej pokračuje v platenej verzii STN