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

Part 1: Guidelines

bsi.

National foreword

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European foreword

This document (CLC/TS 50654-1:2018) 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 60909 (all parts), *Short-circuit currents in three-phase A.C. systems*