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BSI Standards Publication

Design of earth electrode stations for high-voltage direct current (HVDC) links — General guidelines

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee PEL/22, Power electronics.

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

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

DESIGN OF EARTH ELECTRODE STATIONS FOR HIGH-VOLTAGE DIRECT CURRENT (HVDC) LINKS – GENERAL GUIDELINES

FOREWORD

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Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC 62344, which is a technical specification, has been prepared by IEC technical committee 115: High-voltage direct current (HVDC) transmission for d.c. voltages above 100 kV.

This technical specification cancels and replaces IEC/PAS 62344 published in 2007. This first edition constitutes a technical revision.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
115/53/DTS	115/64/RVC

Full information on the voting for the approval of this technical specification can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- transformed into an International Standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

The high-voltage d.c. earth electrode is an important part of the d.c. power transmission system. It takes on the task of guiding the current into the earth under the monopolar metallic return operation mode, and the unbalanced current under the bipolar operation mode. Further, it secures and provides the reference potential of valve neutral point under the bipolar/ monopolar operation mode, to protect the safe operation of valves.

D.C. earth electrodes include land electrodes, sea electrodes, and shore electrodes. Today, there are around tens of d.c. electrodes in the world. Their influence on the nearby and far away environment is produced when there is d.c. current continuously leaking into the earth through d.c. earth electrodes.

Their influence on the surrounding environment includes:

a) influence on humans, mainly due to step voltage, touch voltage and transferred voltage;

b) influence on the electrode itself, mainly reflected by earth temperature rise and corrosion on the electrode;

c) influence on nearby ponds and organisms in the sea;

d) influence on the a.c. power system, mainly reflected by the d.c. voltage excursion of transformer neutral point;

e) influence on buried metallic objects, mainly revealed by the corrosion on buried metallic pipelines, a.c. grounding grids, tower foundations for power transmission lines and armoured cables, etc.

For years, a great deal of experience has been accumulated in the research and design work in many countries, and relevant native standards or enterprise standards have been developed. The aim of this Technical Specification is to develop the design guide for d.c. earth electrodes, on the site selection, material selection, shape, buried depth, adoption of equipment and connection styles, etc. It could be referred to by the specialized employees in different countries, to ensure the safe operation of earth electrode under different modes, control the influence on the environment nearby and the environment far away to the acceptable level, and to reasonably decrease engineering costs.

To ensure this Technical Specification is more scientific, precise and practical, IEC/PAS 62344:2007 is referred to, and some research results obtained in recent years are adopted.

DESIGN OF EARTH ELECTRODE STATIONS FOR HIGH-VOLTAGE DIRECT CURRENT (HVDC) LINKS – GENERAL GUIDELINES

1 Scope

This Technical Specification applies to the design of earth electrode stations for high-voltage direct current (HVDC) links. It is intended to provide necessary guidelines, limits, and precautions to be followed during the design of earth electrodes to ensure safety of personnel and earth electrodes and prevent any significant impact they may exert on d.c. power transmission systems and the surrounding environment.

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.

IEC/TS 60479-1, *Effects of current on human beings and livestock – Part 1: General aspects*

IEC/TS 61201, *Use of conventional touch voltage limits – Application guide*

IEC 61936-1, *Power installations exceeding 1 kV a.c. – Part 1: Common rules*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
earth electrode
ground electrode (US)
structure with a conductor or a group of conductors embedded in the soil or immersed in sea water, directly or surrounded with a specific conductive medium

EXAMPLE Coke, providing an electric connection to the earth, for transmission of d.c. current from a d.c. system.

[SOURCE: IEC 60050-195:1998, 195-02-01]

3.2
land electrode
earth electrode buried in the ground more than 1 km away from the coastline

3.3 shore electrode

3.3.1
beach electrode
electrode located on the beach inside the waterline (usually less than 1 km away from the waterline), and the active part of the electrode makes contact with the soil or with underground water, but not directly with seawater or pond electrodes