



IEC TR 62681

Edition 2.0 2022-05
REDLINE VERSION

INTERNATIONAL STANDARD



**Electromagnetic performance of high voltage direct current (HVDC) overhead
transmission lines**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.240.20

ISBN 978-2-8322-3163-0

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTROMAGNETIC PERFORMANCE OF HIGH VOLTAGE DIRECT
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IEC TR 62681 has been prepared by IEC technical committee 115: High Voltage Direct Current (HVDC) transmission for DC voltages above 100 kV. It is a Technical Report.

This second edition cancels and replaces the first edition, published in 2014. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) the limits of total electric field in some countries have been supplemented and improved;
- b) the definition of 80 %/80 % criteria of radio interference has been clarified;
- c) a table has been added for bipolar excitation which shows the parameters of the IREQ radio interference excitation function;
- d) the clause of CEPRI research results of audible noise has been deleted;
- e) the clause of main conclusion of audible noise has been deleted.

The text of this Technical Report is based on the following documents:

Draft	Report on voting
115/289/DTR	115/292/RVDTR

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Report is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

Electric fields and magnetic fields are produced in the vicinity of a High Voltage Direct Current (HVDC) overhead transmission line. When the electric field at the conductor surface exceeds a critical value, known as the corona onset gradient, positive or negative free charges leave the conductor and interact with the surrounding air and ionization takes place in the layer of surrounding air, leading to the formation of corona discharges. The corona discharge will ~~not only bring out corona loss but also produce electromagnetic environment problems~~ result in corona loss but also change the electro-magnetic properties around the HVDC overhead transmission lines.

The parameters used to describe the electromagnetic ~~environment~~ performance of an HVDC overhead transmission line mainly include the:

- 1) electric field,
- 2) ion current,
- 3) magnetic field,
- 4) radio interference,
- 5) audible noise.

To control these parameters in a reasonable and acceptable range, for years, a great deal of theoretical and experimental research was conducted in many countries, and relevant national standards or enterprise standards were developed. This document collects and records the status of study and progress of electric fields, ion current, magnetic fields, radio interference, and audible noise of HVDC overhead transmission lines. It is recognised that general technical discussion given in this document would be applicable for HVDC sub-stations as well; However, since layout of a station differs very differently, expressions given for HVDC overhead transmission line cannot be directly used as many assumptions would not hold good. Furthermore, an HVDC sub-station is not accessible to the general public, thus the numbers and limits given in this document are not applicable for HVDC sub-stations.

ELECTROMAGNETIC PERFORMANCE OF HIGH VOLTAGE DIRECT CURRENT (HVDC) OVERHEAD TRANSMISSION LINES

1 Scope

This document provides general guidance on the electromagnetic environment issues of HVDC overhead transmission lines. It concerns the major parameters adopted to describe the electromagnetic ~~environment~~ properties of an HVDC overhead transmission line, including electric fields, ion current, magnetic fields, radio interference, and audible noise generated as a consequence of such effects. If the evaluation method and/or criteria of electromagnetic properties are not yet regulated, engineers in different countries can refer to this document to:

- ~~ensure~~ support/guide the ~~safe operation~~ electromagnetic design of HVDC overhead transmission lines,
- limit the influence on the environment within acceptable ranges, and
- optimize engineering costs.

2 Normative references

There are no normative references in this document.

TECHNICAL REPORT



Electromagnetic performance of high voltage direct current (HVDC) overhead transmission lines

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTROMAGNETIC PERFORMANCE OF HIGH VOLTAGE DIRECT
CURRENT (HVDC) OVERHEAD TRANSMISSION LINES**

FOREWORD

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IEC TR 62681 has been prepared by IEC technical committee 115: High Voltage Direct Current (HVDC) transmission for DC voltages above 100 kV. It is a Technical Report.

This second edition cancels and replaces the first edition, published in 2014. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) the limits of total electric field in some countries have been supplemented and improved;
- b) the definition of 80 %/80 % criteria of radio interference has been clarified;
- c) a table has been added for bipolar excitation which shows the parameters of the IREQ radio interference excitation function;
- d) the clause of CEPRI research results of audible noise has been deleted;
- e) the clause of main conclusion of audible noise has been deleted.

The text of this Technical Report is based on the following documents:

Draft	Report on voting
115/289/DTR	115/292/RVDTR

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Report is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

Electric fields and magnetic fields are produced in the vicinity of a High Voltage Direct Current (HVDC) overhead transmission line. When the electric field at the conductor surface exceeds a critical value, known as the corona onset gradient, positive or negative free charges leave the conductor and interact with the surrounding air and ionization takes place in the layer of surrounding air, leading to the formation of corona discharges. The corona discharge will result in corona loss but also change the electro-magnetic properties around the HVDC overhead transmission lines.

The parameters used to describe the electromagnetic performance of an HVDC overhead transmission line mainly include the:

- 1) electric field,
- 2) ion current,
- 3) magnetic field,
- 4) radio interference,
- 5) audible noise.

To control these parameters in a reasonable and acceptable range, for years, a great deal of theoretical and experimental research was conducted in many countries, and relevant national standards or enterprise standards were developed. This document collects and records the status of study and progress of electric fields, ion current, magnetic fields, radio interference, and audible noise of HVDC overhead transmission lines. It is recognised that general technical discussion given in this document would be applicable for HVDC sub-stations as well; However, since layout of a station differs very differently, expressions given for HVDC overhead transmission line cannot be directly used as many assumptions would not hold good. Furthermore, an HVDC sub-station is not accessible to the general public, thus the numbers and limits given in this document are not applicable for HVDC sub-stations.

ELECTROMAGNETIC PERFORMANCE OF HIGH VOLTAGE DIRECT CURRENT (HVDC) OVERHEAD TRANSMISSION LINES

1 Scope

This document provides general guidance on the electromagnetic environment issues of HVDC overhead transmission lines. It concerns the major parameters adopted to describe the electromagnetic properties of an HVDC overhead transmission line, including electric fields, ion current, magnetic fields, radio interference, and audible noise generated as a consequence of such effects. If the evaluation method and/or criteria of electromagnetic properties are not yet regulated, engineers in different countries can refer to this document to:

- support/guide the electromagnetic design of HVDC overhead transmission lines,
- limit the influence on the environment within acceptable ranges, and
- optimize engineering costs.

2 Normative references

There are no normative references in this document.